Highway–Railroad Grade Crossing Collision
Midland, Texas
November 15, 2012

Accident Report

NTSB/HAR-13/02
PB2014-100830

National
Transportation
Safety Board

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National Transportation Safety Board

490 L'Enfant Plaza, SW
Washington, DC 20594

National Transportation Safety Board. 2013. ***Highway–Railroad Grade Crossing Collision, Midland, Texas.*** **Highway Accident Report NTSB/HAR-13/02. Washington, DC.**

Abstract: About 4:35 p.m. on November 15, 2012, in Midland, Texas, a freight train collided with a parade float at a highway–railroad grade crossing, resulting in 4 fatalities and 12 injuries. The float consisted of a 2006 Peterbilt truck-tractor in combination with a 2005 Transcraft D-Eagle drop-deck flatbed semitrailer and was traveling south on South Garfield Street as part of a parade procession honoring US military men and women. The float, occupied by 12 veterans and their spouses, continued along South Garfield Street until it reached the intersection of West Front Avenue, where the traffic signal displayed red. Law enforcement personnel stationed to block cross traffic permitted the float and its escorts to continue across the intersection unhindered. About 80 feet south of the West Front Avenue intersection was an active highway–railroad grade crossing, and the crossing's warning system activated as the float approached. The float continued across the railroad tracks at an estimated speed of 5 mph. A Union Pacific Railroad freight train approached the South Garfield Street crossing from the west at a speed of 62 mph. The train reached the crossing and struck the right rear of the float, causing the flatbed to rotate clockwise 122 degrees. As the flatbed rotated, it struck several occupants who were evacuating the float. It also struck a stationary 2008 Ford Crown Victoria occupied by a sheriff's deputy. The collision did not cause the train to derail. This investigation focused on the following safety issues: driver expectations due to a consistent law enforcement escort, lack of awareness of traffic signal preemption by law enforcement escorts, and lack of parade planning. As a result of this investigation, the NTSB makes recommendations to the Federal Highway Administration, Federal Railroad Administration, city of Midland, National League of Cities, National Association of Counties, National Association of Towns and Townships, United States Conference of Mayors, International City/County Management Association, and International Festivals and Events Association.

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Acronyms and Abbreviations

ABS	antilock brake system
BMI	body mass index
CB	citizen's band (radio)
CDL	commercial driver's license
CFD	Cosumnes Fire Department
CFR	*Code of Federal Regulations*
CSU	Colorado State University
DOT	US Department of Transportation
EVP	emergency vehicle preemption
FAU	Florida Atlantic University
FHWA	Federal Highway Administration
FRA	Federal Railroad Administration
MUTCD	*Manual on Uniform Traffic Control Devices*
NMSU	New Mexico State University
NTSB	National Transportation Safety Board
Show of Support	Show of Support, Military Hunt, Inc.
Union Pacific	Union Pacific Railroad

Executive Summary

About 4:35 p.m. central standard time on Thursday, November 15, 2012, in Midland, Texas, a freight train collided with a parade float at a highway–railroad grade crossing, resulting in 4 fatalities and 12 injuries.

The float, which consisted of a 2006 Peterbilt truck-tractor in combination with a 2005 Transcraft D-Eagle drop-deck flatbed semitrailer, was traveling south on South Garfield Street as part of a parade procession honoring US military men and women. The truck-tractor was driven by a 50-year-old male, and the flatbed was occupied by 12 veterans and their spouses. The float was flanked by two law enforcement escort vehicles.

The float continued along South Garfield Street until it reached the intersection of West Front Avenue, where the traffic signal displayed red. Law enforcement personnel stationed to block cross traffic permitted the float and its escorts to continue across the intersection unhindered. About 80 feet south of the West Front Avenue intersection was a highway–railroad grade crossing equipped with warning bells, warning lights, and an automatic gate assembly. As the float approached, the grade crossing warning system activated. The float continued across the railroad tracks at an estimated speed of 5 mph, and the grade crossing gate descended on the flatbed, striking several of the flag poles lining its right side.

At about the same time, a Union Pacific Railroad (Union Pacific) freight train, consisting of 4 locomotives and 84 loaded freight cars, approached the South Garfield Street crossing from the west at a speed of 62 mph. The engineer sounded the horn and placed the train into emergency braking as the front of the float crossed the tracks. The train reached the crossing and struck the right rear of the float, causing the flatbed to rotate clockwise 122 degrees. As the flatbed rotated, it struck several occupants who were evacuating the float. It also struck a stationary 2008 Ford Crown Victoria occupied by a sheriff's deputy. The collision did not cause the train to derail.

As a result of the collision, four float passengers were killed. Eleven float passengers were injured, and the sheriff's deputy was also injured. The two train crewmembers, the float driver, and nine other float passengers were not injured.

The National Transportation Safety Board (NTSB) determines that the probable cause of this collision was the failure of the city of Midland and the parade organizer, "Show of Support, Military Hunt, Inc." (Show of Support), to identify and mitigate the risks associated with routing a parade through a highway–railroad grade crossing. Contributing to the collision was the lack of traffic signal cues to indicate to law enforcement that an approaching train had preempted the normal highway traffic signal sequence at the intersection of South Garfield Street and West Front Avenue. Further contributing to the collision was an expectancy of safety on the part of the float driver, created by the presence of law enforcement personnel as escorts and for traffic control, leading him to believe that he could turn his attention to his side-view mirrors to monitor the well-being of the parade float occupants as he negotiated a dip in the roadway on approach to the grade crossing.

This investigation focused on the following safety issues:

- **Driver expectations:** The float driver had been escorted by law enforcement vehicles throughout the parade. Law enforcement had blocked cross traffic at each major signalized highway intersection up to the grade crossing. With right of way seemingly established for the parade and with law enforcement escorts on both sides of his vehicle, the float driver diverted his attention from the roadway to attend to the well-being of his passengers as the float negotiated a dip in the road ahead of the grade crossing.

- **Awareness of traffic signal preemption:** Law enforcement escorts were not aware that the highway traffic signal on approach to West Front Avenue had been preempted by an approaching train.

- **Parade planning:** Show of Support had not obtained a parade permit since 2009. The Show of Support parade committee did not have a written safety plan detailing how the parade was to be organized and executed, nor was Union Pacific informed of the parade schedule and route.

As a result of this investigation, the NTSB makes recommendations to the Federal Highway Administration, Federal Railroad Administration, city of Midland, National League of Cities, National Association of Counties, National Association of Towns and Townships, United States Conference of Mayors, International City/County Management Association, and International Festivals and Events Association.

1 Crash Narrative

1.1 Overview

On Thursday, November 15, 2012, about 4:02 p.m. central standard time, a parade sponsored by "Show of Support, Military Hunt, Inc." (Show of Support), commenced in Midland, Texas, to honor a select group of veterans (see figure 1). The parade was an annual event, and generally included a high school band, car and motorcycle clubs, fire and law enforcement vehicles, and emergency medical vehicles, among other participants. The temperature at the time was 71 degrees Fahrenheit. Visibility was 10 miles, and the roadway was dry.

The parade began in downtown Midland and proceeded along West Wall Street until it reached South Garfield Street. The procession then turned left and continued south along South Garfield Street en route to the Midland County Horseshoe Arena. At the turn, the high school band departed and riders from a motorcycle club took its place, leaving only motorized vehicles in the procession. The pace of the parade increased from about 5 mph to 9 mph. The complete parade route was approximately 3.1 miles long (see figure 2).

Figure 1. Location of Midland, Texas.

Figure 2. Parade route showing the location of the crash, denoted with a red symbol.

Among the vehicles in the parade was a float consisting of a 2006 Peterbilt truck-tractor in combination with a 2005 Transcraft D-Eagle drop-deck flatbed semitrailer (see figure 3). The float was operated by a 50-year-old male driver, and was the second of two floats being used to transport veterans and their spouses. The flatbed portion of the float was equipped with 26 metal-framed chairs arranged into 13 rows and held down with nylon cargo straps. All but the first row of chairs were occupied, with veterans seated on the left side (driver side) and spouses seated on the right. Two law enforcement vehicles, positioned on opposite sides of the float, acted as escorts.

Figure 3. Float vehicle.

The float continued along South Garfield Street and reached the intersection of West Front Avenue, where it slowed to about 5 mph (see figure 4). The highway traffic signal at the intersection was red; however, law enforcement personnel blocking traffic on West Front Avenue allowed the float to proceed unhindered (see figure 5). About 80 feet from the south curb of the West Front Avenue intersection was an active hump highway–railroad grade crossing (grade crossing).[1] As the float negotiated the incline on approach to the grade crossing, the warning system activated. The float continued to move forward onto the railroad tracks. As it did so, the grade crossing gate, situated 12 feet north of the tracks, descended on the float. The escort vehicles slowed and came to a stop several feet north of the descending gate.

Figure 4. Traffic lights on southbound South Garfield Street at the intersection with West Front Avenue and the incline leading to grade crossing.

[1] An active grade crossing is one equipped with traffic control devices, such as flashing warning lights, bells, and gates. A hump grade crossing is a crossing where the railroad bed is higher than the road, creating a vertical curve for the motorist to cross.

Figure 5. Aerial view of the crash site with arrows marking route of parade and train. (Photo courtesy of Google Maps)

Union Pacific Railroad (Union Pacific) freight train ZLCAI-14 (train) was traveling east from Los Angeles, California, to Atlanta, Georgia, at a speed of 62 mph. The train crew consisted of a 35-year-old engineer and a 27-year-old conductor. The engineer stated that when he realized the float was not going to stop at the grade crossing, he sounded the train horn and placed the train into emergency braking. At about 4:35 p.m., the right front corner of the locomotive unit struck the right rear portion of the float (see figure 6). The train did not derail and continued braking to a stop.

Figure 6. Reconstruction of the vehicle positions at the time of the collision with train.

The collision caused the flatbed to rotate 122 degrees clockwise and the truck-tractor to rotate 28 degrees clockwise (see figure 7). The flatbed struck a 2008 Ford Crown Victoria (Ford), which was parked on the northbound intersection of South Garfield Street and West Industrial Avenue and was occupied by a deputy for the Midland County Sheriff's Office. The collision killed four float passengers. Eleven float passengers were injured, and the sheriff's deputy was also injured. The two train crewmembers, the float driver, and nine float passengers were not injured.

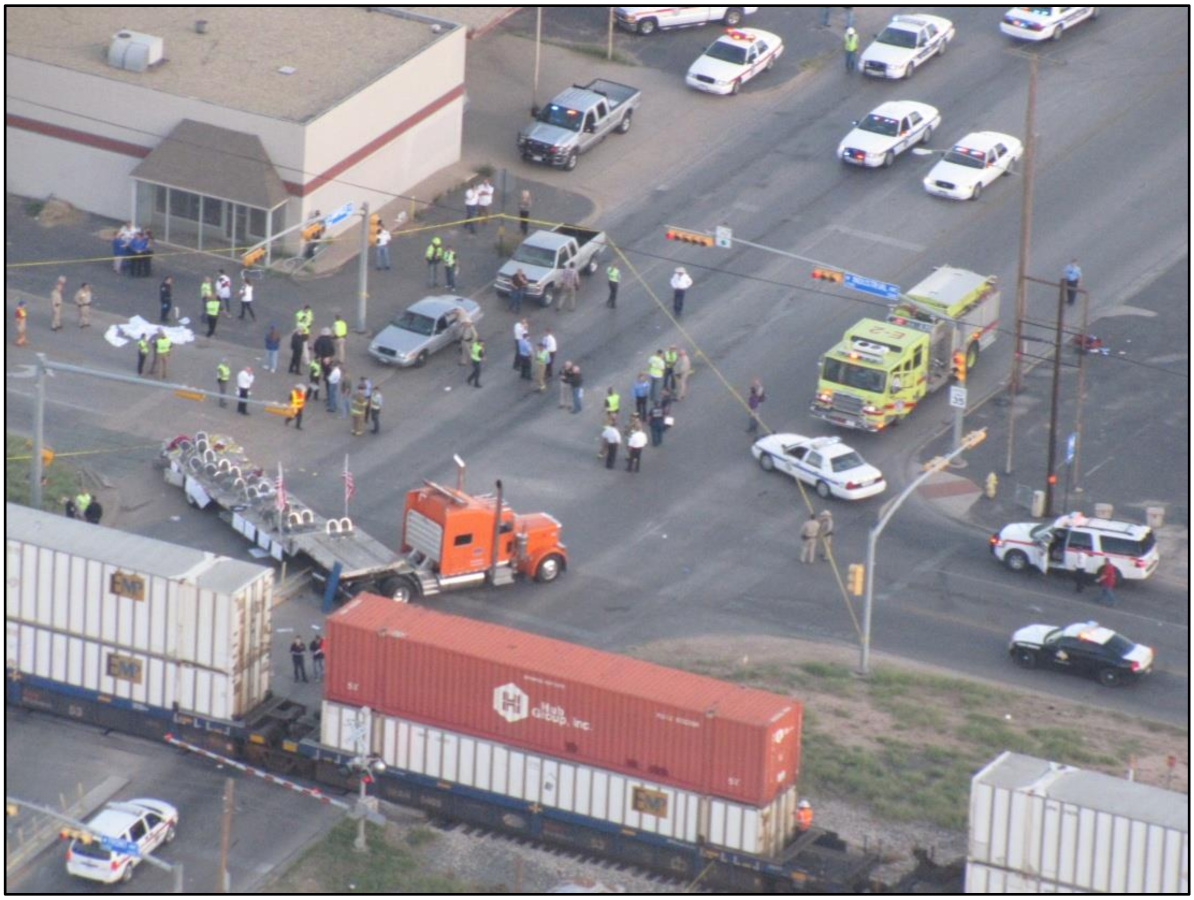

Figure 7. Postcrash scene showing the extent to which the flatbed rotated clockwise after being struck by the train. (Photo courtesy of the Midland City Police Department)

1.2 Crash Reconstruction Details

The National Transportation Safety Board (NTSB) launched a full team of investigators to the crash site (see appendix A) and relied on several sources to reconstruct the events that led to the collision. Video sources included the train's track image recorder, a dash-mounted camera in the Midland County Sheriff's vehicle (escorting the float on the right side), and a camera in the lead float. The NTSB also used data from the locomotive event recorder, physical evidence from vehicles and the roadways, and information from witness interviews.

According to the data, about a minute prior to impact, the train passed a "clear" signal green aspect indicating that it was permitted to proceed past that signal.[2] In the meantime, the float was traveling south at about 9 mph toward the West Front Avenue intersection, flanked by law enforcement escort vehicles. The highway traffic signal displayed red when the float was about 67 feet from the intersection. Additional law enforcement personnel were positioned at the

[2] "Aspect" refers to the visual appearance of the signal. The "clear" indication meant that the track was clear of other train equipment. The signal system does not monitor the tracks for intrusion from highway vehicles nor is the grade crossing warning system tied to the railroad signal system.

intersection to block cross traffic on West Front Avenue. The approaching train preempted the traffic signals on West Front Avenue just as the float began passing over the white stop line at 5 mph.[3] The escort vehicles also continued across the West Front Avenue intersection.

Approximately 21 seconds before impact, as the front of the float approached the south curb of the West Front Avenue intersection, the grade crossing warning system lights and bells activated. The float was approximately 61–64 feet from the grade crossing stop line and 69–72 feet from the crossing gate (see figure 8), which had not yet begun to descend. The float and escort vehicles continued to move forward. Soon after activation of the grade crossing warning system, the driver of the escort vehicle to the left of the float noticed the flashing lights and bells, and repeatedly yelled "train" over the Midland County Sheriff's radio channel.[4] Approximately 13.5 seconds before impact, the crossing gate began to descend on top of the float.

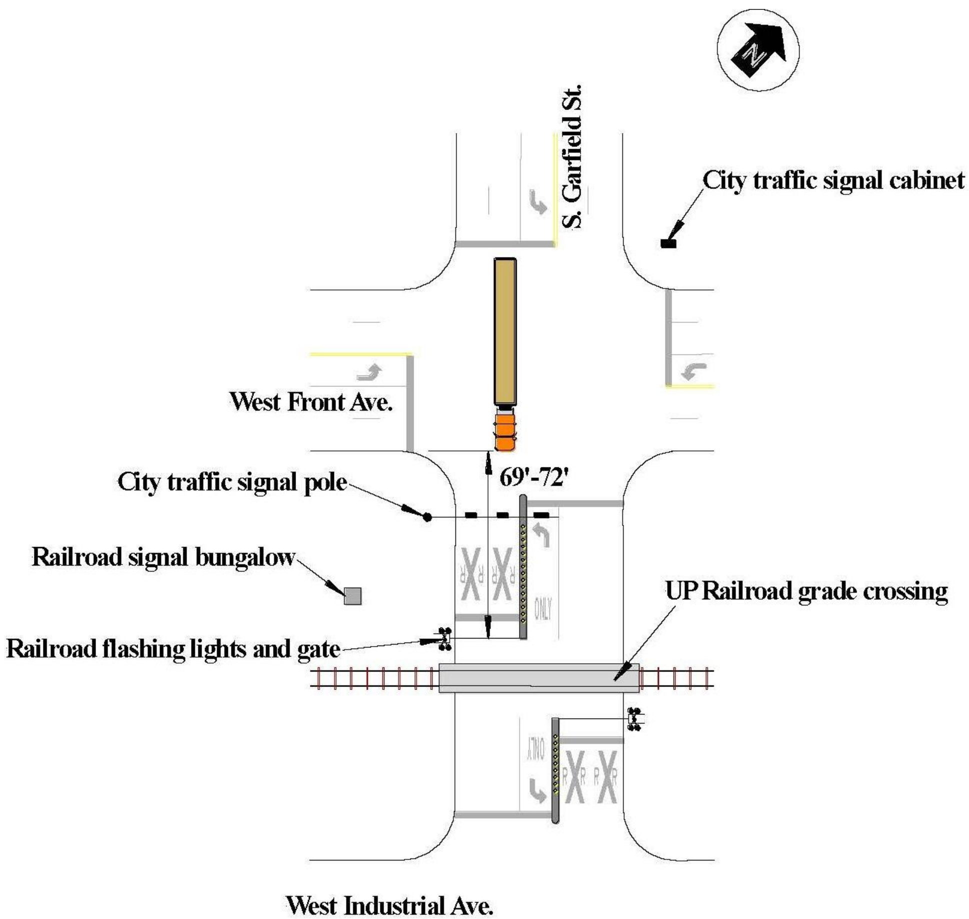

Figure 8. Approximate position of the float when the grade crossing warning system activated.

[3] See Section 2.3.5 for a discussion of highway traffic signal preemption.

[4] Based on interviews with sheriff's deputies taking part in the parade, a back channel was used for communication among deputies during the parade and was not monitored or recorded by the dispatch center; therefore, the exact time of this transmission could not be determined. This channel was not accessible to the float drivers.

The escort vehicles slowed to a stop, halting on the incline several feet north of the crossing gate. The gate continued to descend until it contacted one of the flag poles mounted on the float. Approximately 8.9 seconds before impact, the front of the float was on the tracks. Passengers on the flatbed portion of the float began evacuating. Most passengers evacuated on the south side of the railroad tracks; several passengers seated to the rear of the float evacuated safely to the north side of the tracks.

Approximately 7.8 seconds before impact, the horn on the lead locomotive sounded. The front of the float was 16 feet past the north rail, and the train was approximately 709 feet west of the point of impact. Approximately 4.8 seconds before impact, or 3 seconds after the horn was sounded, the train was placed into emergency braking. Braking continued as the train struck the rear of the float at 4:35 p.m., causing the flatbed to rotate clockwise through an arc of 122 degrees. As the flatbed rotated, it surmounted the highway median and east curb, striking highway signage and at least two passengers who had evacuated the float. The train came to a full stop approximately 78 seconds and 3,547 feet after the emergency brakes were applied, or slightly more than 73 seconds and 3,110 feet after striking the float. Table 1 presents the time and location of the train and float in the moments leading up to the crash, and appendix B illustrates the sequence of events.

Table 1. Crash timeline.

Event	Local Time (p.m.)	Front of Float Relative to North Rail (ft)	Train Relative to Point of Impact (ft)	Time to Impact (sec)	Train Speed (mph)	Float Speed (avg mph)
Float 67 ft before W Front Ave stop line	4:34:55	228	3321	36.5	62	8
Float at W Front Ave stop line	4:35:02	161	2767	30.4	62	6
Traffic signal preempted	4:35:02	157	2729	30.0	62	6
Crossing signal lights active	4:35:11	82	1910	21.0	62	5
Gate descends	4:35:18	25	1228	13.5	62	5
Front of float atop rails	4:35:23	9[a]	808	8.9	62	5
Train horn	4:35:24	16[a]	709	7.8	62	5
Train begins emergency braking	4:35:27	38[a]	437	4.8	62	5
Impact	4:35:32	73[a]	0	0	62	5

[a] References positions south of (past) north rail.

1.3 Injuries

The four passengers who were killed had either evacuated the left side of the float or were in the process of doing so when the train struck. Autopsies showed that the deaths were caused by multiple blunt force traumatic injuries from contact with either the ground or the rotating flatbed. Of those who were seriously injured, one person was hit directly by the train and three were hit by the trailer portion of the float. The minor injuries occurred primarily from evacuating or falling.

Eleven injured flatbed passengers and the sheriff's deputy were transported to a local hospital, with one passenger subsequently flown to a medical center in Lubbock, Texas. The float driver was not injured but also was transported to a local hospital. The train crew was not injured. Table 2 and figure 9 summarize the injuries and fatalities from this collision.

Table 2. Injuries and fatalities.

Injury[a]	Float Driver	Train Crew	Float Passengers	Car Occupant	Total
Fatal	0	0	4	0	4
Serious	0	0	4	0	4
Minor	0	0	7	1	8
None	1	2	9	0	12
Total	1	2	24	1	28

[a] 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.

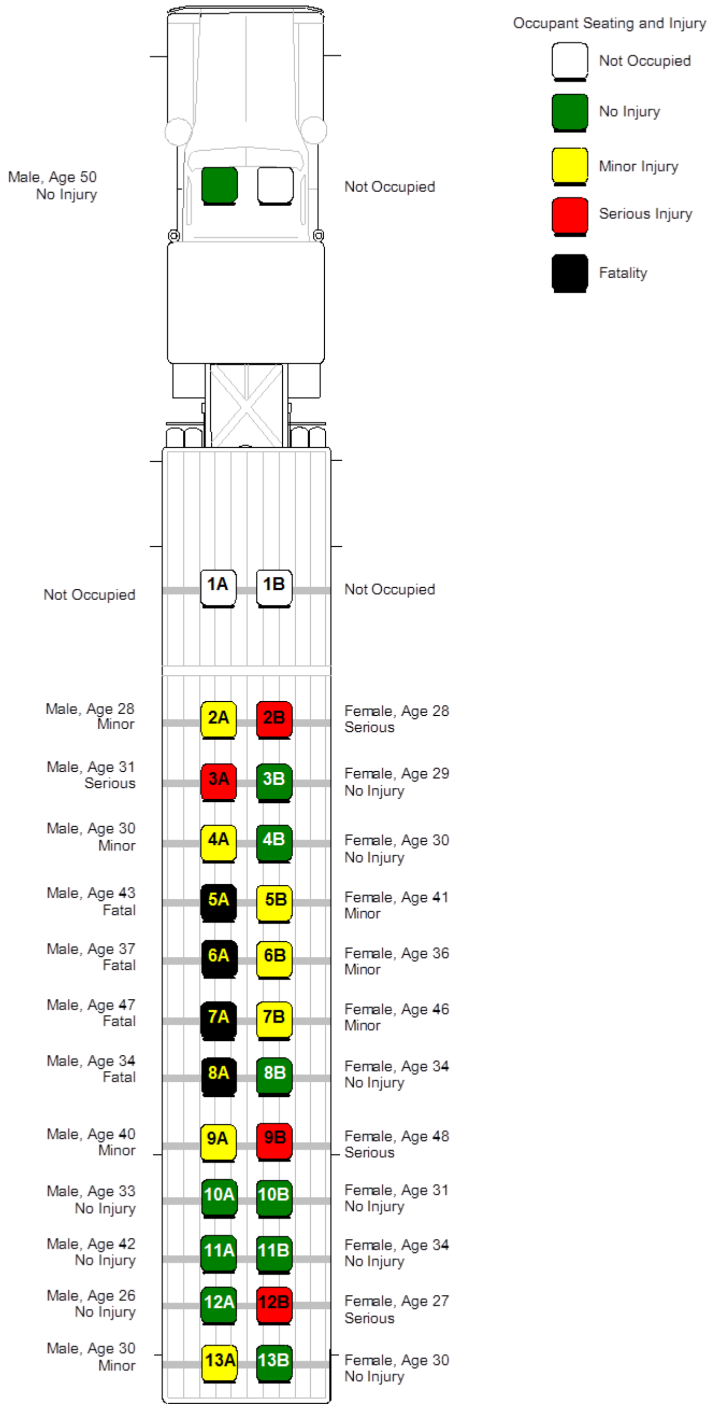

Figure 9. Depiction of the occupant injuries by seating location on the parade float. Note that several occupants had vacated their seats and the float itself prior to the collision with the train.

1.4 Wreckage

The truck-tractor portion of the float was not damaged in the collision (see figure 10); however, the flatbed suffered extensive direct and indirect damage throughout its structure (see figures 11, 12, and 13). The damage included bent and separated frame rails and deck rails; a torn and displaced end plate holding the rear lights, including the antilock brake system (ABS) malfunction indicator light; and a bent and torn outer wheel rim on the right side of the fifth axle. The rear end of the flatbed was deformed laterally toward the driver side, resulting in a skew of its deck, measuring approximately 2 feet at the aft end. In addition, the fourth and fifth axles on the left side of the flatbed had minor damage caused by the collision with the Ford.

Figure 10. Front view of the undamaged truck-tractor at the crash site.

Figure 11. Damage to the flatbed tire rim on the right side of the fifth axle.

Figure 12. Damage on the right side of the flatbed at the fifth axle tire and rim, the area directly impacted by the train.

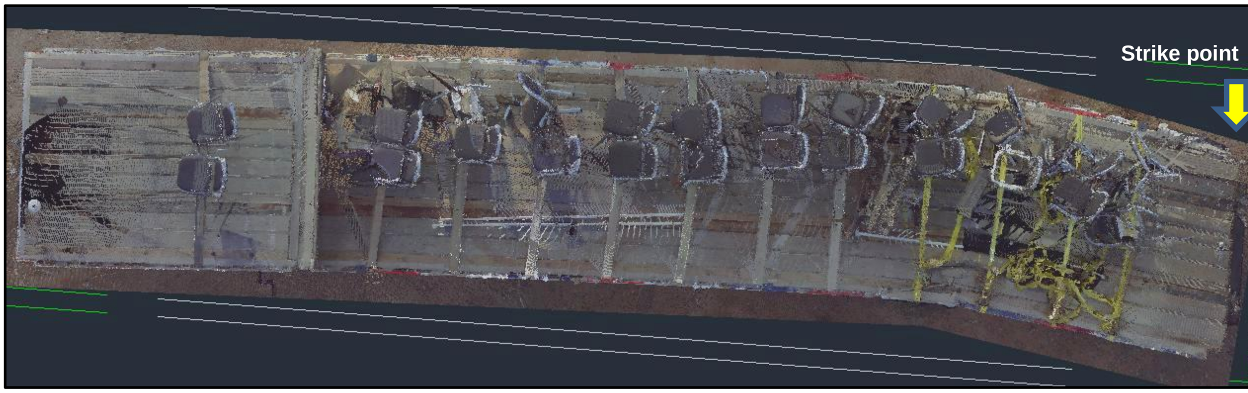

Figure 13. Computerized image showing the degree to which the flatbed was deformed by the collision with the train, with front of flatbed to the left.

The train, which consisted of 4 locomotives and 84 loaded freight cars, was 7,247 feet long and weighed 5,556 gross tons. The locomotives, configured for multiple-unit operation, were controlled from the lead locomotive. Three locomotive units were on the front of the train, and the fourth was at the rear. Damage to the train was limited to the right front corner of the lead locomotive. The plow, end plate, side steps, and side step mounting plate on the right side all exhibited rearward displacement. The hand rail and uncoupling lever were bent, and the plow was cracked (see figures 14 and 15).

Figure 14. Damage to the lead locomotive of the train.

Figure 15. Close-up view of the damage to the front of the lead locomotive, showing gouges and scrapes on lower right corner of the plow and deformation to the side steps.

The Ford was damaged on its right front quarter panel, right rear door, rear quarter panel, and trunk lid (see figure 16). The right rear-view mirror was broken off. Both the right front passenger window and the rear windshield were broken. The right rear wheel was damaged and the tire was deflated. The right rear portion of the back seat exhibited signs of deformation from the inward displacement of the right rear passenger door and C-pillar.[5] Additionally, the right rear C-pillar interior molding was separated from the headliner.

Figure 16. Damage to the Ford.

[5] The C-pillar is the roof support between a car's rearmost side window and its rear window.

2 Collision Factors

2.1 Introduction

The NTSB considered the following factors in its investigation of the Midland, Texas, grade crossing collision: (1) emergency response; (2) vehicle maintenance; (3) motor carrier and train operation; (4) railway infrastructure; (5) float driver actions; (6) highway design and signal operations; and (7) parade planning.

An examination of the timeline and actions of those responding to the grade crossing collision found that emergency responders quickly reached the scene, secured the area, and treated and evacuated the victims. Inspections of the float, the train, and the Ford uncovered no defects, maintenance issues, or utilization issues that caused or contributed to the collision or to the severity of injuries.[6] Examination of the operational practices of Smith Industries—the owner and operator of the 2006 Peterbilt combination unit being used as the float—and Union Pacific revealed no policy or procedural issues that contributed to the crash. In addition, the train engineer was found to be qualified to operate the train. The engineer and the conductor had ample sleep opportunity during the previous days, did not have physiological issues that might have affected their performance, and had only been on duty for 3 hours prior to the crash. The NTSB determined that the engineer's actions in response to the developing situation at the grade crossing were appropriate, given the float's slow approach speed and the inherent risks to crew and rail equipment when a train is placed into emergency braking.[7] A postcrash inspection of the railroad track at and on approach to the South Garfield Street grade crossing noted no issues with the track or the track structure. Data gathered from the train traffic control signal system indicated that the proper signal sequence was displayed for all train movements. Dispatch center data logs showed that the train had been given permission to proceed. In addition, the signal data logs and radio communications from the dispatch center showed routine operations prior to the crash.

The NTSB concludes, therefore, that emergency response, vehicle maintenance, motor carrier and train operation, and railway infrastructure were not factors in the grade crossing collision or resulting injuries.

During its investigation, the NTSB identified three areas warranting further examination: (1) factors that might have caused the float driver to miss or disregard the grade crossing warning signals; (2) the interconnection of the highway traffic signal system and the grade crossing warning system; and (3) the parade planning and permitting process. Section 2.2 provides background information on the float driver before detailing the circumstances that likely led him to cross the railroad tracks, despite the activation of the grade crossing warning system.

[6] Brakes on the flatbed portion of the float malfunctioned during testing due to dust buildup in the ABS modulator valve assembly. This condition was not a factor in the collision, however, because the float driver did not apply the brakes prior to being struck by the freight train. Since the collision, the motor carrier (Smith Industries) has improved its maintenance practices related to dust removal to prevent brake malfunction on its vehicles.

[7] Emergency braking is often considered a last resort because it can damage train components, track structure, and cargo. It can also result in a train derailment.

Section 2.3 describes the interconnection of the highway traffic signal system and the grade crossing warning system, and explores whether sufficient information was provided to law enforcement officials and other road users regarding the preemption of the normal highway traffic signal sequence by an approaching train. Section 2.4 examines whether the steps taken by Show of Support and the city of Midland to organize, permit, and conduct the parade were adequate to ensure the safety of the parade participants.

2.2 Driver Factors

2.2.1 Employment History and Safety Record

The float driver, a 50-year-old male, held a Texas class A commercial driver's license (CDL) at the time of the collision.[8] The CDL was issued in February 2012 and expires in January 2017. It included an N (tank) endorsement and a requirement that the driver wear his prescription eyeglasses while driving. When interviewed by investigators, the float driver stated that he wore his prescription glasses "all the time."

The float driver began working for Smith Industries in September 2011. His employment application indicated that he had about 27 months of experience driving commercial vehicles, such as vans, tank trucks, straight trucks, and truck-tractor semitrailers. Additionally, he had served as a driver examiner in the US Army and had earned the Driver and Mechanic Badge while serving.[9] In total, the float driver had about 4 years of experience driving commercial vehicles. When interviewed, the float driver told investigators that he had "years" of experience with Peterbilt truck-tractors and that he normally drove a Peterbilt on his regular route. The parade was his first time driving the truck-tractor portion of the float. He stated that he experienced no problems with either the truck-tractor or the flatbed prior to the collision.

Driving records indicated that the float driver had been involved in crashes in his personal vehicle in July 2007 and July 2011, but he was not cited in either incident. He was cited for speeding in April 2006 while in a commercial vehicle. The float driver completed two roadside inspections in the past 2 years, including a level I inspection that occurred immediately following the Midland collision.[10] A review of the float driver's logbook entries from September 1 to November 15, 2012, indicated no hours-of-service violations.

[8] A Texas 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.

[9] Per Army Regulation 600-8-22, revised 15 September 2011, the Driver and Mechanic Badge is awarded to drivers, mechanics, and special equipment operators to denote the attainment of a high degree of skill in the operation and maintenance of motor vehicles.

[10] A level I inspection is a detailed inspection of the driver, the vehicle, and the cargo. Five vehicle-related violations were found during the postcrash inspection of the float, with none resulting in the vehicle being placed out of service. The previous roadside inspection conducted in December 2011 resulted in one out-of-service violation for insufficient tie-downs.

The float driver generally worked Monday through Friday, 10–11 hours per day. His duty shift typically started about 7:00 a.m. The float driver was paid by the hour. His duties included delivering and unloading the cargo and helping assemble the delivered units.

2.2.2 Activities Prior to Collision

The NTSB used information gathered from an interview with the float driver, his cell phone records, his logbook entries, video evidence, and an interview with the lead float driver to reconstruct the float driver's activities on the days leading up to the parade. A detailed listing of these activities is provided in appendix C. Table 3 also summarizes the float driver activities.

Table 3. Float driver activities, November 12–15, 2012.

Monday, November 12		
Time	**Event**	**Source**
5:15 a.m.	Logs on duty	Logbook
6:30 p.m.	Logs off duty	Logbook
9:30 p.m.	Goes to bed	Interview[b]
Tuesday, November 13		
Time	**Event**	**Source**
5:15 a.m.	Awakes	Interview[b]
7:00 a.m.	Logs on duty	Logbook
7:30 p.m.	Logs off duty	Logbook
9:30 p.m.	Goes to bed	Interview[b]
Wednesday, November 14		
Time	**Event**	**Source**
5:15 a.m.	Awakes	Interview[b]
7:00 a.m.	Logs on duty	Logbook
4:00 p.m.	Logs off duty	Logbook
9:30 p.m.	Goes to bed	Interview[b]
10:21 p.m.	Sends last outgoing data[a] of day	Cell phone records
Thursday, November 15		
Time	**Event**	**Source**
5:15 a.m.	Awakes	Interview[b]
5:40 a.m.	Leaves home	Interview[b]
5:50 a.m.	Arrives at work	Interview[b]
7:00 a.m.	Logs on duty	Logbook
unknown	Goes home, puts on uniform, returns to work	Interview
2:15 p.m.	Logs driving in Midland, TX	Logbook
2:30 p.m.	Arrives at DoubleTree hotel	Interview with other driver
unknown	Assists veterans onto flatbed	Interview
3:51 p.m.	Last cell activity before collision	Cell phone records
4:02 p.m.	Parade begins	Video
4:35 p.m.	**Collision occurs**	

[a] Text/SMS/pictures are tracked together by the float driver's cellular provider, referred to as "data" in the table.
[b] Denotes the float driver's description of a typical day and not a specific recollection by the driver.

On the day of the parade, the float driver arrived at the Smith Industries terminal at 5:50 a.m. He conducted a pretrip inspection of the float and washed the vehicle. He secured the chairs, supplied by the city of Midland, to the flatbed. He arrived at the parade staging area about 2:30 p.m., and the parade began at 4:02 p.m. When interviewed, the float driver said that this was his first parade and his first involvement with Show of Support. He stated that he had not participated in any meetings regarding the parade and that he had obtained the parade route information from the lead float driver.

The float driver told investigators that, prior to turning onto South Garfield Street, the parade had maintained a slow pace. A block after turning left onto South Garfield Street, the marching band departed, and a motorcycle club took its place. The speed of the parade increased until it reached the intersection of West Front Avenue. He stated that he radioed the lead float driver to voice his concern about the speed and was told that it always increased at that point.

The south end of the West Front Avenue intersection contained a dip, followed by a short incline to the railroad tracks (see figure 17). The float driver indicated that, although he had driven across the grade crossing in his personal vehicle, he had never done so in a commercial vehicle. In an effort to minimize the jolt of the dip on his passengers, the float driver used his left-side mirrors to monitor the tires of the flatbed as they cleared the dip. He then shifted his gaze to the right-side mirror. He stated that he saw flashing lights in that mirror but did not initially attach any meaning to them, because they were "just flashing lights, more flashing lights."[11] The float driver stated that he looked down the tracks and saw the train, but it appeared stationary. In his mirror, he saw the crossing gate descend and strike either the flatbed or one of the flags mounted to it. He stated that he saw people jumping off the flatbed just before the train arrived.

[11] The float driver's statement suggests that he might have seen the grade crossing warning lights facing northbound traffic on the west grade crossing warning mast. Further, his mention of "more flashing lights" likely references the light bars on the law enforcement and fire department vehicles, which were continuously on during the parade.

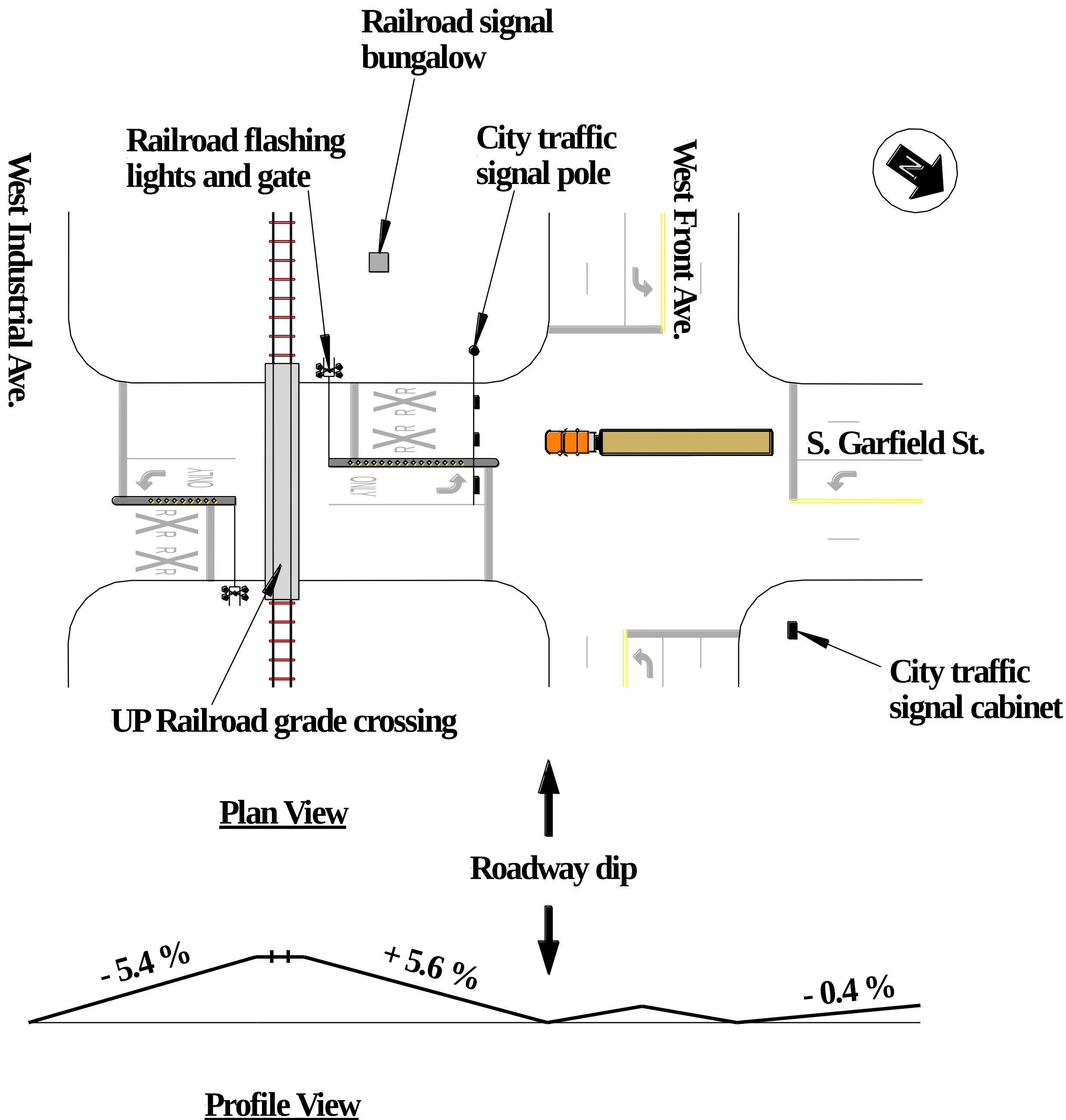

Figure 17. Depiction of the change in vertical slope between West Front Avenue and South Garfield Street, which resulted in a slight dip in the roadway (vertical scale in profile view is exaggerated to better illustrate the changes in slope).

When asked about the warning bells and the train horn, the float driver stated that a train horn mounted on the lead float was sounded throughout the parade. Therefore, he was not sure whether he had heard the horn on the lead float or the horn from the train. He stated that he did not remember hearing the warning bells at the crossing. When asked about the police presence during the parade, the float driver stated that he was escorted by two law enforcement vehicles, one on each side of the float. He noted that additional law enforcement personnel blocked the intersections along the parade route. He stated that he thought law enforcement was there to keep his path clear. He could not recall how many intersections he had passed through during the parade. He did not specifically recall seeing the traffic light at West Front Avenue, and he said that he never bothered looking at the traffic lights during the parade because the intersections were blocked off.

2.2.3 Driver Expectancies

Video evidence indicated that the float driver continued to approach the railroad tracks at a constant speed, despite the activation of the grade crossing warning system. In examining the reasons for the float driver's action, the NTSB considered the following information:

- Prior to the collision, the float had traveled along the parade route for approximately 34 minutes, covering approximately 2 miles. During this time, law enforcement vehicles continuously escorted the float.

- Video from one of the escorts showed that, prior to reaching the West Front Avenue intersection, the float had passed through six signalized intersections. Of those intersections, law enforcement controlled five. The traffic signals at four of the five intersections were red when the float was allowed to proceed without stopping.

- Law enforcement personnel blocked the cross traffic at the intersection of West Front Avenue to allow the float to proceed through a red traffic signal and continue its approach toward the grade crossing.

- According to the *Texas Transportation Code*, Title 7, Subtitle C, section 544.004(a), "The operator of a vehicle or streetcar shall comply with an applicable official traffic-control device placed as provided by this subtitle unless the person is …otherwise directed by a traffic or police officer…."

- The float driver and the escorts did not have an established means of quickly communicating with each other, such as a dedicated radio channel.

- The float driver stated that he did not notice or attend to traffic signals along the parade route due to the presence of law enforcement escorts. Additionally, during his approach and negotiation of the grade crossing, he said that he did not notice or attend to the active visual and auditory warning signals.

Participation in a parade that included law enforcement escorts and law enforcement control of intersections may have created an expectancy of safety and right of way on the part of the float driver, regardless of the highway situation he encountered. Expectancy can be defined as a predisposition to believe that things will happen or be arranged in a certain way (Olson, Dewar, and Farber 2010, 21). Expectancies are associated with all levels of the driving task and all phases of the driving situation. Examples include the arrangement of the brake and acceleration pedals, the sequence of traffic signals, and the behavior of drivers who activate their left-turn indicator light. Such expectancies are learned through exposure to other motorists and to general civil/traffic engineering practices. They directly relate to a driver's readiness to respond to conditions, situations, events, and information (Alexander and Lunenfeld 1986, 8–9). Expectancies can influence the speed and accuracy of driver information processing and are considered one of the most important considerations in the design of highways and presentation of information to drivers. Conditions in accordance with drivers' expectancies help them respond quickly, efficiently, and without error. Conversely, when driver expectancies are violated, longer reaction times, confusion, inappropriate response, and driver error may occur (Alexander and Lunenfeld 1986, 8).

The float driver's statements strongly suggest that his expectation of danger was low due to the situation (a parade), the presence of law enforcement escorts, and the blockage of cross traffic at signalized intersections by additional law enforcement personnel. The continued presence of law enforcement personnel blocking the cross traffic on West Front Avenue and allowing the float driver to proceed through the red traffic signal on South Garfield Street on approach to the grade crossing further enforced this expectancy of safety at all intersections, including at the grade crossing. Because of these circumstances, the float driver likely believed that he could turn his attention from the roadway to his mirrors to confirm that the passengers seated on the flatbed were not being jostled as he negotiated the dip at the south end of West Front Avenue. As a result, the float driver said that he did not notice the lights of the grade crossing warning system until he saw them reflected in his right-side mirror. His interpretation of both the warning signals as "just more lights" and of the train's seemingly stationary presence on the tracks can also be attributed to his expectation of safety.

The NTSB concludes that participation in the parade and law enforcement control of the parade route created an expectation on the part of the float driver that it was safe to continue through the grade crossing. The NTSB further concludes that the float driver did not see the flashing lights of the grade crossing warning system or detect the presence of the train until the float was on the tracks because he had been looking at his side-view mirrors to monitor the well-being of the float passengers.

2.2.4 Visibility

On November 20, 2012, NTSB investigators recorded video from the cab of an exemplar vehicle to capture an approximation of the float driver's view out the passenger side window. The exemplar vehicle was driven through the crossing when the sun was at the same azimuth as during the collision and at a speed that approximated that of the float.[12] Although the sun was in a position to potentially cause brightness and glare issues for drivers looking west down the tracks, during a postcrash interview, the float driver stated that he had seen the train in the distance. The left- and right-side windows and the top portion of the driver-side windshield were tinted on the truck-tractor, allowing 17 percent, 18 percent, and 5 percent of light through, respectively. However, according to the float driver, the right-side window had been fully rolled down, and the left-side window had been rolled down 6 inches. The float driver further stated that he had used the left-side mirrors to monitor his tires as he proceeded over the dip in the road at the south end of the West Front Avenue intersection. These statements suggest that the tinting did not affect his ability to see through the left-side window.

[12] According to the US Naval Observatory, at 4:35 p.m. on November 15, 2012, in Midland, Texas, the sun was at an altitude of 13 degrees above the horizon at 238 degrees east of true north.

The NTSB concludes that the float driver's ability to monitor the scene around him was not hampered by sun glare or by the tinted windows of his vehicle.

2.2.5 Parade Noise

Video of the parade and the list of performers and participants suggest that the parade produced a considerable amount of noise. Sources of noise included onlookers, motorcycle and truck engines, police sirens, and a train horn mounted on the lead float. Although the exact noise level within the vicinity of the grade crossing could not be determined with the available evidence, it is possible that the level and type of noise generated by the parade either masked the sound from the grade crossing warning system or caused the float driver to misinterpret the auditory warning as additional parade noise. It is also possible that the float driver's expectation of safety might have led him to discount the auditory warning.

The city of Midland established a quiet zone around the grade crossing in 2007 restricting the routine sounding of locomotive horns 24 hours a day.[13] Typically, when not in a quiet zone, a train traveling at 62 mph would initiate a horn sequence about 15 seconds (a quarter mile) prior to reaching a grade crossing. The train horn sequence would have been initiated 5 seconds after the activation of the grade crossing lights and bells. Given the ambient noise surrounding the parade, the use of the lead float's train horn throughout the parade, indication by the float driver that he had not heard the grade crossing bells on approach to the grade crossing, and the float driver's expectation of safety, it is unlikely that a typical train horn sequence would have been detected, or if so, properly interpreted.

The NTSB concludes that the float driver's expectation of safety, combined with the noise generated by the parade, likely reduced his ability to hear or properly interpret the grade crossing system warning bells and train horn.

2.2.6 In-Vehicle Distractors

The float driver stated that the only portable electronic device in the truck-tractor was his personal cellular telephone and that he was not using it around the time of the collision. This statement was confirmed by records obtained from his service provider. The float driver stated that the truck-tractor was equipped with a citizen's band (CB) radio, and he used it during the parade to communicate with the lead float driver. He stated that he could use the CB only to communicate with the lead float driver and could not communicate with any law enforcement officials. He told investigators that he was not using his CB as he traversed the grade crossing.

The NTSB concludes that the float driver was not distracted by the use of in-vehicle electronic devices.

[13] In accordance with 49 CFR 222.39, the city of Midland submitted to the Federal Railroad Administration (FRA) a Notice of Establishment of a quiet zone, dated May 1, 2007, for the grade crossing at South Garfield Street. The horn may be sounded in an emergency situation, when the engineer believes that such action is appropriate, to prevent injury, death, or property damage.

2.2.7 Toxicology

In accordance with motor carrier safety regulations, the float driver was tested for alcohol and controlled substances after the collision.[14] An alcohol breath test was administered at 8:11 p.m. on November 15, 2012, and the results were negative for alcohol. A urine sample was also collected at 8:27 p.m., and it tested negative for five classes of drugs of abuse.[15] The NTSB concludes that there is no evidence that the float driver was driving under the influence of alcohol or drugs of abuse.

2.2.8 Health

Records from the float driver's most recent commercial driver fitness examination, which had been conducted on November 16, 2010, show that his hearing and corrected vision were within acceptable federal standards, as specified in 49 CFR 391.43. The float driver's height was recorded as 69 inches, and his weight was recorded as 198 pounds, which corresponds to a body mass index (BMI) of 29.2.[16] The physician who performed the examination qualified the float driver for 2 years, with the only stipulation that he wear his glasses when driving. The float driver's medical certification expired on November 16, 2012, one day after the collision.

The NTSB was unable to locate doctors who had treated or were treating the float driver. When interviewed, the float driver stated that he did not see any doctors on a regular basis. No record of prescription medications was found, and postcrash hospital records did not indicate any conditions that might have affected his ability to operate a motor vehicle. The float driver told investigators that he had not been experiencing any health issues on the day of the parade. He further stated that he had not experienced any significant life changes or stressors in the days and weeks prior to the parade.

The NTSB concludes that there is no evidence that the float driver was experiencing stress or had a health, hearing, or visual condition that affected his ability to perceive the grade crossing warnings, perceive the train, or safely operate his vehicle.

2.2.9 Sleep Habits

The float driver stated that he would typically go to bed by 9:30–10:00 p.m. on nights preceding workdays and wake up at 5:15 a.m. On nights preceding a day off, he typically went to

[14] Per 49 CFR 382.303, commercial drivers are required to submit to postaccident alcohol and controlled substance testing as soon as practicable. If an alcohol test is not administered within 2 hours of an accident, and if a controlled substance test is not administered within 32 hours of an accident, it is the carrier's responsibility to prepare and maintain on file a record stating the reasons the tests could not be promptly administered. The NTSB has verified that Smith Industries has complied with the regulations by maintaining on file a record stating the reasons the alcohol test could not be promptly administered.

[15] Per 49 CFR Part 40, laboratories must test for the following five drugs or classes of drugs in a US Department of Transportation (DOT) drug test: marijuana metabolites, cocaine metabolites, amphetamines, opiate metabolites, and phencyclidine.

[16] The US Centers for Disease Control and Prevention classify a BMI of 30 or greater as obese. Studies indicate that individuals with a BMI over 33 are likely to have obstructive sleep apnea. Also see Gurubhagavatula and others, 2004.

bed by 11:00 p.m. and awoke at 7:00 a.m. He stated that he typically felt rested when he awoke and described his sleep quality as good or average. He told investigators that he had no trouble falling asleep at night or awakening in the morning, and that he does not nap. He typically woke once during the night but had no trouble falling back asleep. He stated that he used an alarm clock on the days when he had to rise at a particular time. Based on his logbook and interview, the driver had approximately 7 hours of sleep opportunity the night before the parade and 7.75 hours of sleep opportunity each of the two prior nights. He had been awake for about 11 hours at the time of the collision.

The NTSB concludes that, based on evidence and statements regarding the float driver's medical history, sleep opportunity, sleep quality, sleep schedule, and time awake, it is unlikely that he was fatigued at the time of the collision.

2.3 Highway Factors

2.3.1 Background

South Garfield Street in the vicinity of the grade crossing was constructed in 1956. The roadway was improved in 2006 to include a raised median and to restripe the roadway to a five-lane cross section. The annual average daily traffic on South Garfield Street in the vicinity of the grade crossing at the time of the collision was 8,784 vehicles in the southbound lanes and 7,448 vehicles in the northbound lanes. The posted speed limit for South Garfield Street is 35 mph.

2.3.2 South Garfield Street Configuration

South Garfield Street in the vicinity of the grade crossing consists of five lanes—two northbound through lanes, two southbound through lanes, and a left-turn-only lane. The northbound and southbound lanes are separated by a 2.5-foot-wide raised concrete median that contains 3-foot-tall yellow delineator posts. The total width of the five-lane cross section is approximately 62.5 feet. The Union Pacific single main track through the city of Midland is paralleled by five-lane West Front Avenue to the north and three-lane West Industrial Avenue to the south.

South of the West Front Avenue intersection, South Garfield Street slopes upward 5.6 percent on approach to the grade crossing. This slope plateaus at the grade crossing for a distance of 2 feet outside the rails. South Garfield Street then slopes downward 5.4 percent toward West Industrial Avenue. The slopes on either side of this grade crossing are not severe enough to obstruct low-clearance vehicles on the tracks. The distance from the south curb line of West Front Avenue to the nearest rail is approximately 80 feet. The distance from the north curb line of West Industrial Avenue to the nearest rail is approximately 67 feet (see figure 18).

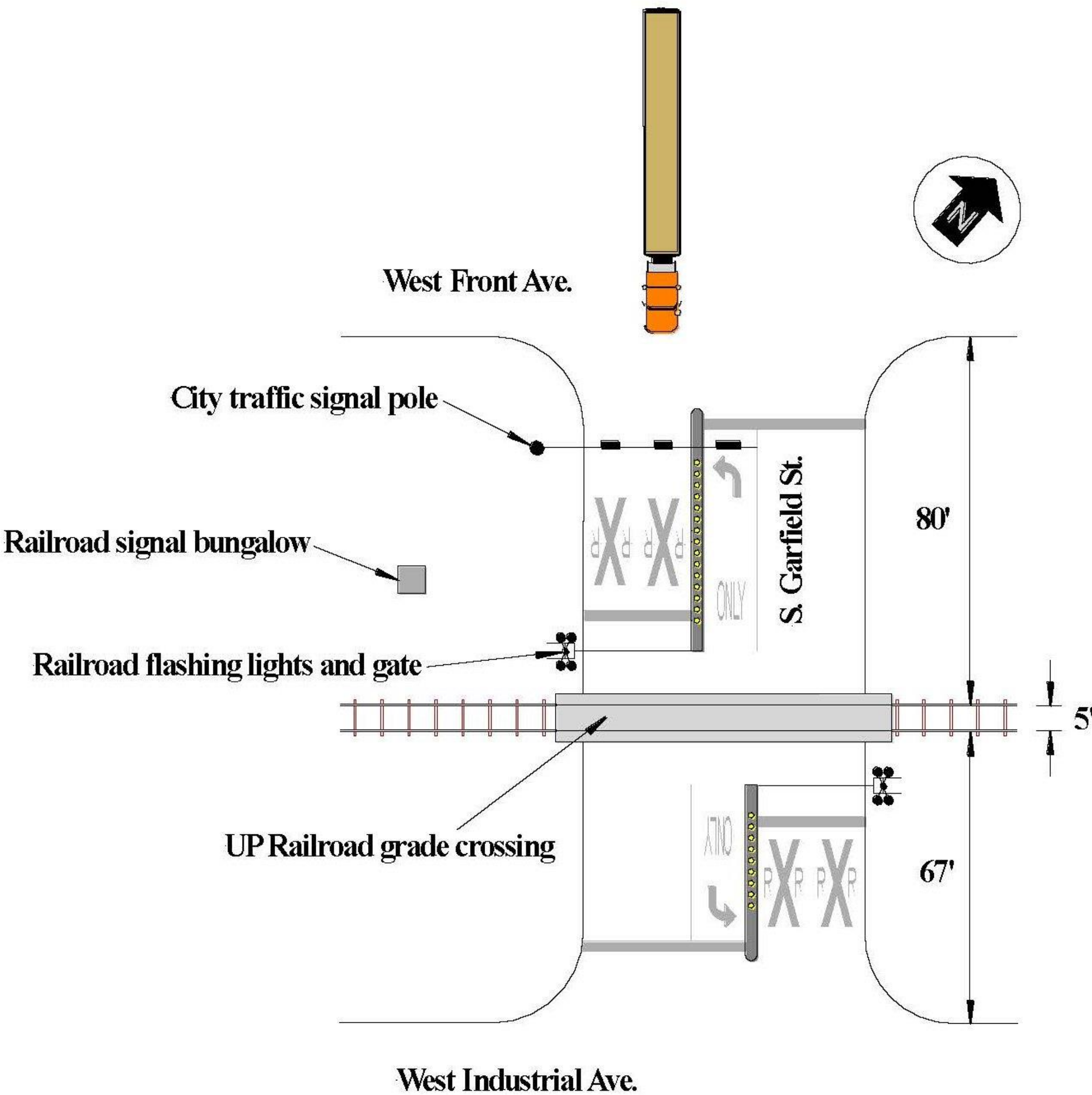

Figure 18. Diagram showing the road markings around the grade crossing, including the railroad crossing markings for each of the two lanes, as well as a stop line.

2.3.3 South Garfield Street Signs and Markings

Figure 19 illustrates the signage in the vicinity of the grade crossing at the time of the collision. The signage on South Garfield Street consisted of an advance railroad crossing sign with a "No Train Horn" sign on both approaches to the grade crossing. A "Do Not Stop on Tracks" sign was located just prior to the tracks in the northbound and southbound directions. The pavement markings in the vicinity of the grade crossing consisted of grade crossing pavement marking symbols located in the two northbound and two southbound through lanes. White stop lines[17] were located approximately 8 feet from the automatic gate on both approaches to the grade crossing. The left-turn lane was marked with left-turn-only markings.

Figure 19. Aerial photo of South Garfield Street around the grade crossing, with street signs highlighted.

2.3.4 South Garfield Street Grade Crossing

According to the DOT crossing inventory, the grade crossing at South Garfield Street is a public grade crossing owned and managed by Union Pacific. Its identification number is 796331L, and it is situated on railroad milepost 554.65. The design speed for the track is 79 mph, and the maximum track speed is 70 mph. On average, 23 trains pass through this grade crossing daily. The freight train involved in the collision was the sixteenth train to cross South Garfield Street that day and the eighth train to cross after 8 a.m. According to the FRA's Office of Safety Analysis website, prior to the Show of Support parade collision, this grade crossing has been the site of 10 accidents since 1979, resulting in 6 injuries. The most recent of these occurred in 1997, resulting in one injury.

[17] A stop line is a solid white line extending across an approach lane to indicate the point at which vehicles are intended to stop, in compliance with a STOP sign, traffic control signal, or some other traffic control device. Also see Federal Highway Administration (FHWA), 2009.

The grade crossing was equipped with an active grade crossing warning system (see figures 20, 21, and 22). The grade crossing warning system on southbound South Garfield Street consisted of two pairs of alternately flashing 12-inch warning lights, a warning bell, and a fiberglass gate arm—all mounted on a mast positioned to the west side of the roadway and 12 feet north of the nearest rail. The pairs of warning lights were mounted on opposite sides of the mast to warn southbound and northbound traffic. The grade crossing warning system on northbound South Garfield Street consisted of identical equipment mounted on a mast on the east side of the roadway.

The red- and white-striped gate arms consisted of a drive mechanism and were equipped with lights. The stripes were spaced alternately red and white at 16-inch intervals measured horizontally. Three 4-inch-diameter red lights were mounted on top of the gate arms. When activated, the gate arm light nearest the tip was continuously lit, and the other two lights flashed alternately in unison with the flashing light signals. When lowered into the horizontal position, the gates extended across all lanes from the curb to the center median in each direction of travel.

The collision between the train and the float damaged the automatic gate arm located in the northbound lanes of South Garfield Street. The gate arm was torn from its drive mechanism and was found on the grass in the southeast quadrant of the grade crossing. Postaccident testing on the gate arm in the southbound lanes found that it began descending about 6.8 seconds after the flashing light units activated. The gate arms assumed a horizontal position less than 15 seconds after the flashing light units were activated.

Figure 20. Driver's view of the traffic signals on West Front Avenue from southbound South Garfield Street, showing the crossing arm, flashing light signal, and crossbuck of the southbound South Garfield Street grade crossing in the background.

Figure 21. Grade crossing warning system mounted on the masts located on both northbound and southbound South Garfield Street.

Figure 22. View of the 12-foot distance between the rails and grade crossing mast on the southbound side of South Garfield Street and the warning light configuration, which provides visual warning for both northbound and southbound traffic. (The grade crossing mast on the northbound side of South Garfield Street is equipped in an identical fashion.)

A microprocessor unit housed in a railroad signal bungalow located in the northwest quadrant of the grade crossing controlled the grade crossing warning system.[18] A separate traffic signal cabinet located in the northeast quadrant of the West Front Avenue intersection controlled the traffic control signals at the West Front Avenue and the West Industrial Avenue intersections.

As required by 49 CFR 234.225,[19] Union Pacific designed the grade crossing warning system to provide motorists with at least 20 seconds of warning time when a train approaches. Additionally, Union Pacific provided a buffer time of 5 seconds to account for fluctuations in warning activation time due to changing ballast and track conditions, as well as variances in the speed of approaching trains.

[18] The train detection and warning system activation was configured through a Safetran grade crossing predictor, model 3000D2, microprocessor unit.

[19] The FRA published a final rule on grade crossing warning times in 1995, and Texas has complied with the final rule since then.

Records indicated that on January 2012, a contractor informed Union Pacific that the manner in which audio frequencies were allocated among the grade crossings between milepost 553.66 and 555.85 could lead to additional fluctuations in train detection time.[20] The South Garfield grade crossing was among those potentially affected. Union Pacific approved plans to eliminate potential frequency issues between these mileposts; however, due to an oversight by Union Pacific, these plans were not implemented.

Postcrash tests on the South Garfield grade crossing warning system revealed that its assigned audio frequency was close enough to the audio frequency at an adjacent grade crossing to cause slight delays in the train detection time. This delay consumed most of the 5-second buffer time and resulted in warning activation times just above 20 seconds. At the time of the collision, the grade crossing warning signals were activated about 21 seconds before the arrival of the train.[21]

Data downloaded from the grade crossing warning system indicated that from October 12 to November 15, 2012, the South Garfield grade crossing met federal warning time requirements on all but one occasion, when on October 29, the system provided 19 seconds of warning time for an approaching train.[22] Apart from this, grade crossing warning times ranged from 21 to 28 seconds. In December 2012, Union Pacific changed the audio frequencies used at the South Garfield grade crossing and at two other crossings to eliminate the frequency issue identified.

The NTSB concludes that the grade crossing warning system provided 20 seconds of warning as required by federal regulations.

2.3.5 Advance Preemption

The *Manual on Uniform Traffic Control Devices* (MUTCD)[23] defines preemption as “the transfer of normal operation of a traffic control signal to a special control mode of operation” (FHWA 2009).

Advance preemption describes the situation at the highway intersections near the South Garfield Street grade crossing, where an approaching train preempts highway traffic signals prior to activating the grade crossing warning system. The traffic signal controller[24] for the signals along South Garfield Street, West Front Avenue, and West Industrial Avenue near the grade crossing is interconnected with the grade crossing warning system and programmed for advance preemption to eliminate traffic conflicts while minimizing congestion. When an approaching train is detected, the normal traffic signal sequence is preempted for a signal pattern that clears vehicles on either side of the tracks on South Garfield Street and prevents additional vehicles

[20] Train detection is accomplished by the use of audio frequencies transmitted along the tracks.

[21] The Safetran grade crossing predictor recorded 21 seconds of warning time. Video evidence indicated about 20.5 seconds of warning time.

[22] During this 35-day period, about 798 trains passed through the South Garfield grade crossing.

[23] The FHWA’s MUTCD sets the minimum standards for and provides guidance to ensure the uniformity of traffic-control devices across the nation.

[24] The traffic signal controller unit was a Naztec Model 900 TS2 running firmware version 980–NTCIP Version 61.3q.

from approaching the grade crossing in advance of activation of the grade crossing warning system. This highway traffic signal pattern is referred to as a "track clearance green interval."

Figure 23 illustrates the typical traffic signal pattern under the track clearance green interval at the West Front Avenue intersection.[25] Advance preemption of the traffic signals is programmed to begin approximately 10 seconds before activation of the grade crossing warning system. Depending on when a train is detected during a normal traffic signal pattern, it could take as long as 5.8 seconds for the traffic signals to cycle to the track clearance green interval. The highway traffic signals would typically continue to operate in this interval for 25 seconds, then transition to a sequence that allows for traffic flow that does not conflict with passage of the train (referred to as the "dwell operation"; see figure 24). Once the train clears the grade crossing and the warning system deactivates, the highway traffic signals return to normal operation.

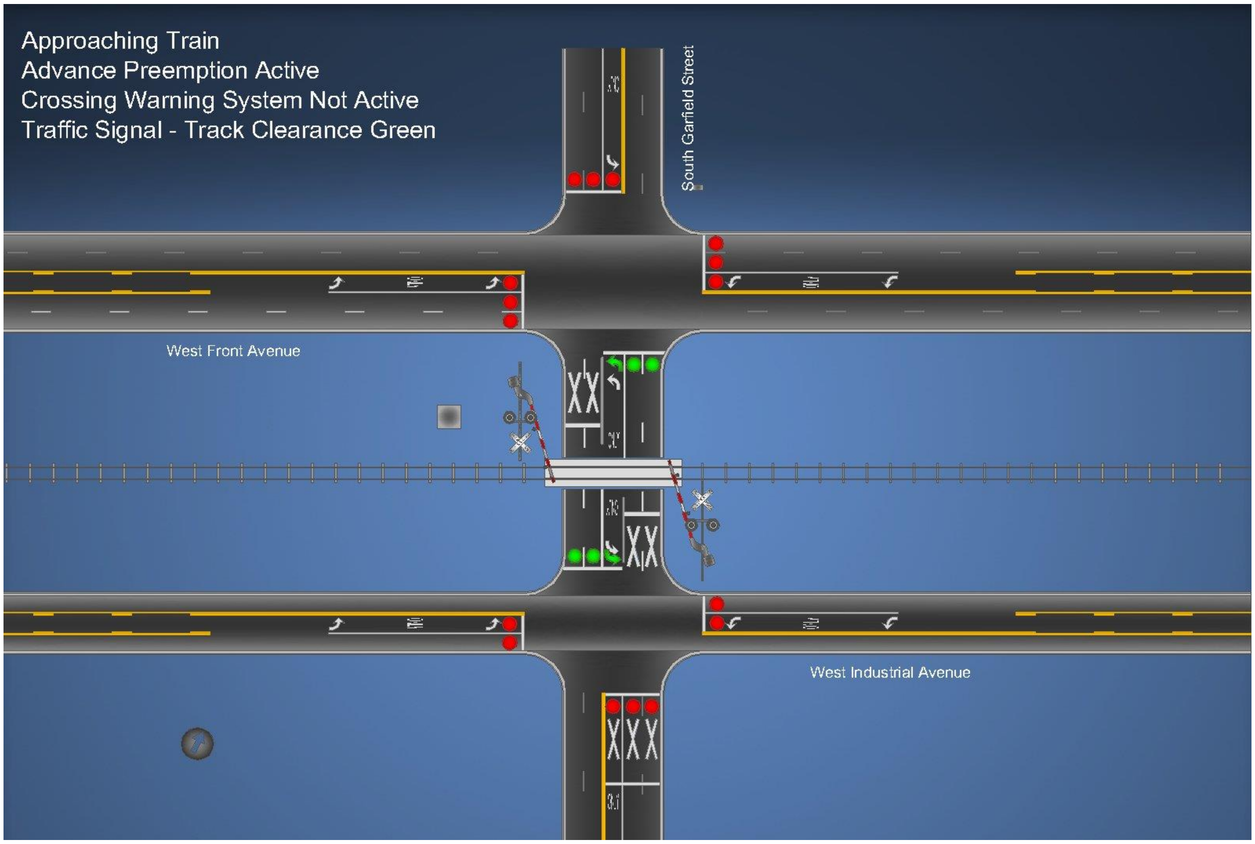

Figure 23. Depiction of the typical track clearance green interval. Only the signal next to the grade crossing is green. All others on South Garfield Street, West Front Avenue, and West Industrial Avenue are red. Note location of signals is for illustration purposes only.

[25] The traffic signal lights at South Garfield Street, West Front Avenue, and West Industrial Avenue consist of a 16-phase signal, and the timings vary depending on the traffic volume.

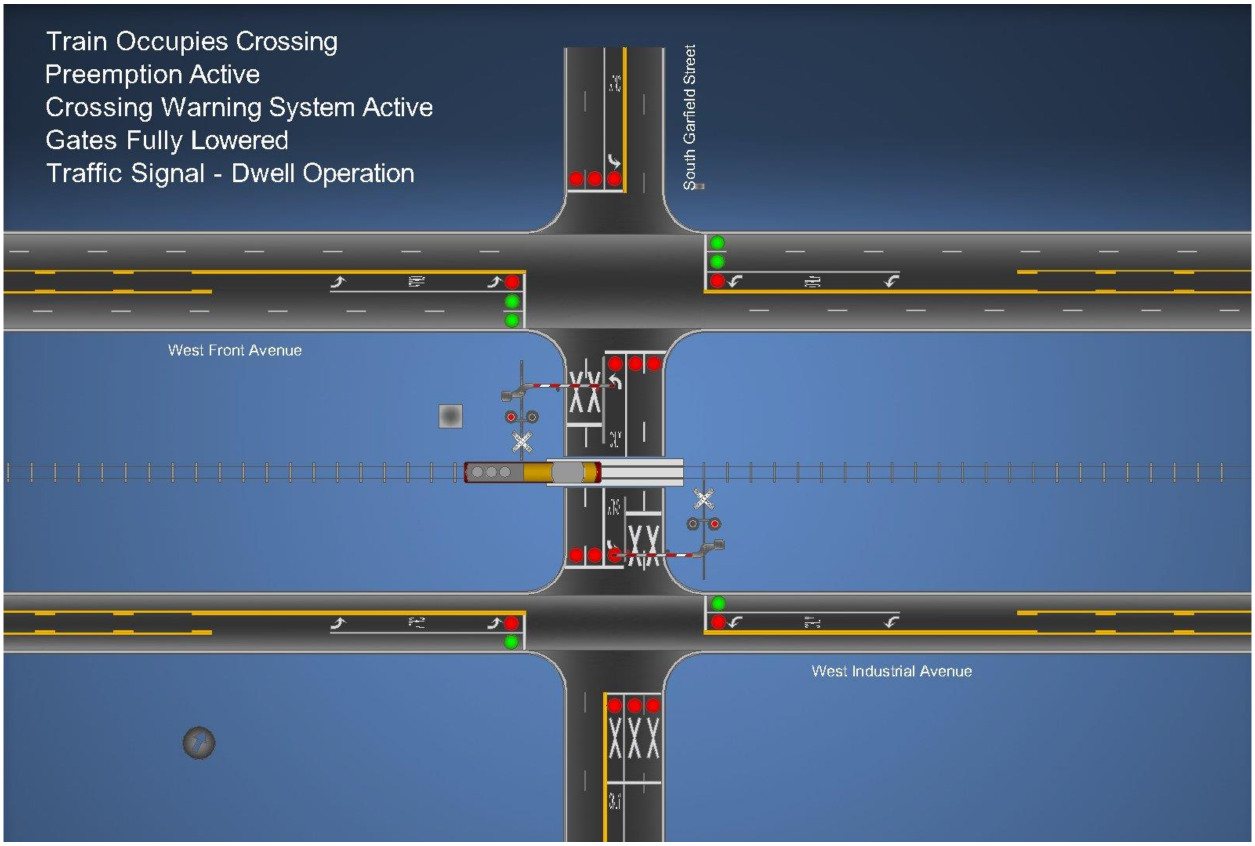

Figure 24. Depiction of the typical traffic signal pattern once the track clearance green interval has expired. This traffic signal pattern would occur while grade crossing gates are down, warning signals are active, and a train occupies the grade crossing—allowing for limited traffic flow that does not conflict with train operations.

Information obtained from the highway traffic signal controller and video footage from a Midland County Sheriff's vehicle dash camera indicated that the highway traffic signal facing southbound South Garfield Street at the West Front Avenue intersection was already displaying red when the float was 67 feet from the stop line (see figure 25). A reconstruction of the collision sequence—based on video evidence, data gathered from the downloaded logs of the grade crossing warning system, and the highway traffic signal controller—established that the highway traffic signals transitioned to advance preemption when the float was approximately 10–17 feet from the north curb line of the West Front Avenue intersection. Because the southbound facing highway traffic signal was programmed to display red during advance preemption, it simply continued to display red, with no overt sign given to drivers on South Garfield Street that the highway traffic signal had transitioned in response to an approaching train.

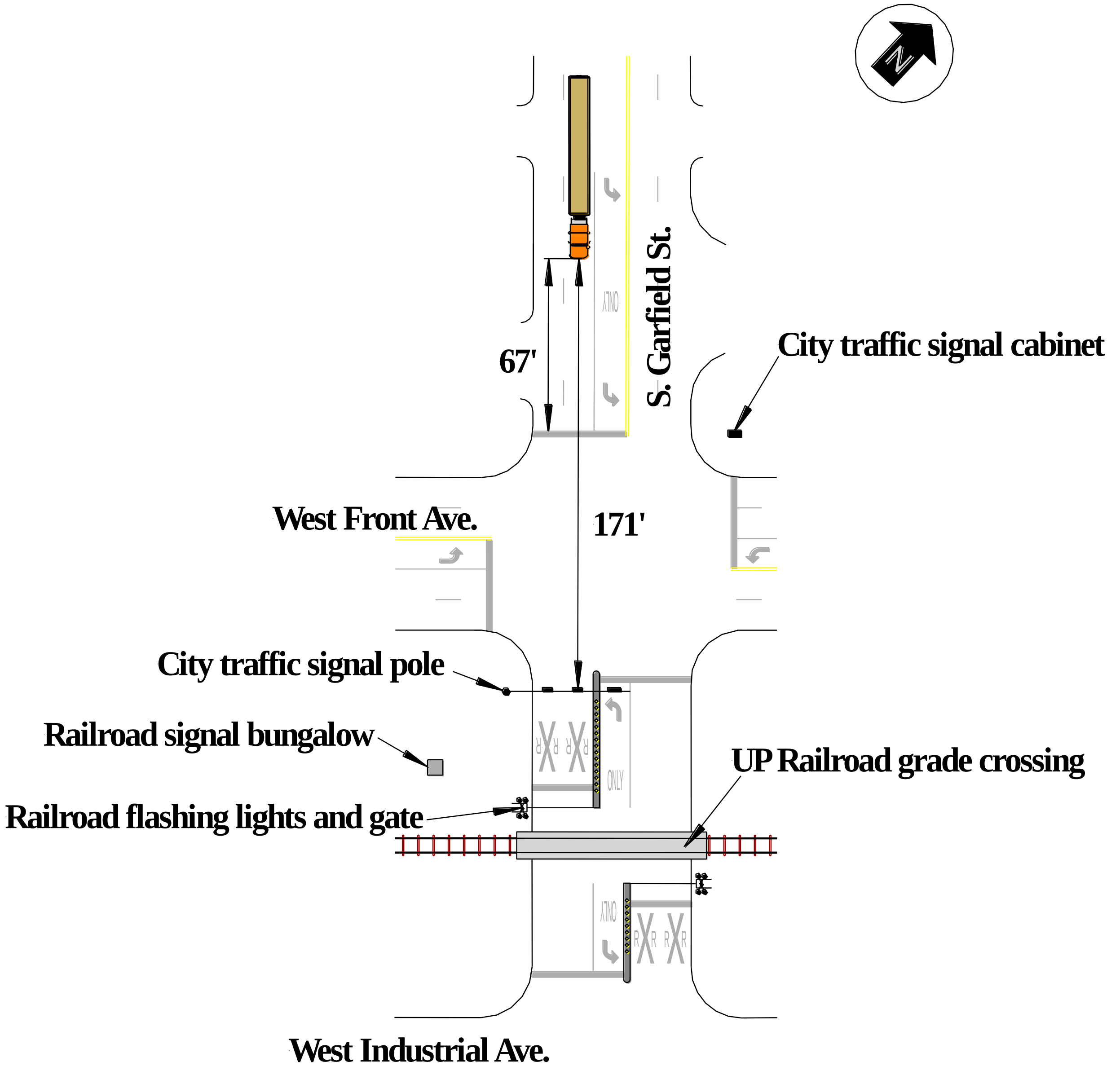

Figure 25. Illustration of the point, 67 feet from the stop line, at which the red stop signal was noticeable on the Midland County Sheriff's vehicle dash camera.

The law enforcement escort vehicles and the law enforcement personnel blocking the West Front Avenue intersection allowed the float to proceed toward the grade crossing, unaware of the advance preemption of the traffic signals and the approaching train. It was only after the grade crossing warning system activated that at least one of the escorts became aware of the danger—at this time, the float was less than 9 seconds from the grade crossing stop line. Had it been possible to quickly identify that the traffic lights had entered preemption because of an approaching train, law enforcement and parade participants would have had almost 10 additional seconds of warning time before the grade crossing lights and bells activated.

Because there are a number of scenarios in which law enforcement officers might bypass a red highway traffic signal—such as parades, funerals, and emergency response situations—it is essential that they be informed when highway traffic signals are preempted by an approaching train. In this case, the preemption status of the highway traffic signal at the intersection of South Garfield Street and West Front Avenue could not be easily recognized without additional cues.

The NTSB concludes that, had visual cues been available to signify that an approaching train had preempted the normal highway traffic signal sequence at the intersection of South Garfield Street and West Front Avenue, there would have been as much as 10 seconds of additional time to warn law enforcement officers and the float driver of the approaching train.

The NTSB found that some communities have equipped signalized intersections near grade crossings with additional lights or signs to inform emergency responders and motorists when an approaching train has preempted traffic signals. For example, in localities where an emergency vehicle preemption (EVP) system has been installed, approaching emergency vehicles can preempt normal traffic signal operations. When an emergency vehicle successfully preempts a highway traffic signal, the traffic signal ahead of the emergency vehicle transitions to green, and a steady white confirmation light displays on the traffic signal post (see figures 26 and 27). Emergency vehicles arriving at the intersection from a different direction see a red signal light, accompanied by a flashing white confirmation light indicating that traffic signals have been preempted. If an intersection equipped with EVP is located near a rail line, an approaching train has precedence over all types of vehicles. Red signal lights are displayed, accompanied by flashing white confirmation lights, in all directions of traffic to inform approaching emergency vehicles that they do not have the right of way.

Figure 26. View of the confirmation light activating at a railroad grade crossing in Minneapolis, Minnesota. This light serves to warn traffic that the normal light sequence has been preempted. (Photo courtesy of the city of Minneapolis, MN)

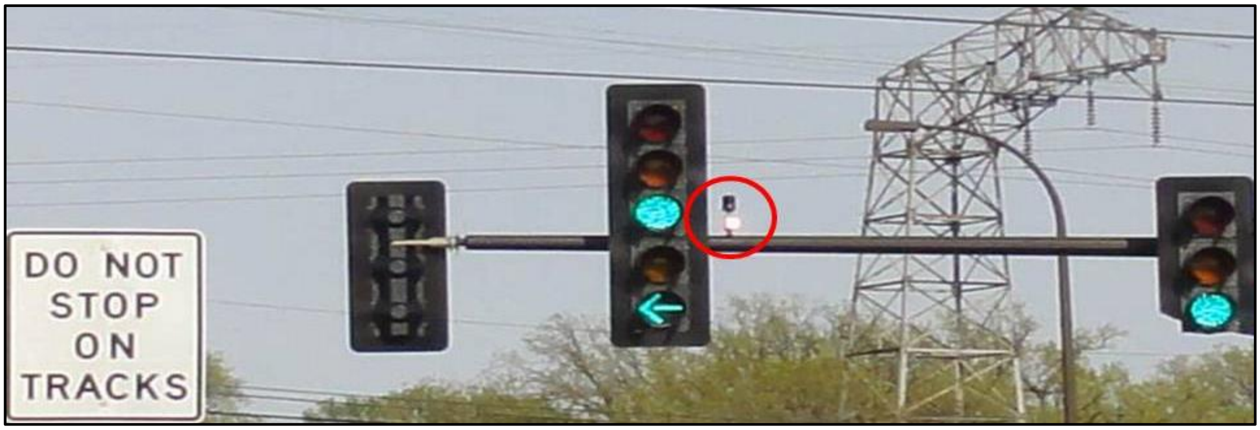

Figure 27. Close-up view of the same confirmation light activating at the same railroad grade crossing in Minneapolis, Minnesota. (Photo courtesy of the city of Minneapolis, MN)

Movement-activated blank-out signs have also been used to inform motorists of the approach of a train. These signs display a fixed message when activated and are blank when inactive (see figures 28, 29, and 30).

Figure 28. No-right-turn, no-left-turn, and no-through movement-activated blank-out signs. (Images courtesy of the FHWA's MUTCD, 2009)

Figure 29. Movement-activated blank-out sign near a grade crossing in Thomasville, North Carolina, reading "no right turn," with the word "train" located at bottom of sign to emphasize that a train is approaching the grade crossing. (Photo courtesy of the North Carolina Department of Transportation)

Figure 30. Movement-activated blank-out sign near grade crossing in Belle Chasse, Louisiana, with a no-right-turn icon and "train" at bottom warning that a train is approaching the crossing. (Photo courtesy of the Louisiana Department of Transportation)

In summary, a number of traffic control options, such as confirmation lights and movement-activated blank-out signs, can be used to warn emergency responders and motorists that an approaching train has preempted traffic signals. The MUTCD references only movement-activated blank-out signs and does not describe where confirmation lights should be used. Specifically, it is difficult to discern from the manual the circumstances in which movement-activated blank-out signs would be appropriate near highway–rail grade crossings.

The NTSB concludes that confirmation lights and movement-activated blank-out signs can help law enforcement and emergency responders quickly determine whether an approaching train has preempted a highway traffic signal and might have alerted law enforcement escorts sooner of the need to stop the parade to avoid the approaching train.

The NTSB recommends that the FHWA work with the FRA to (1) include guidance in the MUTCD for the installation of advance warning devices, such as movement-activated blank-out signs, that specifically use the word "train" to indicate the preemption of highway traffic signals by an approaching train, and (2) amend the MUTCD to indicate that preemption confirmation lights, while not intended to provide guidance to the general public, would be useful in providing advance information on train movements to law enforcement and emergency responders.

2.4 Show of Support Parade Factors

2.4.1 Background

The parade was part of a 4-day event sponsored by Show of Support, whose stated purpose is to "…demonstrate public support for the men and women of the military by providing outdoor opportunities to those injured in service to our country." The parade traditionally takes place the week before Thanksgiving and involves several community organizations that have volunteered their time and equipment. Participants in the 2012 parade included 25 veterans, their spouses, the Midland Police Department, the Midland County Sheriff's Office, the Midland Fire Department, the Midland Christian School Band, the Gold Star Mothers,[26] the National Honor Society, the Patriot Guard Riders,[27] and the local Corvette and antique car clubs. Smith Industries donated the use of the combination units to transport the veterans and their spouses, and the drivers donated their time.

The founder of Show of Support and a former Midland City Police lieutenant in charge of traffic enforcement worked together to conceive and organize the parade. According to the former lieutenant, who retired in March 2012, when the Show of Support event began in 2004, it consisted only of a few vehicles, including two limousines that transported the veterans. In the intervening years, the parade grew as community participation increased. By 2011, approximately 100 vehicles and several groups were taking part in the parade.

The parade route has changed twice since 2004. For the first 2 years, the parade was routed through an underpass to avoid the railroad tracks (see figure 31). The parade organizers changed the route in 2006 to accommodate the growing number of participants and to increase Show of Support's exposure in the community (see figure 32). This revised parade route proceeded west from the DoubleTree Hotel on West Wall Street to South Garfield Street, turned south on South Garfield Street to the grade crossing, turned right on West Industrial Avenue for two blocks, and then turned left onto Cotton Flat Road to the Midland County Horseshoe Arena. Parade organizers adopted the current parade route in 2011 after South Garfield Street was extended to the Horseshoe Arena (see figure 33).

[26] Gold Star Mothers was formed to provide support to those who have lost a loved one in a war.

[27] Patriot Guard Riders is a diverse organization of motorcycle enthusiasts who participate primarily in funeral processions, services, and special events held in honor of deceased war veterans, police officers, and firefighters.

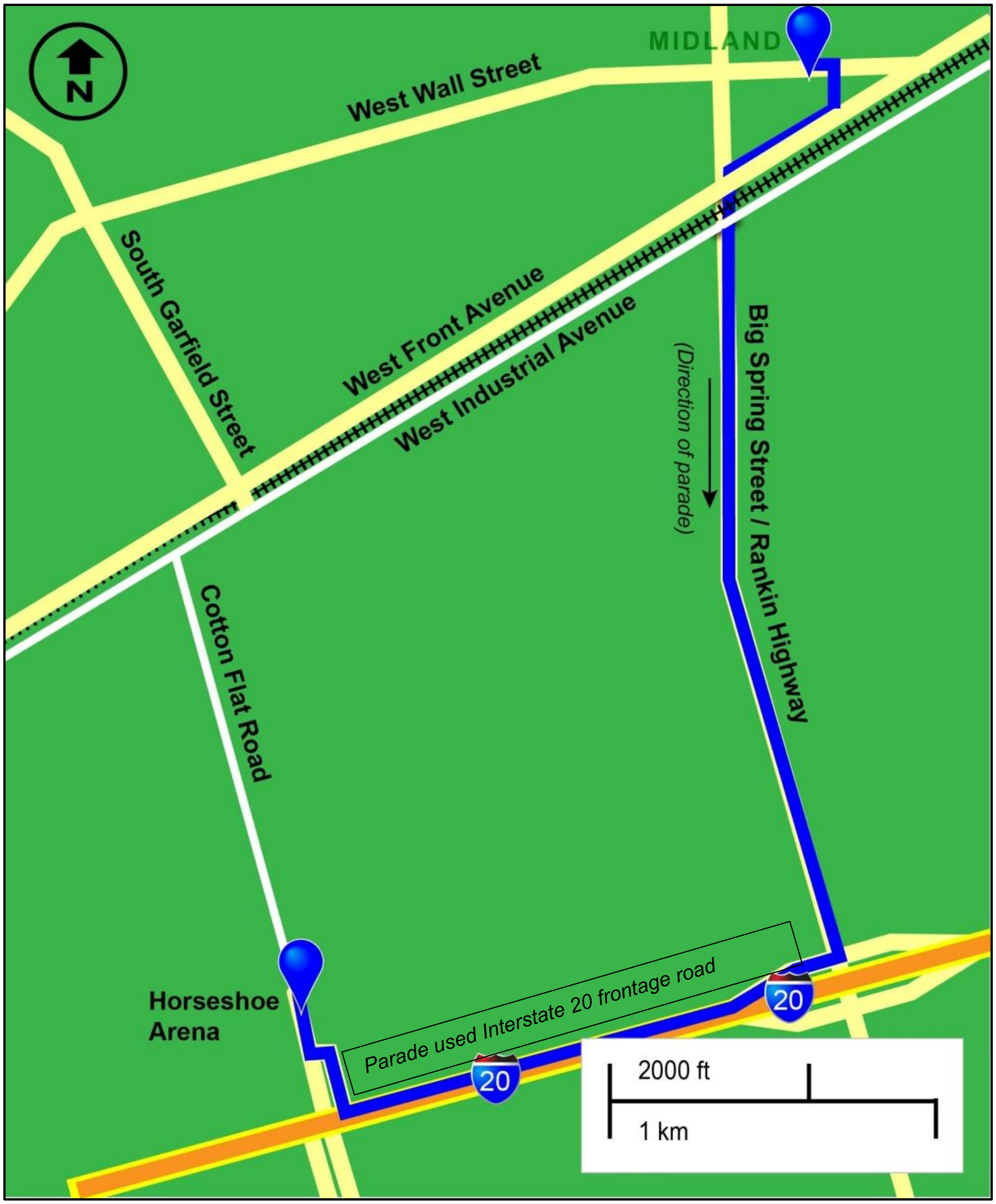

Figure 31. Parade route 2004–2005.

Figure 32. Parade route 2006–2010.

Figure 33. Parade route 2011–2012.

2.4.2 Parade Permit Process

The NTSB investigation found that Show of Support failed to obtain a parade permit, and the city of Midland failed to enforce its ordinance by allowing the parade to take place despite the absence of a permit. According to the city ordinance in place at the time of the 2012 parade:

> No procession, excepting the forces of the United States Army or Navy, the military forces of this state, and the forces of the police and fire departments, shall occupy, march or proceed along any street except in accordance with a permit issued by the chief of police and such other regulations as are set forth in this Title which may apply. The above does not apply to funeral processions.

A permit had to be submitted at least 30 days prior to an event date. The fine for violating the parade permit ordinance was $500. The permit form listed a number of requirements that needed to be met before a permit was issued, including:

- Verifying if a Temporary Land Use Permit is required;
- Submitting an event map indicating the location or route of the event;
- Obtaining the required city officials' signatures (city manager; city attorney; transportation supervisor; police department representative, i.e. traffic lieutenant; Health Department representative; Fire Department representative; and Solid Waste Services representative); and
- Obtaining insurance indemnifying the city and obtaining a $1 million insurance policy covering the conduct of the event.

The absence of a parade permit is indicative of the lax and informal manner by which the parade was organized, approved, and executed. According to the former lieutenant, when the parade was first established in 2004, he assumed responsibility for obtaining the parade permit. Show of Support itself did not initiate or retain any documents related to city approval of the parade or other activities. In 2009, when the former lieutenant again submitted an application for a parade permit, he was told by a number of city officials that the event no longer needed a permit because it qualified as a "city-sponsored" event.[28,29] Thereafter, from 2010 until 2012, the former lieutenant and his successor did not initiate the process to obtain a parade permit. The NTSB obtained a copy of the incomplete 2009 permit application from the city transportation manager and also from the city's insurance agent. The permit was signed by the former lieutenant but contained no city officials' names.

When NTSB investigators asked city officials why they allowed the parade to proceed for 4 years without issuing a permit, they were told that the ordinance required Show of Support to obtain a permit. NTSB investigators were not provided any documents indicating that a permit

[28] The former lieutenant first obtained this information from an assistant to the director of the city's Transportation Department. He then verified it with the director of the city's Safety and Risk Department and with either the city manager or the city attorney (he could not remember which one).

[29] The supposition that the Show of Support parade qualified as a "city-sponsored event" may have originated when the city began purchasing supplemental insurance annually for parades to cover persons along the parade route who might be injured from incidental activity, such as the throwing of candy by parade participants.

was obtained or approved for the 2012 parade, or that the permit requirements listed above were fulfilled. In a press release dated November 21, 2012, the city of Midland stated that it did not issue a permit nor had the city received a permit application from Show of Support. The city of Midland did not fine Show of Support for violating the parade permit ordinance.

The NTSB concludes that the city of Midland failed to follow and enforce its own ordinances, and allowed the Show of Support parade to take place without a permit from 2009 to 2012.

In February 2013, the Midland city council amended its parade ordinance to prohibit the city manager from issuing permits for special events that propose crossing over a railroad track. According to the city code of Midland, only the city council can issue such a permit, and it can do so only after an applicant submits proof of having received permission from the appropriate railroad officials to traverse the railroad crossing.

2.4.3 Railroad Notification

When the railroad is notified in advance of an event that traverses or is held near a grade crossing, the railroad may take actions, such as arranging to halt train traffic, restrict train speeds, or provide a flagman.[30] At the time of the collision, the city of Midland did not require the railroad to be notified when a parade was planned to be routed over a grade crossing. The former lieutenant stated that he had notified the railroad of the parade in 2006 and 2007, the first 2 years the parade crossed the grade crossing at South Garfield Street and West Front Avenue. He discontinued notifying the railroad in 2008, opting instead to post police officers at the grade crossing to monitor train activity. After the lieutenant retired and was replaced by a successor, the Show of Support parade took place in November 2012 without the railroad being notified or officers being posted at the crossing with the specific purpose of monitoring for oncoming trains.

Although the absence of additional officers at the grade crossing to specifically monitor train traffic during the parade might have played a role in the collision, research suggests that individuals commonly underestimate the approach speed and distance of trains and other large objects. Therefore, a reliance on train monitors may not be an effective method of detecting trains and estimating their arrival (Cohn and Nguyen 2003; Cooper and Ragland 2008). Train monitors at this particular grade crossing might have supplemented the alerts provided by the grade crossing warning system, but a rapid and reliable method of communication would still be needed for monitors to convey any impending dangers because the float drivers may have been attending to other visually demanding tasks.[31] Additionally, the fast approach speed of an oncoming train still presents a hazard unless the track speed is lowered or train traffic is halted during the time of the parade. Hence, though train monitors may be beneficial to the safety of parades that traverse a grade crossing, they are not an effective substitute for notifying the railroad.

[30] This information was provided by the director of Public Safety for Union Pacific during a phone interview on October 25, 2013.

[31] As described previously, the communication systems used by law enforcement and the two float drivers were incompatible; the float drivers were only able to communicate with each other and not with law enforcement.

NTSB investigators obtained and evaluated parade permit ordinances and procedures from several Texas cities.[32] Most of these documents were more thorough in their requirements than those on record in Midland. When interviewed by investigators, the Stanton chief of police stated that he officially notified the railroad when a city event occurred close to its highway–railroad grade crossing.[33] None of the ordinances obtained by the NTSB, however, specifically mentioned notifying the railroad in the event that a parade route was scheduled to traverse a grade crossing.

The NTSB concludes that, with the exception of avoiding the grade crossing entirely, the most effective way for the city of Midland and Show of Support to have prevented a grade crossing collision would have been to notify the railroad in advance of the parade. Additionally, the NTSB concludes that the absence of ordinances or laws addressing risks related to parades and other events traversing a grade crossing poses a safety hazard for event participants and spectators.

2.4.4 Parade Planning

The Show of Support parade was organized by a committee of about 28 volunteers, each with an area of responsibility.[34] According to committee members interviewed by NTSB investigators, a written plan delineating the specific responsibilities of each committee member was never drafted because the committee was of the opinion that everyone knew his/her role in preparing for the parade. According to the former lieutenant, the Midland Police Department's responsibilities were to coordinate law enforcement activities with the Sheriff's Department and to coordinate parade participant activities; the Transportation Department's responsibilities included blocking streets and establishing sufficient traffic control along the route. The NTSB requested, but did not receive, written documentation related to the planning or operation of the 2012 parade from the Midland Police Department or the Department of Transportation.

By not developing and implementing a written plan that identified and addressed all possible risks to the event, Show of Support, the Midland Police Department, and the committee members overlooked several important aspects of parade safety. As previously noted, Show of Support and its committee failed to conduct a risk assessment that specifically addressed the hazards of the grade crossing. However, other aspects of parade safety that may suffer in the absence of a safety plan include traffic management throughout the city, safety-related coordination and communication among all event participants, and contingency planning.[35] A safety plan could have further benefited the parade planners by providing a framework for

[32] In addition to the neighboring cities of Odessa and Stanton, the NTSB evaluated the ordinances of Plano, Dallas, Killeen, and Fort Worth.

[33] In response to the notification, the railroad would restrict the speed of trains passing through the area to 15 mph.

[34] The exact number of volunteer organizations participating in the event is not known because no planning or related documents were available.

[35] The NTSB uses the term "safety plan" to refer to any written plan that addresses all aspects of risk mitigation and contingency planning. A safety plan may be a standalone document or a part of a larger operational plan for an event.

conducting postevent evaluations to address any deficiencies and improve the safety of future events.

The NTSB concludes that the failure of Show of Support, the Midland Police Department, and other parade committee members to develop and implement a written safety plan covering all aspects of the parade led to a failure to manage the safety hazards along the parade route.

2.4.5 Parade Float Operation

The NTSB discovered that there are no nationally accepted guidelines for the design of vehicles involved in parades. However, the NTSB also found that parade float incidents involving serious injury or death occur infrequently. Additionally, there is no evidence that traditional vehicle impact crashworthiness features—such as seatbelts or crush zones—would be beneficial on floats, because they do not normally travel at speeds that would require crash mitigation. Although emergency exits are a provision in some parade float guidelines, they are intended for enclosed spaces.

To assess the relative safety of float operation during the Show of Support parade, NTSB investigators consulted publicly available documents from several cities, municipalities, and universities to identify common practices.[36] If a safety requirement was included in several of the documents, NTSB considered it a common practice. For example, several documents listed various means of hazard recognition and communication, with the general objective being the mitigation of driver error. Appendix D lists the entities and sources used to evaluate common practices and presents a matrix of operational guidance. In general, the source documents consulted addressed four areas of parade float operational risk:

- Risk of fire,
- Risk of injury from parade activities,
- Risk of driver error and driver visibility, and
- Risk of poor planning and poor instructions for float operators.

Fire and injury from parade activities—such as people approaching the float or people throwing candy—were not factors in this collision. However, common practices related to driver error and visibility, along with poor planning and instructions for float operators, were relevant to the investigation.

[36] "Common practice" is a term used to describe a qualitative assessment of actions that can be considered typical and expected given a reasonably well organized operation. In categorizing each practice, the NTSB focused on the objective (for example, float passenger safety) rather than the method used to arrive at the objective.

The sources consulted revealed six practices relevant to driver error and driver visibility: (1) having an unobstructed view, (2) providing drivers with a means of communicating with passengers or other parade participants, (3) having spotters accompany the float,[37] (4) providing drivers with safety drills or checklists, (5) providing float passengers with an emergency sound device, and (6) limiting the speed of the float. Only one of these six practices (unobstructed view) was met during the Show of Support parade. Had the passengers been equipped with a means to communicate with the float driver, they might have been able to alert him to the grade crossing warning system signals or to the oncoming train. Had spotters been assigned to monitor the area in front of and around the float, they also could have warned the float driver.

Video evidence suggests that the four law enforcement escorts assigned to the two floats were not consistent in the execution of their duties. Three of the escort vehicles generally remained alongside the floats, while the escort vehicle to the right of the lead float frequently sped ahead to temporarily block cross traffic at intersections. It is unlikely that the escort drivers were meant to act as spotters because: (1) spotters, generally on foot and dedicated to a float, typically avoid assuming secondary roles so they can remain focused and react quickly to potential dangers to spectators and parade participants; (2) the escort vehicles lacked a means of quickly communicating hazards to the float drivers; and (3) traffic control is an entirely separate function.

The background noise and unique environment of a parade must also be considered. In the Midland collision, these factors rendered less effective the typical warnings from the train, reinforcing the importance of dedicated methods of hazard identification and alerts. A prearranged alerting method would have prepared the float driver to expect and better discriminate an emergency signal from background noise. Additionally, had the driver been provided with drills or a safety checklist that addressed the grade crossing, he might have been more aware of the intended roles of the police escorts and the limits of their duties.

Cities, municipalities, and universities commonly require the presence of a parade director[38] and the approval of a route plan. The Show of Support parade included a person who acted in a role similar to a parade director; however, the planning committee did not review the parade route.

The NTSB concludes that a safety plan that followed common parade float operation practices could have prevented the circumstances that led to this collision.

2.4.6 Parade and Event Safety

The NTSB examined four other parade and special event incidents to determine if a lack of safety planning contributed to their occurrence. Two of the incidents involved vehicles

[37] Spotters generally walk along the side and rear of a float during the parade. They have the responsibility of staying with their assigned float and making sure the following occurs: (1) spectators maintain a safe distance from the floats; (2) the float driver knows when and where to start, stop, reverse, or increase speed; and (3) the float driver is aware of potential dangers to participants/spectators.

[38] A parade director (sometimes referred to as a parade marshal) is the person with top level responsibility for all phases of a parade event, from planning and permitting to postevent activities.

striking pedestrians, one involved a collision between two vehicles, and one involved parade float passenger activity.

On July 16, 2003, in Santa Monica, California,[39] a 1992 Buick LeSabre driven by an 86-year-old man struck a sedan that had stopped for pedestrians in a crosswalk. The Buick continued through the intersection and drove into a farmers' market that was held on a blocked off street. The vehicle struck pedestrians and vendor displays, resulting in 10 fatalities and 63 injuries. On May 18, 2013, in Damascus, Virginia, an 87-year-old man driving a 1996 Cadillac DeVille sedan as part of the 27th Annual Appalachian Trail Days festival parade lost control of his vehicle and struck parade participants, spectators, and other vehicles. Two people were seriously injured and approximately 60 others suffered minor injuries.[40] Some planning and traffic control measures were in place in Santa Monica and Damascus, but neither event included a safety plan.

In Santa Monica, event permitting and planning included a certification process for the market vendors, a temporary traffic plan, and a review by the fire and police departments for emergency vehicle access. The NTSB investigation concluded that the city failed to comply with its own internal guidance, as well as state and federal guidance, on temporary road closures that require a higher level of protection for the pedestrians located in temporary traffic control areas. In the Damascus parade, it is less clear what could have been done to prevent an incident involving a driver suddenly losing control of his vehicle. A safety plan, however, could be used to identify special circumstances in events that might require additional risk mitigation beyond the minimum requirements—for example, additional driver screening, driver escorts, and special vehicle provisions. A safety plan should not impose arbitrary rules but should help organizers consider potential risks and mitigation strategies.

On July 4, 2013, during a parade in Bangor, Maine, a 1930 McCann Pump Engine fire truck operated by a 29-year-old firefighter struck a 1941 John Deere farm tractor operated by a 64-year-old man. As the vehicles approached an intersection, the farm tractor had slowed to make a turn and was struck from behind by the fire truck, causing the tractor to overturn. The tractor operator was run over by the fire truck and killed.[41] The local law enforcement investigation found evidence of faulty brakes on the fire truck due to insufficient quantity and quality of brake fluid. The brakes operated sufficiently on level ground but were ineffective on a shallow downward slope. No maintenance documentation for the fire truck was identified, and the parade organizers had exempted emergency response vehicles from the parade float application process. The parade organizers did not have, nor were they required to have, a safety plan, a route plan, a vehicle inspection process, or any other parade safety requirement. Parade vehicle safety is an item commonly included in parade guidelines or requirements.

On July 4, 2013, a 2013 Toyota Tundra pickup truck, driven by a 44-year-old man, was hauling an 18-foot flatbed trailer carrying several child passengers in the LibertyFest Independence Day Parade in Edmond, Oklahoma. The parade was nearing the end of the route, and the vehicles were returning to a staging area, when witnesses reported seeing children

[39] See NTSB/HAR-04/04, a final report published by the NTSB in 2004. (See "References.")

[40] See the NTSB public docket, HWY13-IH-011.

[41] See the NTSB public docket, HWY13-IH-017.

jumping on and off the trailer as the truck approached an intersection at a low speed. One child, who either jumped or fell from the trailer, was run over by the trailer and killed.[42] The LibertyFest event, in general, and the parade, in particular, included various elements of safety planning, float inspections, and float safety requirements. The rules required passengers to remain on the floats at all times while on the parade route, included provisions for the supervision of child passengers, and required floats to have handholds or other provisions for the securement of passengers. Low-profile hay bales were installed for the passengers to sit on, but the float did not have handholds. In this incident, a safety plan existed; however, it was not fully implemented and executed. This incident, as well as the Bangor, Maine, incident previously described, illustrates the importance of developing a safety culture that emphasizes clear communication and adherence to safety requirements.

These four incidents might have been prevented had the organizers developed, communicated, and implemented a written safety plan that addressed risk mitigation and contingency planning. The topics and scope of a safety plan may differ depending on the type and size of the event, but common elements in parade planning include route safety, safe zone protection, participant control, vehicle occupant control, and vehicle safety. Many organizations have safety plans in place for their events, with several making these plans publicly available on the Internet, but the NTSB's investigation shows that many others still proceed without one.

The NTSB concludes that many communities and organizations engaged in parade and special event planning fail to develop and implement a written safety plan.

To minimize the risk of accidents during a parade or any other celebratory event, the NTSB makes the following recommendations: First, the NTSB recommends that the city of Midland include in its city ordinances a requirement that all organizations create a safety plan as part of the city's event and parade approval process, to include, at a minimum, the following elements: route selection, mitigation of unavoidable hazards, lines of communication among event participants, notification of railroads or other entities with control over possible hazards, development of operating and emergency procedures, and a safety briefing for vehicle operators. Second, the NTSB recommends that the National League of Cities, National Association of Counties, National Association of Towns and Townships, United States Conference of Mayors, and International City/County Management Association encourage their members to require, as part of the parade and special event approval process, that organizations create a written safety plan, which, at a minimum, addresses the following elements: risk mitigation and contingency planning, with provisions for communication among event participants and other stakeholders; safety briefings for event participants and other stakeholders; driver and vehicle screening; safe float operation; and notification of railroads or other entities with control over possible hazards. Third, the NTSB recommends that the International City/County Management Association—with the assistance of the International Festivals and Events Association, National League of Cities, and National Association of Counties—develop and disseminate a list of key elements that state and local officials can use as a resource to create guidelines, standard operating procedures, or ordinances for the safe planning and operation of parades and other special events.

[42] See the NTSB public docket, HWY13-IH-016.

3 Conclusions

3.1 Findings

1. Emergency response, vehicle maintenance, motor carrier and train operation, and railway infrastructure were not factors in the grade crossing collision or resulting injuries.

2. Participation in the parade and law enforcement control of the parade route created an expectation on the part of the float driver that it was safe to continue through the grade crossing.

3. The float driver did not see the flashing lights of the grade crossing warning system or detect the presence of the train until the float was on the tracks because he was looking at his side-view mirrors to monitor the well-being of the float passengers.

4. The float driver's ability to monitor the scene around him was not hampered by sun glare or by the tinted windows of his vehicle.

5. The float driver's expectation of safety, combined with the noise generated by the parade, likely reduced the driver's ability to hear or properly interpret the grade crossing system warning bells and train horn.

6. The float driver was not distracted by the use of in-vehicle electronic devices.

7. There is no evidence that the float driver was driving under the influence of alcohol or drugs of abuse.

8. There is no evidence that the float driver was experiencing stress or had a health, hearing, or visual condition that affected his ability to perceive the grade crossing warnings, perceive the train, or safely operate his vehicle.

9. Based on evidence and statements regarding the float driver's medical history, sleep opportunity, sleep quality, sleep schedule, and time awake, it is unlikely that he was fatigued at the time of the collision.

10. The grade crossing warning system provided 20 seconds of warning as required by federal regulations.

11. Had visual cues been available to signify that an approaching train had preempted the normal highway traffic signal sequence at the intersection of South Garfield Street and West Front Avenue, there would have been as much as 10 seconds of additional time to warn law enforcement officers and the float driver of the approaching train.

12. Confirmation lights and movement-activated blank-out signs can help law enforcement and emergency responders quickly determine whether an approaching train has preempted a highway traffic signal and might have alerted law enforcement escorts sooner of the need to stop the parade to avoid the approaching train.

13. The city of Midland failed to follow and enforce its own ordinances, and allowed the Show of Support parade to take place without a permit from 2009 to 2012.

14. With the exception of avoiding the grade crossing entirely, the most effective way for the city of Midland and Show of Support, Military Hunt, Inc. to have prevented a grade crossing collision would have been to notify the railroad in advance of the parade.

15. The absence of ordinances or laws addressing risks related to parades and other events traversing a grade crossing poses a safety hazard for event participants and spectators.

16. The failure of Show of Support, Military Hunt, Inc.; the Midland Police Department; and other parade committee members to develop and implement a written safety plan covering all aspects of the parade led to a failure to manage the safety hazards along the parade route.

17. A safety plan that followed common parade float operation practices could have prevented the circumstances that led to this collision.

18. Many communities and organizations engaged in parade and special event planning fail to develop and implement a written safety plan.

3.2 Probable Cause

The National Transportation Safety Board determines that the probable cause of this collision was the failure of the city of Midland and the parade organizer, "Show of Support, Military Hunt, Inc.," to identify and mitigate the risks associated with routing a parade through a highway–railroad grade crossing. Contributing to the collision was the lack of traffic signal cues to indicate to law enforcement that an approaching train had preempted the normal highway traffic signal sequence at the intersection of South Garfield Street and West Front Avenue. Further contributing to the collision was an expectancy of safety on the part of the float driver, created by the presence of law enforcement personnel as escorts and for traffic control, leading him to believe that he could turn his attention to his side-view mirrors to monitor the well-being of the parade float occupants as he negotiated a dip in the roadway on approach to the grade crossing.

4 Recommendations

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

To the Federal Highway Administration:

> Work with the Federal Railroad Administration to (1) include guidance in the *Manual on Uniform Traffic Control Devices* (MUTCD) for the installation of advance warning devices, such as movement-activated blank-out signs, that specifically use the word “train” to indicate the preemption of highway traffic signals by an approaching train, and (2) amend the MUTCD to indicate that preemption confirmation lights, while not intended to provide guidance to the general public, would be useful in providing advance information on train movements to law enforcement and emergency responders. (H-13-41)

To the Federal Railroad Administration:

> Work with the Federal Highway Administration to (1) include guidance in the *Manual on Uniform Traffic Control Devices* (MUTCD) for the installation of advance warning devices, such as movement-activated blank-out signs, that specifically use the word “train” to indicate the preemption of highway traffic signals by an approaching train, and (2) amend the MUTCD to indicate that preemption confirmation lights, while not intended to provide guidance to the general public, would be useful in providing advance information on train movements to law enforcement and emergency responders. (R-13-38)

To the city of Midland, Texas:

> Include in your city ordinances a requirement that all organizations create a safety plan as part of the city’s event and parade approval process, to include, at a minimum, the following elements: route selection, mitigation of unavoidable hazards, lines of communication among event participants, notification of railroads or other entities with control over possible hazards, development of operating and emergency procedures, and a safety briefing for vehicle operators. (H-13-42)

To the National League of Cities, National Association of Counties, National Association of Towns and Townships, United States Conference of Mayors, and International City/County Management Association:

> Encourage your members to require, as part of the parade and special event approval process, that organizations create a written safety plan, which, at a minimum, addresses the following elements: risk mitigation and contingency

planning, with provisions for communication among event participants and other stakeholders; safety briefings for event participants and other stakeholders; driver and vehicle screening; safe float operation; and notification of railroads or other entities with control over possible hazards. (H-13-43)

To the International City/County Management Association:

With the assistance of the International Festivals and Events Association, National League of Cities, and National Association of Counties, develop and disseminate a list of key elements that state and local officials can use as a resource to create guidelines, standard operating procedures, or ordinances for the safe planning and operation of parades and other special events. (H-13-44)

To the International Festivals and Events Association, National League of Cities, and National Association of Counties:

Assist the International City/County Management Association in developing and disseminating a list of key elements that state and local officials can use as a resource to create guidelines, standard operating procedures, or ordinances for the safe planning and operation of parades and other special events. (H-13-45)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

DEBORAH A.P. HERSMAN
Chairman

ROBERT L. SUMWALT
Member

CHRISTOPHER A. HART
Vice Chairman

MARK R. ROSEKIND
Member

EARL F. WEENER
Member

Adopted: November 5, 2013

Member Weener filed the following concurring statement on November 14, 2013.

Board Member Statement

Notation 8462A
Member Earl F. Weener, concurring:

All of the accidents we investigate have a tragic aspect. Yet this accident, involving men and women who voluntarily placed themselves in harm's way through military service only now to return and face harm in the least expected of places, a memorial parade, particularly touches our hearts. Sadly, this is an accident where expectations were not met. Now the board, in pursuit of its mission to prevent recurrence of such accidents, is expected to objectively review and analyze the facts surrounding the event, and make recommendations as appropriate. With this goal in mind, I prepared this statement. The final report reflects a comprehensive investigative and analytic effort by the staff; however, I believe the final record of this tragic event would benefit from a more detailed discussion of the responsibilities attendant with operating a motor vehicle.

The primary responsibility of a motor vehicle operator, as with other vehicular modes of transportation, is to operate the vehicle safely. This responsibility rests solely with the driver of the vehicle. Congress recognized this responsibility and the need to ensure drivers of large commercial motor vehicles particularly, were equipped with the necessary knowledge and skills to operate such vehicles by enacting the Commercial Motor Vehicle Safety Act of 1986 (the Act). Aimed at removing unqualified drivers from the road, the Act established uniform commercial driver licensing requirements across the country and eliminated the practice of issuing/holding multiple commercial drivers' licenses (CDLs). The Act has since been implemented through promulgation of certain federal motor carrier safety regulations, which *require CDL drivers to have knowledge of driving safety superior to non-commercial vehicle drivers*.[1]

In this accident involving a truck-tractor in combination with a drop-deck flatbed, the driver of the accident vehicle held a CDL. However, as extensively addressed in the report, the driver faced a number of challenges to the normal driving task. Several of these challenges competed for and diverted the driver's attention from the forward roadway - a critical task for maintaining situation awareness to ensure safe operation of the vehicle. The fatal diversion was the driver's attention away from the forward roadway to his side view mirror for a length of time which in turn caused a loss of situation awareness. The board does not, however, consider the diversion of the driver's attention a distraction, which bears further discussion.

In completing the investigation of a multiple motor vehicle accident in Gray Summit, Missouri, the board adopted report language distinguishing between diversions of attention for

[1] Lt. John Harmon Et. Al., National District Attorneys Association, Commercial Drivers' Licenses: A Prosecutor's Guide to the Basics of Commercial Motor Vehicle Licensing and Violations (2012), 4 n.23.

"driving-related safety concerns" and "nondriving-related distractions."[2] The distinction being diversions of attention for activities related to the primary task of driving, are not considered distractions. This is the standard the board applied to the actions of the bus driver in the Gray Summit accident whose attention was diverted from the forward roadway by activities occurring on the side of the road. The Midland accident report provides an opportunity to again review this rationale, and refine the board's position on distraction.

In this accident, similar to Gray Summit, the driver's attention was diverted away from the forward roadway, and for a period of time, to the care of his passengers. As discussed at the Midland accident board meeting, staff believe the accident driver's diversion of attention to his passengers was part of his driving task, and therefore not a distraction from the driving task. I agree with the application of the rationale, in this case; however, each case requires independent review. Further, I note the board is now in the process of refining its guidance on distraction to ensure consistency in application across the modes.

The task of driving involves a number of competing demands on a driver's attention. Yet, as explained in the Gray Summit report, a driver's attention to the forward roadway is paramount in terms of safety.[3] As well, the Gray Summit report mentions the hazard caused by drivers focusing too long on mirrors, rather than the forward roadway – recommending drivers limit their attention shifts to mirrors to glances. In short, a driver needs to be constantly shifting his attention within the parameters of the driving task, to monitor the roadway and vehicle operation, in order to maintain situation awareness and safely execute the driving task. However, the successful driver prioritizes these shifts or diversions of attention to minimize the risk of losing situation awareness. In this case, sadly, we have a case of poor prioritization by the driver, along with a delay in focusing his attention on the highest priority of monitoring the forward roadway. Unlike the bus driver in Gray Summit, though, this report is not critical of the length of time the driver's attention was diverted to the side mirror. Instead, it rationalizes the driver's actions based on a theory of expectancy.

Referring back to my initial point, drivers holding CDLs are expected to be safer drivers; they are held to a higher standard regardless of the driving environment. Based on this expectation and in the interest of preventing a recurrence of this type of accident, I believe it important to note a driver's responsibilities are not obviated by a parade context or police escort – a driver's primary responsibility when operating a vehicle remains the safe operation of the vehicle. In this accident sequence, the driver knew this crossing to be active; there were no obstacles blocking the view of the tracks; the rail crossing signal system activated properly and well in advance of the approaching accident truck; the driver saw the train with its headlights on, although mistakenly thought it was stationary; there was sufficient space between floats for the accident vehicle to expedite traversing the tracks; and the point of impact indicates it was a mere fraction of a second between the accident vehicle clearing the track and being hit.

Granted, hindsight is 20-20. There were significant lapses in risk assessment and mitigation identified throughout this report, and responsibility for these lapses duly assigned. But

[2] *Multivehicle Collision Interstate 44 Eastbound Gray Summit, Missouri, August 5, 2010*. Highway Accident Report NTSB/HAR-11/03 (Washington, DC: National Transportation Safety Board, 2011).

[3] *Id.* at 61-62.

from an objective standpoint, the driver's decision-making played a central role in this accident and it bears emphasizing: the responsibility for safely operating a motor vehicle, first and foremost, rests with the driver.

Earl F. Weener
November 14, 2013

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Appendix A: Investigation

The National Transportation Safety Board (NTSB) received notification of this collision on November 15, 2012, and launched highway investigators to address motor carrier, survival factors, human factors, vehicle, and highway issues. Additionally, the NTSB launched rail investigators to address train operations, and mechanical and signals issues. The NTSB team included staff from the Transportation Disaster Assistance Office and support staff from the Offices of Public Affairs, Government Affairs, and Research and Engineering. Member Mark R. Rosekind was the spokesman on scene. Parties to the investigation were the Federal Highway Administration, the Federal Motor Carrier Safety Administration, the Federal Railroad Administration, the Texas Department of Transportation, the city of Midland, the Midland Police Department, Meritor WABCO, Union Pacific Railroad, the United Transportation Union, the Brotherhood of Locomotive Engineers and Trainmen, the Brotherhood of Railroad Signalmen, and Smith Industries. No public hearing was held in connection with this collision, and no depositions were taken.

Appendix B: Reconstruction Timeline Details

NTSB investigators constructed this timeline to detail the location of the float and the train at key points prior to the collision.

Figure B.1: Time to impact: 36.5 seconds
Float 67 feet before stop line / Float distance to impact 301 feet / Train distance to impact 3,321 feet

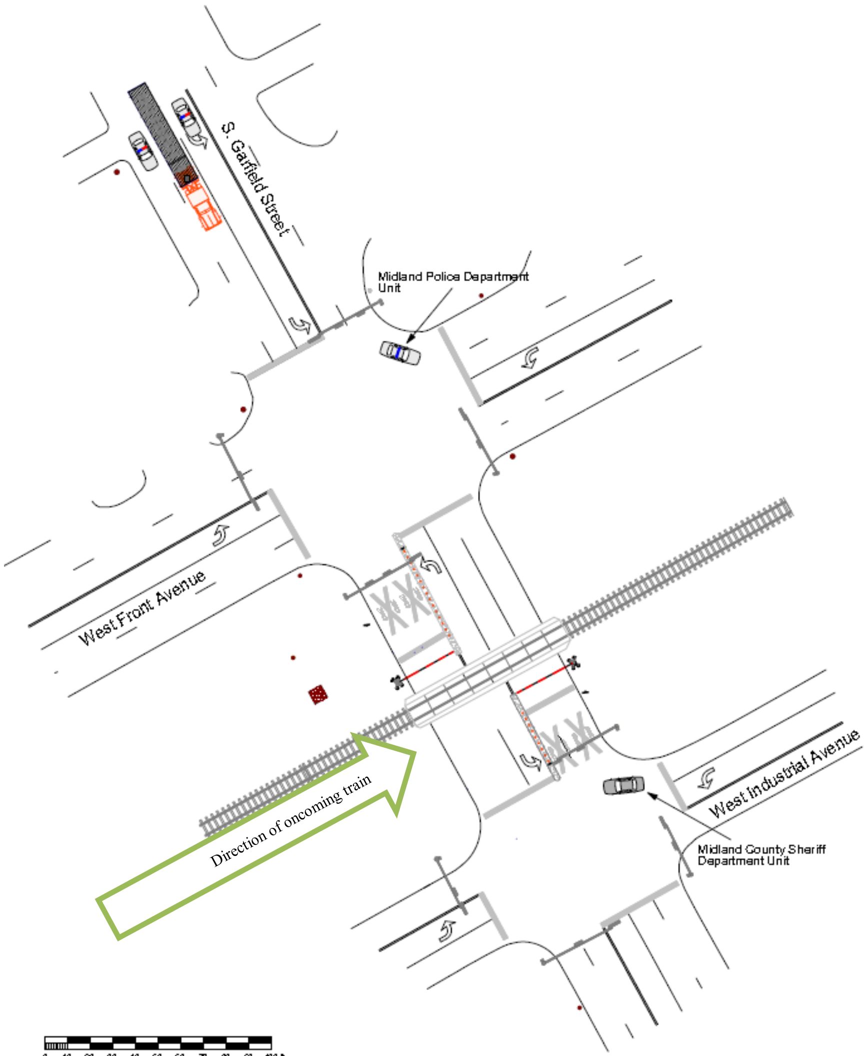


Figure B.2: Time to Impact: 30.4 seconds

Float at north stop line of West Front Avenue / Float distance to impact 243 feet / Train distance to impact 2,767 feet

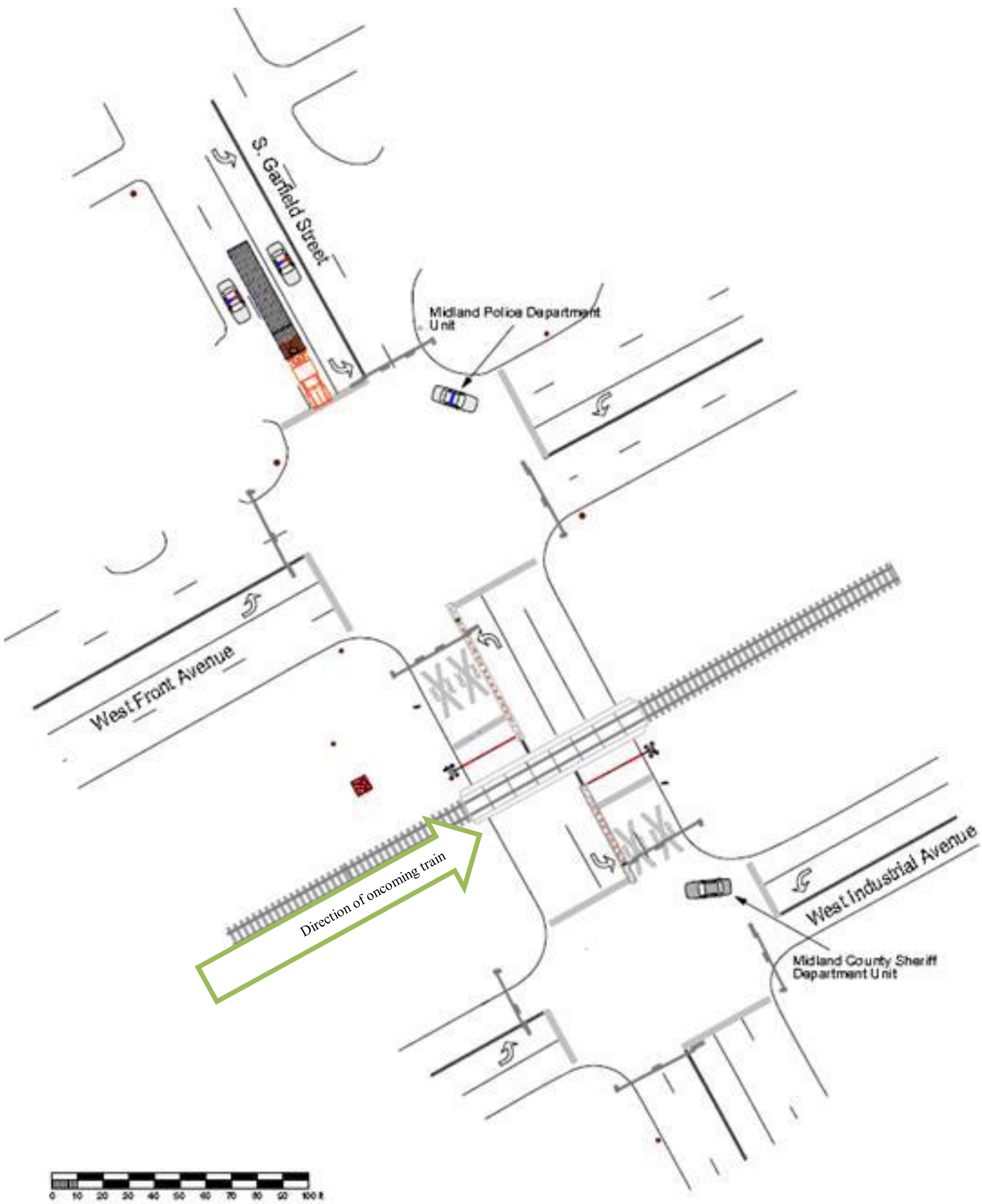


Figure B.3: Time to Impact: 30 seconds

Float at highway traffic signal preemption / Float distance to impact 231 feet / Train distance to impact 2,729 feet

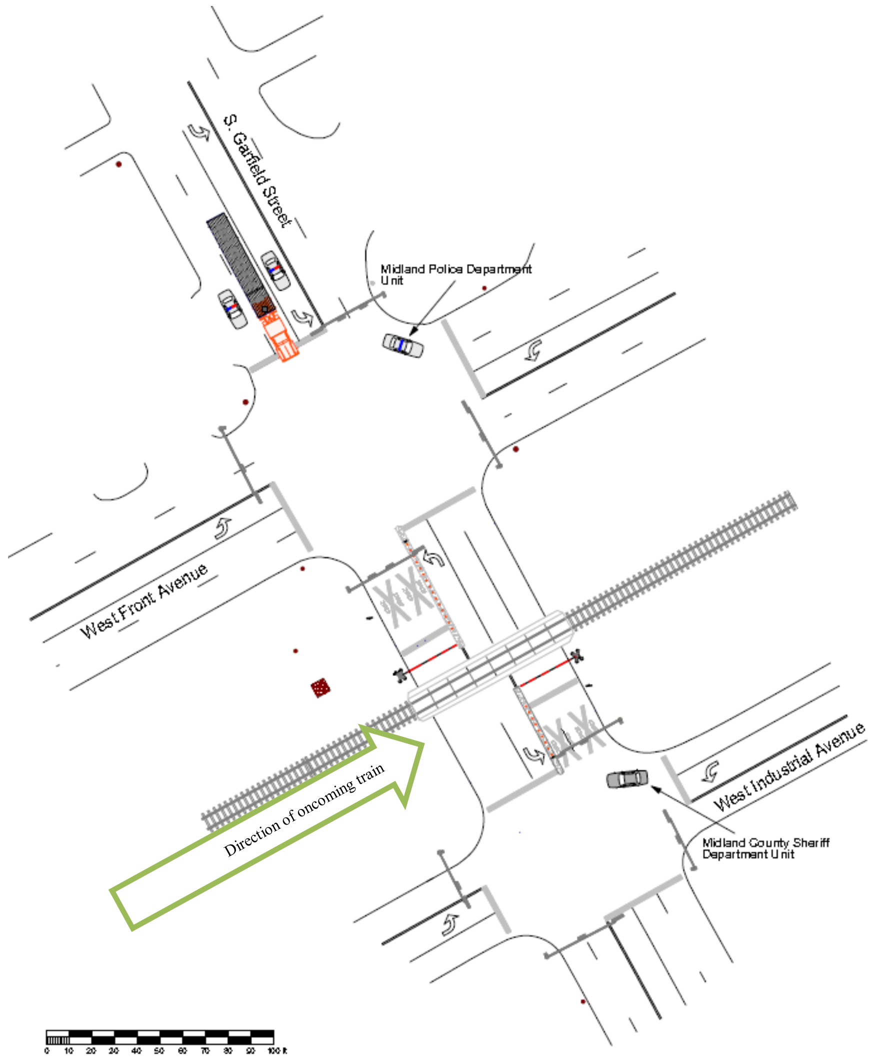


Figure B.4: Time to Impact: 21 seconds

Grade crossing warning system activation / Float distance to impact 155 feet / Train distance to impact 1,910 feet

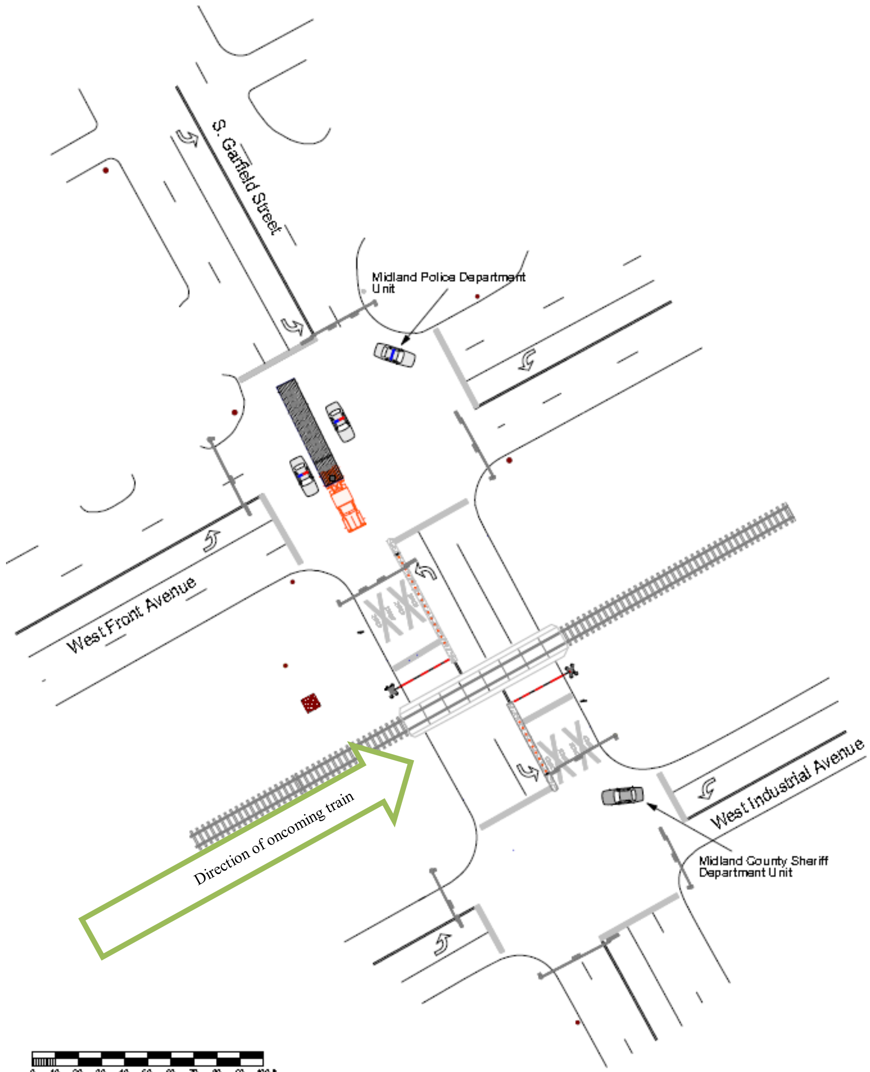


Figure B.5: Time to Impact: 13.5 seconds

Float at beginning gate descent / Float distance to impact 98 feet / Train distance to impact 1,228 feet

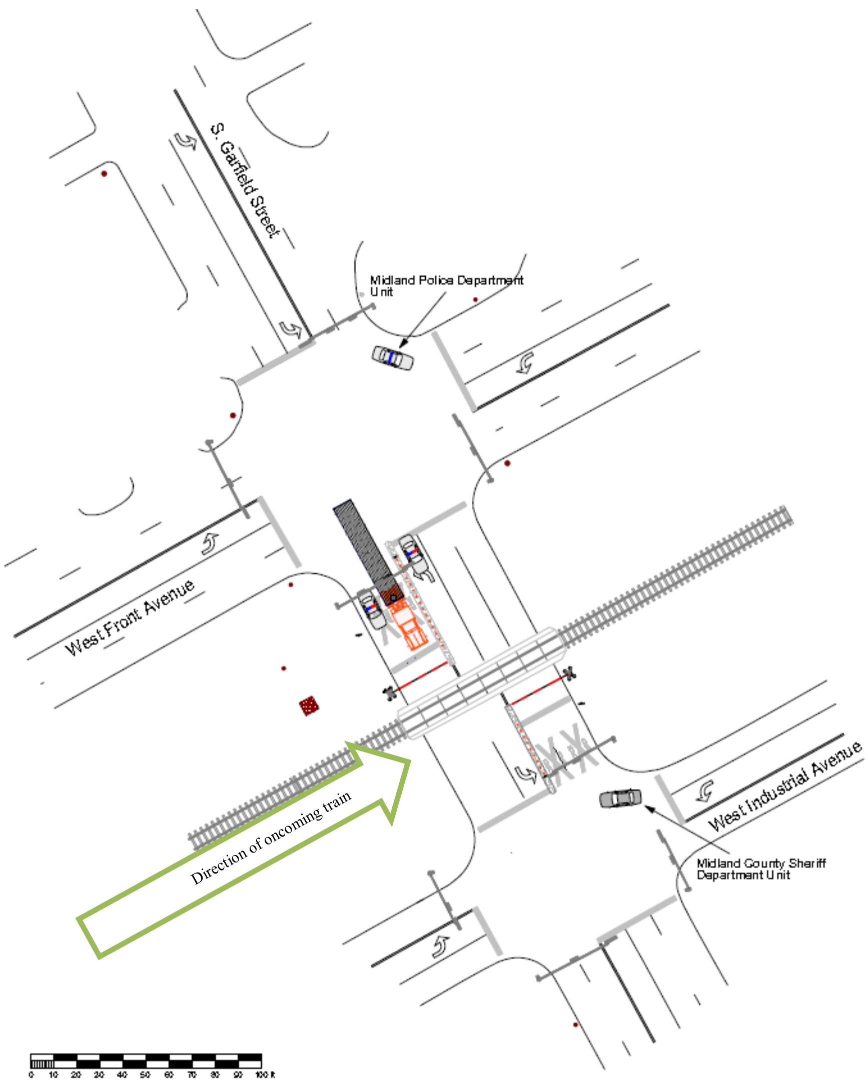


Figure B.6: Time to Impact: 8.9 seconds

Float crossing rails / Float distance to impact 65 feet / Train distance to impact 808 feet

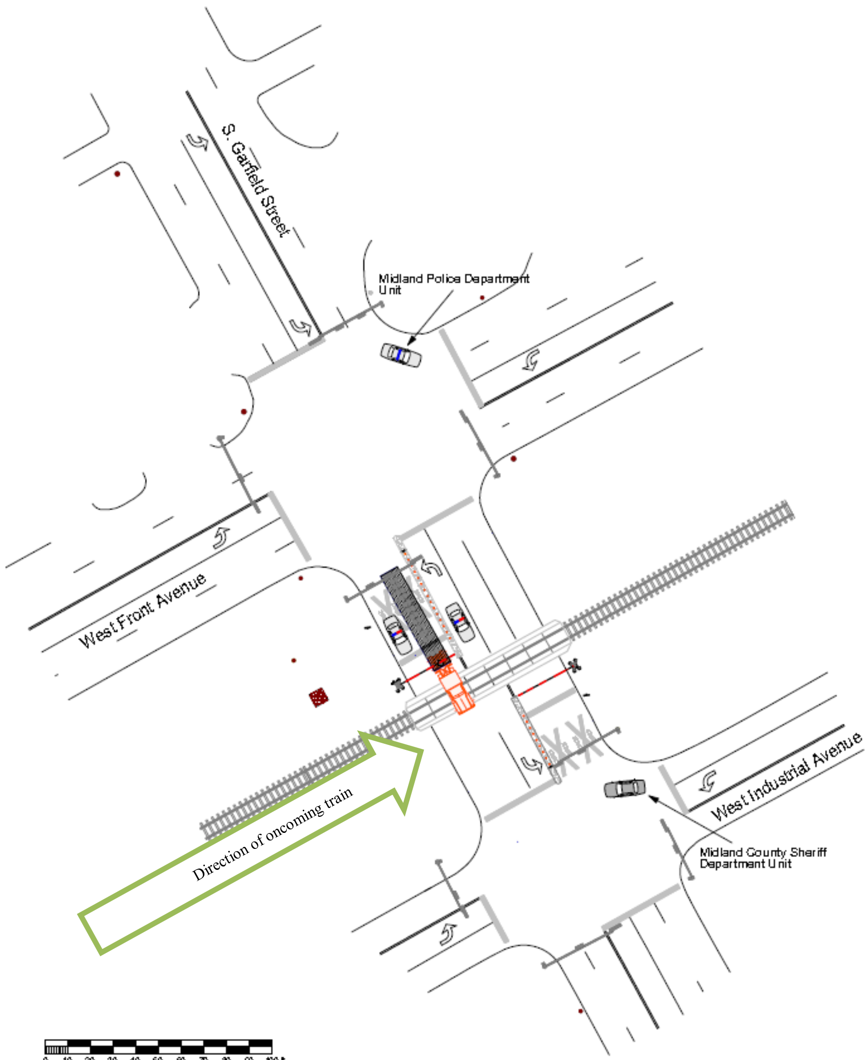


Figure B.7: Time to Impact: 7.8 seconds

Train horn sounds / Float distance to impact 57 feet / Train distance to impact 709 feet

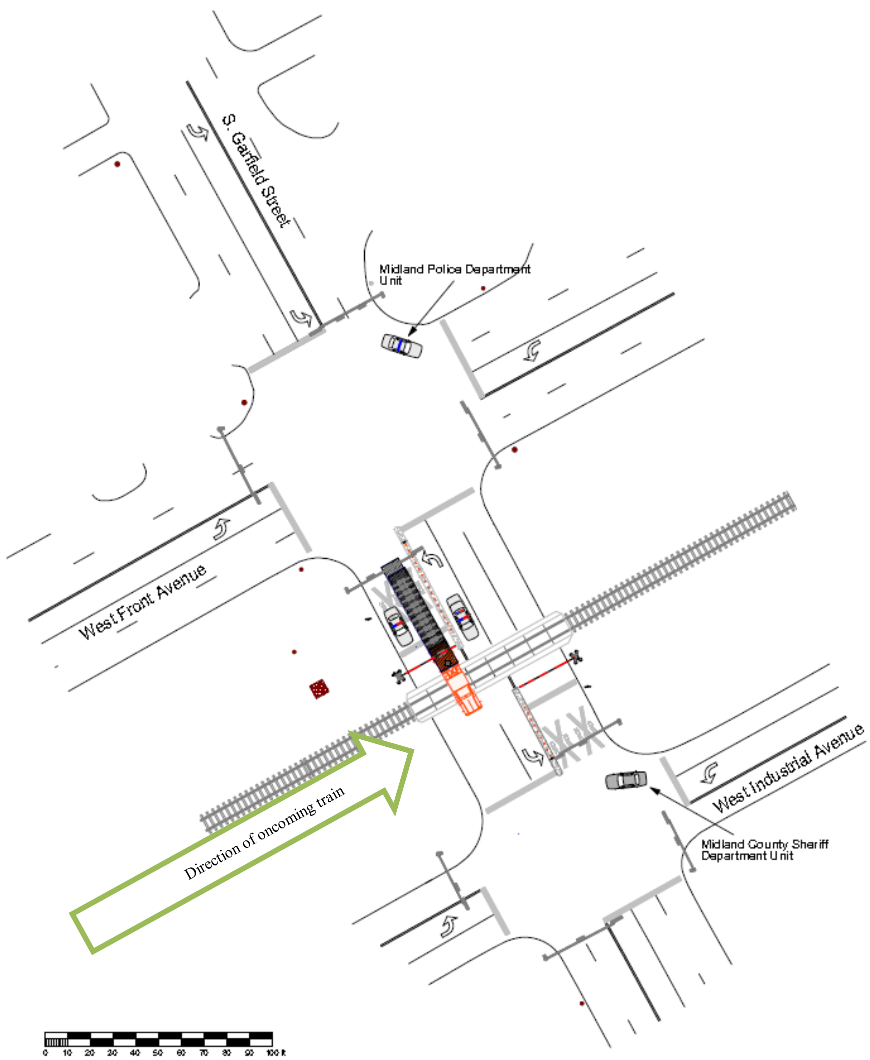


Figure B.8: Time to Impact: 4.8 seconds

Train begins braking / Float distance to impact 36 feet / Train distance to impact 437 feet

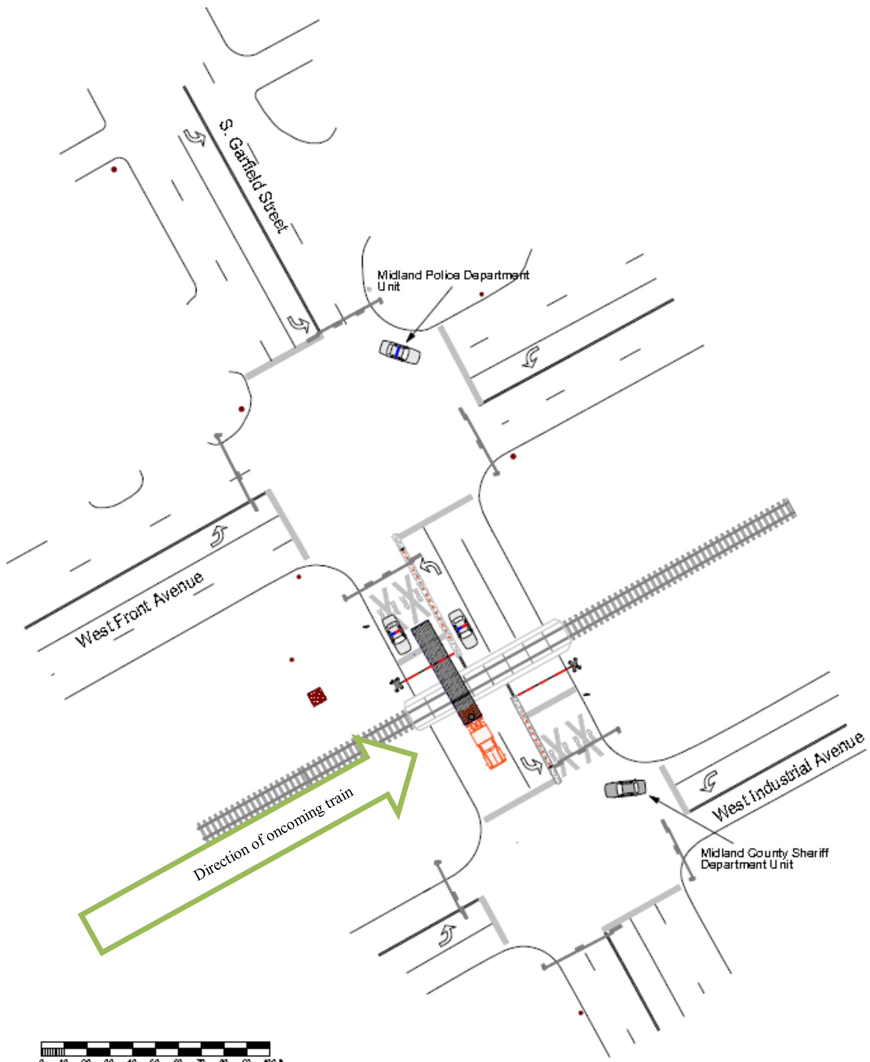
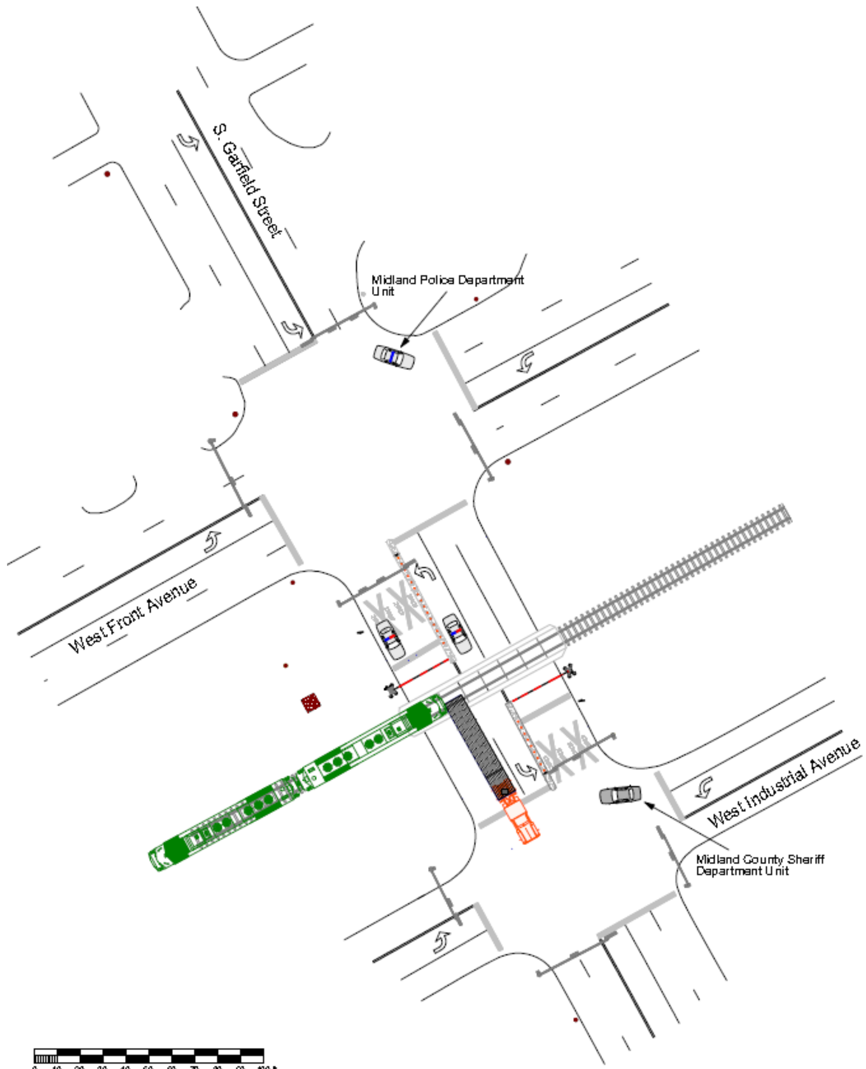


Figure B.9: Impact
Float distance past north rail 73 feet



Appendix C: Float Driver Activities (Nov. 12–15, 2012)

Monday, November 12		
Time	**Event**	**Source**
5:15 a.m.	Logs on duty, not driving in Midland	Logbook
5:30 a.m.	Logs driving in Midland	Logbook
6:47 a.m.	Sends first outgoing data[a] of day	Cell phone records
10:45 a.m.	Logs on duty, not driving in Florence	Logbook
11:00 a.m.	Logs sleeper berth in Florence	Logbook
12:00 noon	Logs on duty, not driving in Florence	Logbook
1:15 p.m.	Logs driving in Florence	Logbook
4:27 p.m.	Receives, answers first call of day	Cell phone records
6:15 p.m.	Logs on duty, not driving in Midland	Logbook
6:30 p.m.	Logs off duty in Midland	Logbook
6:37 p.m.	Receives, answers last call of day	Cell phone records
unknown	Returns home	Interview[b]
unknown	Eats dinner	Interview[b]
8:11 p.m.	Sends last outgoing data of day	Cell phone records
9:30 p.m.	Goes to bed	Interview[b]
Tuesday, November 13		
Time	**Event**	**Source**
5:15 a.m.	Awakes	Interview[b]
5:40 a.m.	Leaves his home	Interview[b]
5:50 a.m.	Arrives at the yard	Interview[b]
6:40 a.m.	Sends first outgoing data of day	Cell phone records
7:00 a.m.	Logs on duty, not driving in Midland	Logbook
9:15 a.m.	Logs driving in Midland	Logbook
10:45 a.m.	Logs on duty, not driving in Patricia	Logbook
6:00 p.m.	Logs driving in Patricia	Logbook
6:50 p.m.	Checks his voicemail; first phone activity	Cell phone records
7:15 p.m.	Logs on duty, not driving in Midland	Logbook
7:30 p.m.	Logs off duty in Midland	Logbook
unknown	Returns home	Interview[b]
unknown	Eats dinner	Interview[b]
8:08 p.m.	Makes last outgoing call of day	Cell phone records
9:24 p.m.	Sends last outgoing data of day	Cell phone records
9:30 p.m.	Goes to bed	Interview[b]

Wednesday, November 14		
Time	**Event**	**Source**
5:15 a.m.	Awakes	Interview[b]
5:20 a.m.	Checks voicemail; first phone activity	Cell phone records
5:40 a.m.	Leaves his home	Interview[b]
5:50 a.m.	Arrives at the yard	Interview[b]
6:43 a.m.	Sends first outgoing data of day	Cell phone records
7:00 a.m.	Logs on duty, not driving in Midland	Logbook
8:14 a.m.	Makes outgoing call; first activity of day	Cell phone records
8:30 a.m.	Logs driving in Midland	Logbook
11:30 a.m.	Logs on duty, not driving in Mentone	Logbook
12:00 noon	Logs driving in Mentone	Logbook
1:30 p.m.	Logs on duty, not driving in Kermit	Logbook
2:15 p.m.	Logs driving in Kermit	Logbook
3:30 p.m.	Logs on duty, not driving in Midland	Logbook
4:00 p.m.	Logs off duty in Midland	Logbook
unknown	Returns home	Interview[b]
unknown	Eats dinner	Interview[b]
6:00 p.m.	Watches television	Interview[b]
6:00 p.m.	Makes last outgoing call of day	Cell phone records
9:30 p.m.	Goes to bed	Interview[b]
10:21 p.m.	Sends last outgoing data of day	Cell phone records
Thursday, November 15		
Time	**Event**	**Source**
5:15 a.m.	Awakes	Interview[b]
5:40 a.m.	Leaves his home	Interview[b]
5:50 a.m.	Arrives at the yard	Interview[b]
7:00 a.m.	Logs on duty, not driving in Midland	Logbook
7:08 a.m.	Sends first outgoing data of day	Cell phone records
unknown	Helps other drivers with their loads	Interview
unknown	Washes float at yard	Interview
11:26 a.m.	Makes outgoing call; first activity of day	Cell phone records
unknown	Goes home, puts on uniform, returns	Interview
unknown	Polishes chrome on truck, puts on flags/chairs	Interview
2:15 p.m.	Logs driving in Midland	Logbook
2:30 p.m.	Arrives at DoubleTree hotel	Interview (other float driver)
unknown	Assists veterans onto flatbed	Interview
3:51 p.m.	Receives incoming data; last activity before collision	Cell phone records
4:02 p.m.	Parade begins	Video
4:35 p.m.	**Collision**	

[a] Text/SMS/pictures are tracked together by the driver’s cellular provider; referred to as “data” in the table.
[b] Denotes the driver's description of a typical day and not a specific recollection by the driver.

Appendix D: Parade Operations Guidelines

Table D-1 summarizes selected information found online in documents from the entities listed below (also see "References" for specific source/location). Using this matrix, the National Transportation Safety Board was able to establish commonalities among parade float operation practices.

Cities/Municipalities

- City of Dallas, Texas (Office of Special Events Guidelines)
- City of San Diego, California (Parade Float Regulations)
- City of Fremont, California (Parade Float Guidelines)
- City of Arlington, Texas (Holiday Light Parade Float Building 101)
- Sacramento, California, Cosumnes Fire Department (CFD) (Requirements for Parade Floats)

Universities

- Baylor University (Parade Float Safety Requirements for Homecoming)
- New Mexico State University (NMSU) (Float Safety Requirements)
- Florida Atlantic University (FAU) (Float Safety Requirements)
- Colorado State University (CSU) (Homecoming Parade Float Builder's Manual 2009)

Table D-1. Selected parade float operational requirements or guidelines, accessed through the Internet in April 2013.

	Baylor	CFD flyer	Dallas	CSU	FAU	Arlington	San Diego	Fremont	NMSU
Risk of Fire									
Use of generators	N	C	C	C	C	C	C	C	C
Fuel storage or re-fueling	P	N	N	G	P	N	P	P	P
Smoking / alcohol	N	P	N	N	P	N	P	P	P
Open flame	P	N	N	P	N	N	P	P	P
Space heaters	N	P	N	N	N	N	N	N	N
Risk of Injury from Parade Activities									
Movement on or off of float during parade	N	N	P	P	P	N	N	P	P
Objects thrown from float	N	N	P	P	N	P	N	N	P
Animals	P	N	C	N	N	N	N	P	N
Squirt guns, silly string, etc	N	N	P	N	N	N	N	N	N
Risk of Driver Error, Driver Visibility									
Driver view	C[a]	N	N	N	R[a]	N	N	G	C[a]
Driver communication	R	N	N	N	R[d]	N	N	N	R
Spotters, walking support	N	N	C	R[b]	G	N	N	N	N
Driver safety checklist/drill	N	N	N	N	R	N	N	R	R
Emergency sound device	N	N	N	N	R	N	N	N	R
Speed limited	N	N	N	C[c]	C[e]	N	N	N	C[e]
Driver Direction and Planning									
Parade director	N	N	R	N	N	N	N	N	N
Route plan approval	N	N	R	N	N	N	N	N	N

Key:

P: Prohibited
G: Follow good practice
R: Required
C: Controlled or Restricted
S: Suggested
N: Not addressed

[a]: 180-degree unrestricted view.
[b]: At least two spotters to walk near the float to monitor occupants.
[c]: Parade moves 4 to 5 mph for the entire route.
[d]: Communication between driver and float occupants.
[e]: Float must be capable of 10 mph and occupied must not exceed 20 mph.