

Multivehicle Work Zone Crash
on Interstate 75
Chattanooga, Tennessee
June 25, 2015



Accident Report

NTSB/HAR-16/01
PB2016-104807



**National
Transportation
Safety Board**

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PB2016-104807
Notation 8730A
Adopted October 17, 2016

Highway Accident Report

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**National
Transportation
Safety Board**

490 L'Enfant Plaza SW
Washington, DC 20594

National Transportation Safety Board. 2016. *Multivehicle Work Zone Crash on Interstate 75, Chattanooga, Tennessee, June 25, 2015. Highway Accident Report NTSB/HAR-16/01. Washington, DC.*

Abstract: On June 25, 2015, about 7:10 p.m., a 2007 Peterbilt truck-tractor in combination with a 2005 Great Dane semitrailer, operated by Cool Runnings Express, Inc., was traveling northbound on Interstate 75, near Chattanooga, Tennessee, when it struck the rear of a 2010 Toyota Prius at an estimated speed of 78–82 mph. Traffic had slowed because of road construction and a work zone lane closure at milepost 12. The truck-tractor continued forward and collided with seven additional vehicles, forcing them into subsequent collisions. Of the 18 vehicle occupants, six died and four were injured. A postcrash fire consumed one vehicle. The truck driver was returning to the carrier terminal in London, Kentucky, having begun his trip about 5:16 a.m. in Haines City, Florida. This investigation identified the truck driver's performance, limitations of the current drug testing program, inadequacies of driver license records and background checks, and the overrepresentation of trucks in work zone crashes as safety issues. The NTSB made new recommendations to the Federal Motor Carrier Safety Administration (FMCSA), the Kentucky Transportation Cabinet and the Idaho Transportation Department, and the Tennessee Department of Transportation and the Tennessee Highway Patrol. In addition, the NTSB reiterated one recommendation to the Federal Highway Administration, and reiterated and reclassified one recommendation to the FMCSA.

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Acronyms and Abbreviations

ABS	antilock brake system
ACM	air bag control module
ADT	average daily traffic
ATSSA	American Traffic Safety Services Association
BASIC	behavior analysis and safety improvement categories [FMCSA]
CAMI	Civil Aerospace Medical Institute
CDL	commercial driver's license
CDLIS	Commercial Driver's License Information System
CFD	Chattanooga Fire Department
<i>CFR</i>	<i>Code of Federal Regulations</i>
CMV	commercial motor vehicle
CNS	central nervous system
CPD	Chattanooga Police Department
CR	compliance review
CSMD	Tennessee Controlled Substance Monitoring Database
CVSA	Commercial Vehicle Safety Alliance
DHHS	US Department of Health and Human Services
DMS	dynamic message sign
DOT	US Department of Transportation
DRE	drug recognition expert
ECM	engine control module
EDR	event data recorder
EMS	emergency medical services
FARS	Fatality Analysis Reporting System [NHTSA]
FAST Act	Fixing America's Surface Transportation Act

FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FMCSRs	<i>Federal Motor Carrier Safety Regulations</i>
FR	<i>Federal Register</i>
ft/s	foot per second
GAO	US Government Accountability Office
GPS	global positioning system
GVWR	gross vehicle weight rating
HOS	hours-of-service
I-75	Interstate 75
IACP	International Association of Chiefs of Police
IC	incident command/incident commander
KASPER	Kentucky All Schedule Prescription Electronic Reporting System
µg/mL	microgram per milliliter
MCMIS	Motor Carrier Management Information System
MM	milemarker [MUTCD]
MP	milepost
MUTCD	<i>Manual on Uniform Traffic Control Devices</i>
NAIP	National Agriculture Imagery Program [USDA]
NCHRP	National Cooperative Highway Research Program
NDR	National Driver Register
NHTSA	National Highway Traffic Safety Administration
NOC	Notice of Claim [FMCSA]
NTSB	National Transportation Safety Board
ODOT	Oregon Department of Transportation
OOS	out-of-service
PCP	phencyclidine

PDPS	Problem Driver Pointer System [NHTSA]
PSP	Pre-Employment Screening Program [FMCSA]
SAE	SAE International
SAMHSA	Substance Abuse and Mental Health Services Administration
TDOT	Tennessee Department of Transportation
THP	Tennessee Highway Patrol
TITAN	Tennessee Integrated Traffic Analysis Network
TL	test level [NCHRP]
TRB	Transportation Research Board
TriComm VFD	Tricomcommunity Volunteer Fire Department
TSI	Transportation Safety Institute
US-11	US Route 11
<i>USC</i>	<i>United States Code</i>
USDA	US Department of Agriculture
USDOT	US Department of Transportation [motor carrier number]

Executive Summary

Investigation Synopsis

On June 25, 2015, about 7:10 p.m., a 2007 Peterbilt truck-tractor in combination with a 2005 Great Dane semitrailer, operated by Cool Runnings Express, Inc., was traveling northbound in the center lane of Interstate 75, near Chattanooga, Tennessee, when the driver did not respond to the slow-moving traffic ahead and collided with the rear of a 2010 Toyota Prius. Traffic had slowed near milepost 11.7 because of road construction and a work zone lane closure at milepost 12. The truck-tractor continued forward and collided with seven additional vehicles, forcing them into subsequent collisions. Of the 18 vehicle occupants, six died and four were injured. A postcrash fire consumed one vehicle. The truck driver's trip began earlier that day, about 5:16 a.m., in Haines City, Florida. His destination was the carrier terminal in London, Kentucky.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the Chattanooga, Tennessee, crash was the truck driver's failure to respond to the slow-moving traffic within a work zone because of performance decrements likely associated with his fatigue and methamphetamine use. Contributing to the crash was the failure of the pre-employment screening process to identify driver risk factors. Contributing to the severity of the crash was the truck-tractor's high impact speed.

The investigation identified the following safety issues:

- ***Truck driver's performance:*** The truck driver did not respond to the slowed traffic and the formation of the traffic queue. His lack of evasive steering maneuvers or emergency braking indicates a performance decrement, which was likely associated with fatigue and methamphetamine use.
- ***Limitations of current drug testing program:*** National Transportation Safety Board (NTSB) investigators reviewed the truck driver's toxicology test results from a variety of sources—including a urine test, a hair test, and a postcrash blood test. The test results indicated a pattern of drug use not identified by the US Department of Transportation drug testing program. This investigation reaffirmed the need to gather data on the prevalence of commercial motor vehicle (CMV) driver use of impairing substances and to consider alternative drug testing methods.
- ***Inadequacies of driver license records and background checks:*** The commonwealth of Kentucky is one of only two US jurisdictions that do not provide crash data in their 3-year driver license records. Consequently, Cool Runnings Express did not have crash data for the truck driver, limiting its ability to assess his safety performance and potential risk. The driver had had four crashes in the previous 3 years, two of which were CMV crashes.

- ***Truck overrepresentation in work zone crashes:*** Although trucks account for 11.4 percent of all fatal crashes, they are involved in 30.1 percent of fatal work zone crashes. Speeding, distraction, and impairment are key factors in these crashes. To improve work zone safety, local agencies can take more proactive actions with regard to procedures and training for law enforcement presence and control. At the national level, additional guidance can be developed for the use of supplemental traffic control strategies to mitigate work zone crashes involving trucks or heavy vehicles.

Recommendations

The NTSB makes new safety recommendations to the Federal Motor Carrier Safety Administration (FMCSA), the Kentucky Transportation Cabinet and the Idaho Transportation Department, and the Tennessee Department of Transportation and the Tennessee Highway Patrol. The NTSB also reiterates one recommendation to the Federal Highway Administration, and reiterates and reclassifies one recommendation to the FMCSA.

1 Factual Information

1.1 Crash Narrative

On Thursday, June 25, 2015, about 7:10 p.m., a 2007 Peterbilt truck-tractor in combination with a 2005 Great Dane semitrailer, operated by Cool Runnings Express, Inc., was traveling northbound in the center lane of Interstate 75 (I-75), near Chattanooga, Tennessee (figure 1), when it struck the rear of a 2010 Toyota Prius at an estimated speed of 78–82 mph.¹ The truck-tractor, occupied by a 39-year-old driver and a 38-year-old passenger, had departed Haines City, Florida, at 5:16 a.m. that day. The final destination was the carrier terminal in London, Kentucky.

Traffic had been moving slowly because of a lane closure and construction at milepost (MP) 12. Following the initial collision with the Prius near MP 11.7, the truck-tractor continued forward, about 448 feet, colliding with additional vehicles and forcing them into subsequent collisions. Seven other vehicles were involved in this crash: a 2010 Scion tC, a 2005 GMC Savana, a 2003 Mazda Tribute, a 2001 Ford F-150, a 2007 Chevrolet Uplander, a 2014 Cadillac CTS, and a 2015 Toyota Tundra. A postcrash fire consumed the Scion.

Six people died as a result of this crash—including the drivers of the Prius and the Mazda, and the four occupants of the Scion. One person was seriously injured, three people sustained minor injuries, and eight others were uninjured (including the truck driver and his passenger). At the time of the crash, it was daylight with clear weather and a dry road surface.

¹ (a) Throughout this report, the accident truck-tractor, in combination with the semitrailer, is interchangeably referred to as the “truck-tractor” or the “combination vehicle.” (b) The speed limit at this location is 65 mph, with a 55-mph speed limit for trucks. The 78–82 mph is a calculated impact speed derived from the change in velocity recorded by the Prius event data recorder (EDR).



Figure 1. Map showing crash location on I-75 in Chattanooga, Tennessee.

1.2 Crash Sequence and Video Evidence

The crash scene covered an area 495 feet long.² Figure 2 shows the roadway layout, roadway evidence, and at-rest position of all nine vehicles. The initiating impact with the Prius occurred in the center lane, adjacent to the gore area that separates the right lane from the US Route 11 (US-11; Lee Highway) entrance ramp.³ The crash sequence continued as follows:

- The truck-tractor and the Prius collided with the Scion and the GMC, resulting in ejection of the Scion driver.
- The truck-tractor then struck the Mazda, which remained in contact with the front of the combination vehicle as they moved forward into the other four vehicles. (See sections 1.6.1 and 1.6.2 for additional information on the truck-tractor and the other eight vehicles.)

² National Transportation Safety Board (NTSB) investigators documented roadway evidence using photographs and total station data provided by the Chattanooga Police Department (CPD), and data obtained from three-dimensional laser scanning.

³ (a) A gore area is typically a triangular-shaped boundary created by white lines. Its purpose is to separate an entrance ramp from the lanes of the highway. (b) Each of the vehicles involved in this crash, except for the GMC, was initially traveling in the center lane.

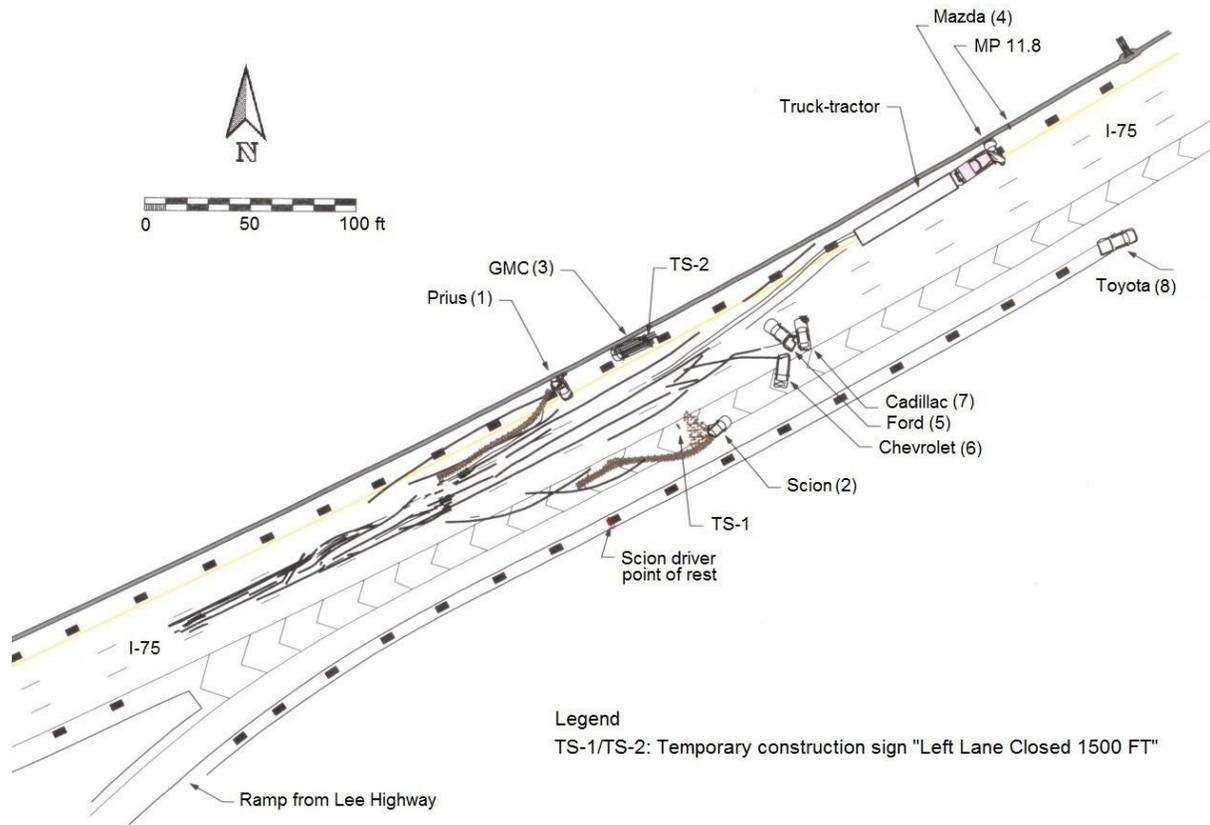


Figure 2. Crash scene diagram, with vehicles numbered according to their engagement with truck-tractor.

Video surveillance systems at two businesses, located on the east side of I-75 northbound, captured relevant portions of the highway scene. The video evidence preceding the collision showed stop-and-go traffic within the center and left travel lanes. Most interruptions in traffic flow averaged 1–2 seconds. The longest pause in traffic flow was in the center lane, lasting about 6 seconds. In the right lane, traffic occasionally flowed uninterrupted at a more rapid pace.

Figure 3, an aerial view of the crash vicinity, shows the relative location of the cameras, their view of the roadway, the area of initial impact, and the truck-tractor position of rest. National Transportation Safety Board (NTSB) investigators analyzed the videos to estimate vehicle speed and traffic conditions at, and just prior to, the time of the crash.

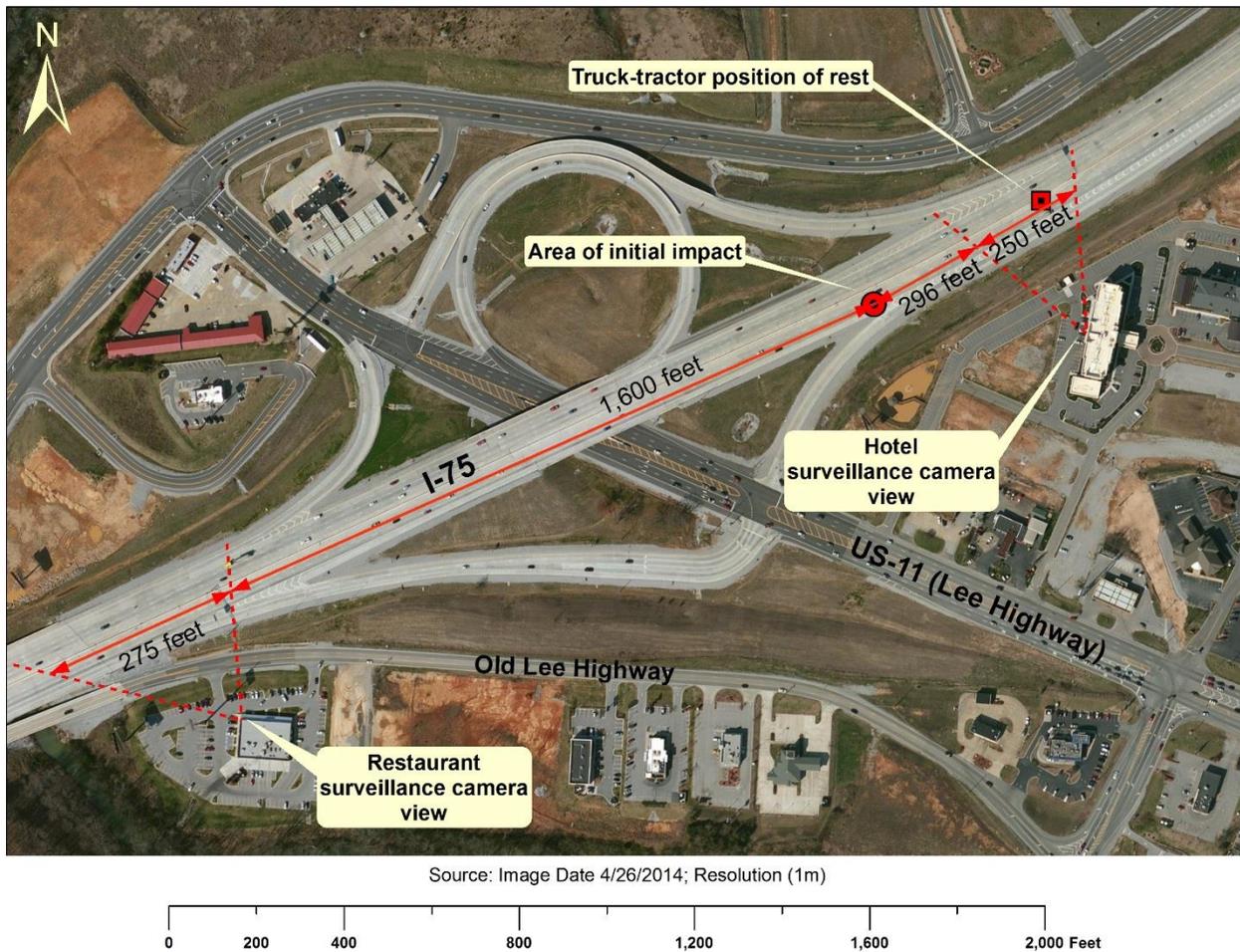


Figure 3. Aerial view of I-75–US-11 roadway interchange and relative location of video cameras, photographed April 26, 2014. (Source: USDA NAIP)

The first video originated at a restaurant on Old Lee Highway, just south of the exit to US-11. The unobstructed view for this camera included 275 feet of the northbound roadway. The 7-minute video segment shows the truck-tractor passing through the field of view.⁴ The flow of traffic in all lanes is uncongested and apparently traveling at highway speeds. Vehicle headways appear to range from 2 to 5 seconds. NTSB video analysis of the truck-tractor’s movement revealed that it passed through the camera’s view at an approximate constant velocity of 76 ± 2 mph.⁵ A sampling of other individual vehicles identified travel speeds of 63–68 mph.

The second video was from a hotel located north of US-11. The unobstructed view for this camera included 250 feet of the northbound roadway, beginning about 296 feet north of the initial area of impact (onset of roadway evidence). The 7-minute video captures some of the final events of the crash sequence—including the truck-tractor (with Mazda engaged), the Chevrolet,

⁴ The truck-tractor is the second combination vehicle to appear in the footage. It enters the field of view about 47 seconds into the video.

⁵ See the video analysis report in the NTSB public docket for this investigation.

and the Toyota coming to a stop. The Ford and Cadillac come to rest near the Chevrolet, but the view is somewhat obscured. The preceding impacts involving the other vehicles are outside the field of view.

1.3 Survival Factors

1.3.1 Occupant Injury

Table 1 summarizes the occupant injury information for each vehicle. Of the 18 people associated with the nine vehicles, six died, one was seriously injured, three sustained minor injuries, and eight were uninjured.

Table 1. Injury levels for truck and vehicle occupants.^a

	Fatal	Serious	Minor	None	TOTAL
Truck-tractor	0	0	0	2	2
Prius	1	0	0	0	1
Scion	4	0	0	0	4
GMC	0	0	0	2	2
Mazda	1	0	0	0	1
Ford	0	1	0	0	1
Chevrolet	0	0	2	0	2
Cadillac	0	0	1	0	1
Toyota	0	0	0	4	4
TOTAL	6	1	3	8	18

^a Although 49 *Code of Federal Regulations (CFR)* Part 830 pertains to the reporting of aircraft accidents and incidents to the NTSB, section 830.2 defines fatal injury as any injury that results in death within 30 days of the accident, and serious injury as any injury that: (1) requires hospitalization for more than 48 hours, commencing within 7 days from the date of injury; (2) results in a fracture of any bone (except simple fractures of fingers, toes, or nose); (3) causes severe hemorrhages, nerve, or tendon damage; (4) involves any internal organ; or (5) involves second- or third-degree burns, or any burn affecting more than 5 percent of the body surface.

Table 2 categorizes the 18 vehicle occupants according to their age and sex, seating position, restraint use, and injury. Tennessee has a primary enforcement seat belt use law that requires drivers and front seat passengers to be restrained when the vehicle is in motion.⁶

Table 2. Categorization of vehicle occupants by age/sex, seating position, restraint use, and injury severity.

Vehicle	Occupant	Age/Sex	Seating Position	Restraint Use	Injury Severity
Truck-tractor	Driver	39/M	Driver	Unknown	None
	Passenger 1	38/F	Sleeper berth	Not functional	None
Prius	Driver only	37/M	Driver	Yes	Fatal
Scion ^a	Driver	31/F	Driver	Yes	Fatal (driver ejected)
	Passenger 1	50/F	Front right	Yes	Fatal
	Passenger 2	11/F	Rear right	Yes	Fatal
	Passenger 3	9/F	Rear left	Yes	Fatal
GMC	Driver	31/M	Driver	Yes	None
	Passenger 1	41/M	Front right	Unknown	None
Mazda	Driver only	36/M	Driver	Yes	Fatal
Ford	Driver only	24/M	Driver	Yes	Serious
Chevrolet	Driver	57/M	Driver	Yes	Minor
	Passenger 1	55/F	Front right	Yes	Minor
Cadillac	Driver only	60/M	Driver	Yes	Minor
Toyota	Driver	41/M	Driver	Yes	None
	Passenger 1	39/F	Front right	Yes	None
	Passenger 2	12/M	Rear	Unknown	None
	Passenger 3	6/F	Rear	Unknown	None

^a Although the Scion was consumed in a postcrash fire, none of the occupants of the vehicle exhibited evidence of inhaling smoke or products of combustion. The driver seat frame was severely deformed, and portions of the front seats were displaced into the rear seats.

⁶ (a) See Tenn. Code Ann. section 55-9-603 (2016). (b) Primary enforcement seat belt use laws allow enforcement officers to ticket a driver/vehicle occupant for not wearing a seat belt without the driver having committed any other traffic offense. Typically, drivers are cited for themselves and other passengers under a certain age; the maximum age varies among states. Adult occupants not wearing a seat belt are themselves cited. (c) Secondary enforcement seat belt use laws allow enforcement officers to ticket a driver/vehicle occupant for not wearing a seat belt only after stopping the vehicle for another offense.

1.3.2 Emergency Communications and Medical Response

Table 3 presents a timeline, beginning with the 911 call at 7:10 p.m. on June 25 and ending with clearance of the crash scene and reopening of the interstate the next morning.

Table 3. Summary timeline of emergency communication and response, June 25–26, 2015.

Time	Responding Agency ^a	Action ^b
Thursday, June 25, 2015		
7:10 p.m.	Hamilton County 911 call center	Dispatches law enforcement, fire, and EMS
7:14	TriComm VFD Engine 1244	Arrives on scene, captain (a) assumes initial IC, (b) assigns firefighters to handle vehicle fires, (c) assigns firefighter to assist motorists self-evacuating
7:14	Hamilton County EMS	Assists with triage
--	TriComm VFD chief	Arrives on scene and assumes IC
7:17	CPD	Assumes law enforcement jurisdiction with 18 units, securing scene, coordinating response, and controlling traffic
7:23	CFD	Rescue truck and multipurpose ladder truck arrive, four emergency medical technicians and three firefighters assist in extricating vehicle occupants, then assist with equipment and lights, and retrieve deceased from vehicles
7:27	CFD	Battalion chief arrives on scene, allowing TriComm VFD chief to retain IC to avoid disruption of activities
7:34	TDOT ^c	Two roadside assistance units deploy control measures (queue trucks and dynamic message signs) to manage traffic
7:40	THP	Assumes responsibility for truck-tractor investigation; notifies Atlanta, Georgia, police department that this segment of I-75 is closed
7:40	CPD	Assumes responsibility for investigation of other accident vehicles
10:00 p.m.	Collegedale Police Department	Initiates traffic control measures at I-75 north exit 11
Friday, June 26, 2015		
3:10 a.m.	THP and CPD	Conclude on-scene investigation
7:00 a.m.	THP and CPD	Clear crash scene; reopen this portion of I-75
^a TriComm VFD = Tricomunity Volunteer Fire Department; EMS = emergency medical services; CPD = Chattanooga Police Department; CFD = Chattanooga Fire Department; TDOT = Tennessee Department of Transportation; THP = Tennessee Highway Patrol. ^b IC = incident command. ^c Tennessee HELP program; see tn.gov/tdot/topic/help-program-contact , accessed May 16, 2016.		

Each of the Hamilton County ambulances was an advanced life support unit with a paramedic on board. The first ambulance transported the driver of the Ford to Erlanger Health System Baroness Hospital in Chattanooga. The second ambulance took the driver and passenger of the Chevrolet to CHI Memorial Hospital in Chattanooga. Both ambulances left the crash scene by 7:40 p.m. The third ambulance—which left the scene by 8:37 p.m.—transported the driver of the Cadillac to Baroness Hospital. Its departure was delayed due to the patient initially denying injuries. The other emergency medical services (EMS) units on scene transported the deceased to the Hamilton County forensics center.

1.4 Truck Driver Factors

1.4.1 Licensing and Experience

The driver of the truck-tractor, a 39-year-old male, started driving with Cool Runnings Express on June 22, 2015—just 3 days before the crash. He held a Kentucky class A commercial driver's license (CDL) with a tanker endorsement, issued in December 2012 and expiring in December 2016.⁷ According to information in his driver qualification file, he had been driving truck-tractors long distance for about 5 months and driving locally for about 12 years. He reported on the Cool Runnings Express employment application that he left his previous job after being involved in a commercial motor vehicle (CMV) crash.

1.4.2 Driving History

NTSB investigators examined the driver's driving history by reviewing records from the Kentucky Transportation Cabinet, the Commercial Driver's License Information System (CDLIS), a CMV inspection report, and the National Highway Traffic Safety Administration (NHTSA) National Driver Register (NDR).⁸

1.4.2.1 Kentucky Transportation Cabinet. This agency issues 3- and 5-year driver license history records. The 3-year record is a public record and can be obtained through a website by registering and paying a fee.⁹ It includes license status, license expiration, driving restrictions, and traffic violations but excludes crash data. In an interview with NTSB investigators, the

⁷ (a) A Kentucky class A CDL permits the holder to operate, in commerce, a vehicle with a gross vehicle weight rating (GVWR) of 26,001 pounds or more in combination with a trailer with a GVWR of 10,001 pounds or more. (b) A class A or B CDL tanker endorsement is required to operate a vehicle carrying a liquid or liquid gas in a tank or tanks having an individual rated capacity of more than 119 gallons and an aggregate rated capacity of 1,000 gallons or more that is either permanently or temporarily attached to the vehicle or the chassis, or a class C vehicle when the vehicle is used to transport hazardous materials in liquid or gas form in previously described rated tanks.

⁸ (a) CDLIS was established under the Commercial Motor Vehicle Safety Act of 1986, Public Law 99-570, Title XII, section 12007, 100 Stat. 3207-170 (codified as amended at 49 *United States Code* [USC] 31309), and is administered by the Federal Motor Carrier Safety Administration (FMCSA). See *Federal Motor Carrier Safety Regulations* (FMCSRs; 49 *CFR* Parts 383 and 384). It was set up to ensure that individual driver licensing information is complete and accessible to all jurisdictions. Authorized CDLIS users include employees and contractors of federal, state, or local enforcement agencies. (b) NHTSA established and manages the NDR Problem Driver Pointer System (PDPS) database; see 49 *USC* 30301–30308, 23 *CFR* Part 1327.

⁹ The 5-year record, which includes crash data, can be obtained from a driver licensing field office after obtaining a signed release from the driver.

owner of Cool Runnings Express stated that he had obtained a 3-year record when he hired the driver. The record listed a single moving violation: exceeding the speed limit by 16–25 mph.¹⁰

The 5-year driving history record contains information such as traffic violations, administrative entries, and crash data. It is available to prospective employers for a fee and requires the written consent of the driver.¹¹ In the case of the accident driver, the 5-year record included the speeding violation plus seven motor vehicle crashes, three of which were in CMVs.

1.4.2.2 Commercial Driver’s License Information System. CDLIS is a nationwide computer system that enables state driver licensing agencies to ensure that each commercial driver has only one driver’s license and a complete driver record. According to the CDLIS report dated June 26, 2015, the accident driver had one speeding violation and was involved in seven noninjury motor vehicle crashes from 2011 to 2015. Three of the seven crashes were in CMVs.¹²

1.4.2.3 CMV Inspections. The truck driver underwent a Commercial Vehicle Safety Alliance (CVSA) North American Standard Level III roadside inspection on November 14, 2012, in Somerset, Kentucky, while employed by Hilltop Transportation & Warehousing.¹³ According to the inspection report, he was cited for traveling at least 15 mph over the speed limit (71 mph in a 55-mph zone) and using a hand-held mobile telephone while operating a CMV. Although the inspection report further indicated that the driver was issued traffic citations for these violations, they did not appear in his driving history.

1.4.2.4 National Driver Register. An NTSB query of the NDR found no indication that the truck driver had been listed in the Problem Driver Pointer System (PDPS). The PDPS includes information on drivers whose privilege to operate a motor vehicle has been revoked, suspended, canceled, or denied—or who have been convicted of serious traffic-related offenses.¹⁴ Although the driver had numerous entries in his Kentucky driving history record and CDLIS, none of them met the criteria for inclusion in the NDR.

¹⁰ This speeding violation was issued on December 10, 2014; the conviction date was January 26, 2015.

¹¹ The record contains information per 601 Ky. Admin. Regs. 11-020 (2016).

¹² This count does not include a crash that occurred in Florida on June 24, 2015—the day before the Chattanooga crash. Also excluded was a June 22, 2013, crash that occurred while the driver was operating a CMV. The Kentucky uniform police traffic collision report had miscoded this crash as a non-CMV collision.

¹³ A CVSA Level III inspection includes the CMV operator’s driver’s license, medical examiner’s certificate and skill performance evaluation certificate, driver’s record-of-duty status/hours of service, seat belt usage, and motor vehicle law compliance.

¹⁴ State motor vehicle departments responsible for issuing driver licenses, including the District of Columbia, are required to send this information to the PDPS within 31 days of the receipt of convictions from the courts.

1.4.3 Medical Certification, Health, and Toxicology

1.4.3.1 Medical Certification. At the time of the crash, the truck driver was medically certified to operate a CMV.¹⁵ According to his most recent CDL medical examination, conducted on November 21, 2014, his height was 70 inches and his weight was 198 pounds, corresponding to a body mass index of 28.4.¹⁶ The medical examiner identified no medical issues, and the driver received a 2-year medical certification.

1.4.3.2 Health. NTSB investigators interviewed the truck driver, reviewed his medical and prescription records, and reviewed his most recent CMV driver fitness determination exam. The driver reported no illnesses, medical conditions, or current use of any medication (prescribed or over-the-counter).

No recent prescriptions were found in records from the driver's physician or in records from pharmacies in the area of the driver's residence. Both the Kentucky All Schedule Prescription Electronic Reporting (KASPER) system and the Tennessee Controlled Substance Monitoring Database (CSMD) were queried for prescriptions, and none were found.¹⁷

NTSB investigators found a partially empty bottle of Advanced Detox Solutions Immediate Cleanser 2 among the driver's personal belongings in the sleeper berth.¹⁸ According to the driver, the bottle was not his and he did not know where it came from, despite having cleaned the berth upon moving into it the week prior to the crash.

1.4.3.3 Toxicology. A roadside breath alcohol test was negative.¹⁹ At 8:54 p.m., about 1.5 hours postcrash, the CPD obtained blood from the driver. The sample was sent to the Tennessee Bureau of Investigation for drug testing and analysis on July 1, 2015. The driver's blood tested positive for methamphetamine (0.08 microgram per milliliter [$\mu\text{g}/\text{mL}$]) and for its primary active metabolite amphetamine ($<0.05 \mu\text{g}/\text{mL}$). The blood was negative for barbiturates, cannabinoids, cocaine, and opiates. Upon completing its analysis, the Tennessee Bureau of Investigation forwarded a portion of the remaining blood specimen to the Civil Aerospace Medical Institute (CAMI) Bioaeronautical Sciences Research Laboratory on September 15. CAMI analysis identified $0.045 \mu\text{g}/\text{mL}$ of methamphetamine and $0.022 \mu\text{g}/\text{mL}$ of amphetamine in the driver's blood.²⁰

¹⁵ Title 49 *CFR* 391.41 requires that a person who operates a CMV in commerce be medically certified as physically qualified to operate such vehicles.

¹⁶ The medical exam was conducted by an advanced practice nurse registered in the National Medical Registry.

¹⁷ (a) KASPER includes scheduled prescriptions for an individual, the prescriber, and the dispenser. (b) The Tennessee CSMD monitors all scheduled prescriptions within the state.

¹⁸ According to the manufacturer, this product is used to quickly flush toxins from the body. An online search suggests that it is commonly used to mask drug metabolites in the urine; NTSB investigators found no scientific research on its effectiveness.

¹⁹ The truck driver was administered a breath alcohol test on a CMI, Inc., intoxilyzer at 9:16 p.m. The results of the test were 0.00 gram per 210 liters of breath.

²⁰ Various factors may account for the discrepancies between the Tennessee Bureau of Investigation and CAMI test results, such as the 2-month difference in when the tests were conducted or differences in equipment and testing methodologies.

About 9:50 p.m.—2 hours 40 minutes following the crash—a drug recognition expert (DRE) evaluated the physical condition of the truck driver.²¹ The evaluation included observations, critical indicators of impairment, vital signs, eye examination, and psychophysical indicators. The DRE officer concluded that the driver was under the influence of a central nervous system (CNS) stimulant and a CNS depressant. During the late phase of CNS stimulant drug use, the user may display physiological symptoms of fatigue, sleepiness, and lowered heart rate, among others, which are consistent with a CNS depressant. These symptoms occur as the body attempts to overcome the effects of the stimulating effect of the drug and return to a state of homeostasis (NHTSA–Transportation Safety Institute [TSI]–International Association of Chiefs of Police [IACP] 2015).

Cool Runnings Express directed the truck driver to take a urine drug test, which was conducted 38 hours following the crash, on June 27.²² The urine sample tested negative for amphetamines, cocaine, marijuana, opiates, phencyclidine (PCP), and 6-acetylmorphine (a metabolite of heroin).²³

1.4.4 History of Drug Use

Title 49 *CFR* Part 382 requires CMV drivers to submit pre-employment, random, and postcrash urine specimens for drug testing “to help prevent accidents and injuries resulting from the misuse of alcohol or use of controlled substances.” A commercial driver is prohibited from reporting for duty or remaining on duty when using controlled substances, including Schedule I drugs.²⁴

NTSB investigators obtained toxicology test results from multiple sources to examine the truck driver’s possible history of drug use.

1.4.4.1 Previous Employer Drug Test. On July 22, 2013, the truck driver was involved in a minor crash while employed as a commercial driver at Hilltop Transportation & Warehousing. He was administered a 12-panel urine drug test postcrash and tested positive for oxymorphone

²¹ (a) A DRE is a police officer trained to recognize impairment in drivers under the influence of drugs other than, or in addition to, alcohol. (b) For a detailed description of the driver’s evaluation, see the human performance factors report in the NTSB public docket for this investigation.

²² Title 49 *CFR* 382.303 requires that the employer administer a controlled substances test as soon as practicable following a motor vehicle accident that results in the loss of human life. The results of a urine test for controlled substances, conducted by law enforcement, can be used to meet the requirements of this section if the test conforms to the applicable requirements and the employer obtains the test results. If a required test is not completed within 32 hours of the crash, the employer must stop any attempts and document why the test was not promptly administered. See www.fmcsa.dot.gov/regulations/title49/section/382.303, accessed September 23, 2016.

²³ Title 49 *CFR* 40.85 specifies the five categories of drugs in a US Department of Transportation (DOT) drug test: amphetamines, cocaine, marijuana, opiates, and PCP. Laboratories cannot test “DOT specimens” for any other drugs.

²⁴ (a) See 49 *CFR* 382.213. (b) Schedule I consists of the drugs and other substances listed in 21 *CFR* 1308.11. Each drug or substance has a Drug Enforcement Administration controlled substances code number. See www.deadiversion.usdoj.gov/21cfr/cfr/1308/1308_11.htm, accessed May 17, 2016.

(drug level not reported).²⁵ The driver tested negative for amphetamines, barbiturates, benzodiazepines, cocaine metabolites, marijuana metabolites, methadone, methaqualone, oxycodone, PCP, propoxyphene, and ethanol.

1.4.4.2 Hair Test. On May 8, 2015—about 5 weeks before the crash—the truck driver was administered a hair drug test as directed by court order for a matter unrelated to this investigation. His hair tested positive for metabolites of methamphetamine and amphetamine, and was negative for cocaine, opiates, PCP, and marijuana. Hair analysis drug testing detects drugs and drug metabolites incorporated into the hair matrix from the bloodstream or from sweat secreted on the scalp and absorbed into the hair. Compared with other human specimens used for drug testing, such as urine or blood, hair testing allows for a much longer window of detection—from days to months after use. Under some conditions, drugs may be detectable in hair for over a year (Pragst and Balikova 2006).²⁶ In general, the greater the intake of a drug over time, the higher the drug concentration observed in the hair (Wille and others 2014). Hair testing is limited, though, in that it cannot detect very recent use.

1.4.4.3 Pre-employment Test. On June 16, 2015, the truck driver was administered a urine drug test, in accordance with 49 *CFR* Part 382, as a condition of employment by Cool Runnings Express. The test was given by a commercial laboratory in London, Kentucky, in accordance with US Department of Transportation (DOT) requirements. The driver's urine tested negative for 6-acetylmorphine, amphetamines, cocaine, marijuana, opiates, and PCP.

1.4.5 Precrash Activities

A review of cell phone provider records showed that the truck driver was not using his cell phone at or near the time of the crash.²⁷ NTSB investigators used information from multiple sources to establish the driver's activities in the days prior to the crash. Vehicle location, speed, and engine status data were obtained from an integrated global positioning system (GPS) aboard the truck-tractor.²⁸ Additional evidence included fuel receipts, weigh station receipts, invoices, and bills of lading found in the truck-tractor. When possible, NTSB investigators interviewed employees of the businesses that provided these documents. Table 4 presents a timeline of the driver's activities from June 22 to 25, 2015. Figure 4 shows key activities along the driver's route.

²⁵ (a) The employer requested a 12-panel test, not the five-panel test described in 49 *CFR* 40.85. (b) Oxymorphone is an opioid and a Schedule II controlled substance (see 21 *CFR* 1308.12). It is also an active metabolite of the more commonly prescribed medication oxycodone, another Schedule II controlled substance.

²⁶ Hair length, texture, and color—and the use of hair products—can influence drug detection.

²⁷ The content of text messages from the cell phone suggests that it was shared by the truck driver and his passenger. The occasions on which phone use can be attributed to the driver are noted in table 4.

²⁸ For GPS data points, see the technical reconstruction factual report in the NTSB public docket for this investigation.

Table 4. Precrash activities of truck driver, June 22–25, 2015.

Monday, June 22, 2015		
Time	Description	Source^a
3:26 a.m.	<i>Vehicle recorded in London, Kentucky</i>	GPS
12:26 p.m.	Departs carrier terminal in London	GPS/driver interview
2:19	<i>Vehicle breaks down near Horse Cave</i>	GPS/driver interview
3:13	<i>Vehicle recorded at cargo shipper in Horse Cave</i>	GPS
5:05	<i>Vehicle repairs completed</i>	Invoice
7:30 p.m.	Goes off duty (sleeper berth) in Horse Cave	Driver interview
Tuesday, June 23, 2015		
2:26 a.m.	Docks for loading in Horse Cave	Shipper staff interview
4:44	Departs Horse Cave	Driver interview/bill of lading/GPS
7:01	<i>Vehicle malfunctions at carrier storage lot in London</i> Goes off duty	GPS/driver interview
11:44	Goes on duty <i>Vehicle repairs completed, breaks down again at repair shop in London</i>	Driver interview
2:11 p.m.	<i>Vehicle repairs completed</i> Departs repair shop in Corbin	GPS/driver interview
2:24–3:12	Returns to carrier terminal, then to repair shop in Corbin	GPS
5:08	Departs repair shop	GPS
6:21–6:45	Fuels truck and refrigerator unit, and weighs load in Corbin	Fuel receipt/scale ticket
7:20	Departs Corbin	GPS
8:35	<i>Vehicle recorded at truck stop in Heiskell, Tennessee, 74 miles from Corbin</i>	GPS
8:59	Resumes driving	GPS
11:17–11:22 p.m.	<i>Vehicle recorded at rest area in Resaca, Georgia, 146 miles from Heiskell</i>	GPS
Wednesday, June 24, 2015		
12:22 a.m.	<i>Vehicle recorded on I-285 in Atlanta, 60 miles from Resaca</i>	GPS
1:21	<i>Vehicle recorded at Flying J Travel Plaza in Jackson, 54 miles from Atlanta</i>	GPS
2:04	Sends text message	Cell phone device
2:23	Departs truck stop in Jackson	GPS
4:21–5:03	<i>Vehicle recorded at rest area in Sycamore, 112 miles from Jackson</i>	GPS

6:07–6:08	<i>Vehicle recorded at truck stop in Valdosta, 64 miles from Sycamore</i>	GPS/fuel receipt
6:31	Resumes driving after fuel purchase	GPS
6:45–7:01	<i>Vehicle recorded at rest area in Jennings, Florida, 12 miles from Valdosta</i>	GPS
7:56–8:09	<i>Vehicle recorded at rest area in Lake City, 57 miles from Jennings</i>	GPS
8:22	<i>Vehicle recorded on highway in Alachua, 15 miles from Lake City</i>	GPS
9:28 a.m.– 2:41 p.m.	<i>Vehicle recorded on highway in Wildwood (location of minor crash/breakdown)</i> Receives citation, resumes driving	GPS/Florida Highway Patrol
4:50	<i>Vehicle recorded at truck stop in Haines City, 62 miles from Wildwood</i> Goes off duty	GPS/driver interview
6:22 p.m.	Sends text message	Cell phone device
Thursday, June 25, 2015		
12:30 a.m.	<i>Vehicle recorded in Haines City</i>	GPS
4:30	Wakes up/begins workday	Driver interview
5:16	Departs truck stop in Haines City	GPS
5:32	<i>Vehicle recorded at shipper in Haines City</i>	GPS
7:45	Departs shipper	GPS
9:12–9:20	<i>Vehicle recorded at rest area in Wesley Chapel, 70 miles from Haines City</i>	GPS
12:02 p.m.	<i>Vehicle recorded at truck stop in Jasper, 180 miles from Wesley Chapel</i>	GPS
12:10	Purchases meal in Jasper	Food receipt
12:30	Resumes driving	GPS
12:47–1:10	<i>Vehicle recorded at rest area in Lake Park, Georgia, 18 miles from Jasper</i>	GPS
1:23–1:41	<i>Vehicle recorded at truck stop in Valdosta, 8 miles from Lake Park</i>	GPS
4:33	<i>Vehicle recorded on highway in Jonesboro, 206 miles from Valdosta</i>	GPS
6:21–6:23	<i>Vehicle recorded at rest area in Adairsville, 65 miles from Jonesboro</i>	GPS
6:23	Resumes driving	GPS
7:10 p.m.	Crash occurs	911 records
^a See the human performance group summary report in the NTSB public docket for this investigation.		

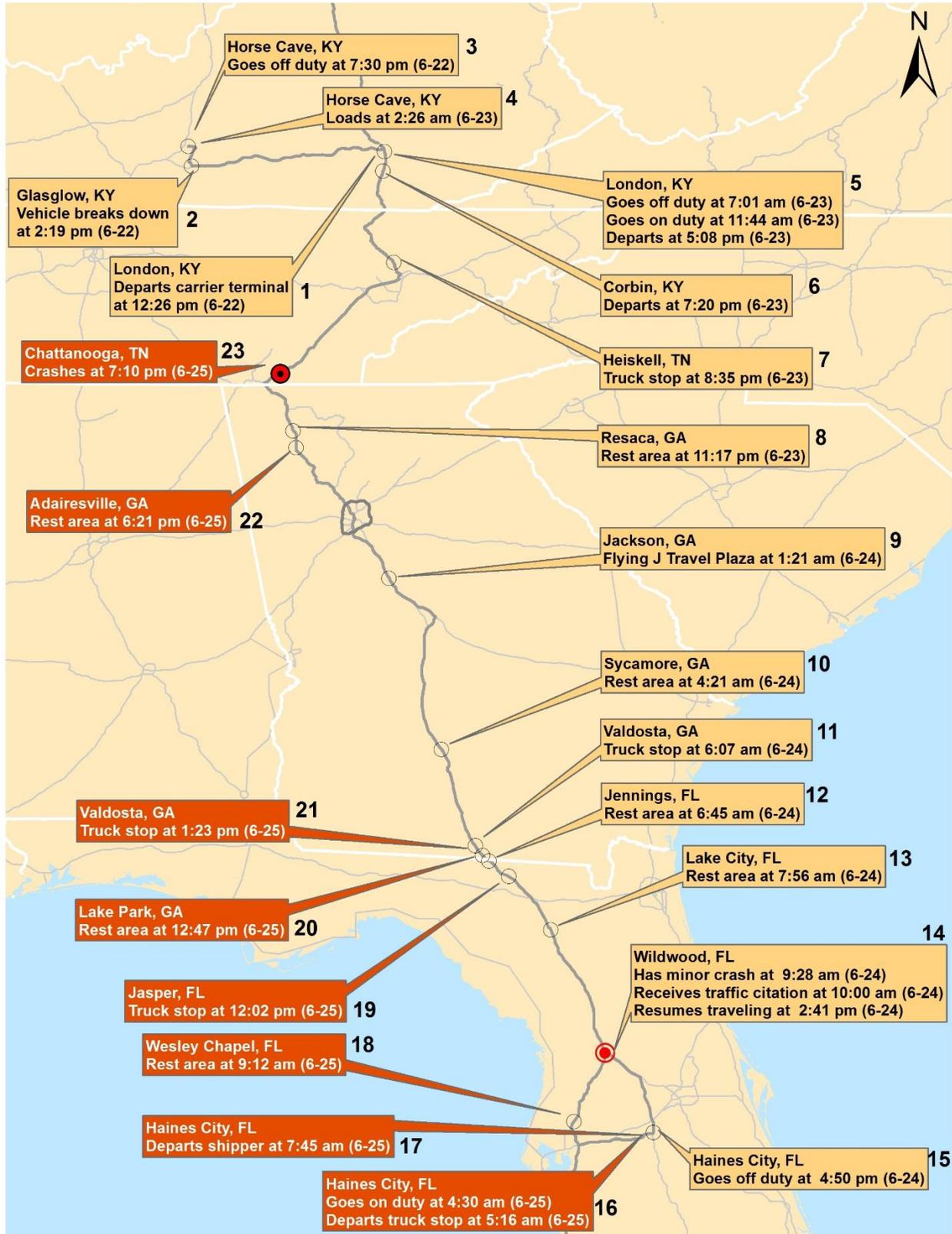


Figure 4. Map showing southbound and northbound trips, from London, Kentucky, to Haines City, Florida, to crash site in Chattanooga, with activities numbered sequentially.

1.4.5.1 Southbound Trip (Kentucky to Florida). The truck driver's assignment on June 22 was to transport goods from Horse Cave, Kentucky, to Haines City, Florida. However, the truck-tractor experienced a mechanical problem while en route to the shipper's facility, which delayed departure until early the next morning.²⁹ The driver reported entering his sleeper berth at 7:30 p.m., where he had a 7-hour opportunity for rest. On the morning of June 23—following another vehicle malfunction—the owner of Cool Runnings Express took the truck-tractor to a repair shop in London, Kentucky.³⁰ At 5:08 p.m. that day, the driver finally departed London en route to Haines City.

The driver traveled through the night, making seven stops along the way (ranging from 5 to 62 minutes each). On June 24, at 9:28 a.m., the truck-tractor was involved in a collision on State Route 91 near Wildwood, Florida, as the driver was attempting to pass another CMV. He was issued a citation for “operating a motor vehicle in a careless or negligent manner.” At the time of this collision, the driver had been on duty/driving for about 45 hours without the 10-hour rest period required by 49 *CFR* 395.3.³¹ As a result of this crash, the truck-tractor received disabling damage, and roadside repairs were necessary.³²

The driver remained in the truck-tractor while the repairs were completed. He stated that the temperature was extremely hot, and he napped on and off in the front seat.³³ At 2:41 p.m., he resumed travel, arriving in Haines City about 4:30 p.m.—too late for the scheduled delivery.

The driver parked at a nearby truck stop and went off duty around 4:50 p.m. on June 24, having driven more than 900 miles from London to Haines City. At this point, he had been on duty or driving for about 52 hours without a qualifying DOT 10-hour rest period. The last cell phone activity that can be attributed to the driver occurred at 6:22 p.m., and he began work the next day at 4:30 a.m.—which presented a 10-hour opportunity for rest. Although the air conditioning in the truck-tractor was not working, the load being transported required operation

²⁹ The mechanic made a service call to clamp a broken air line to the air compressor so that the truck-tractor could be driven to the carrier terminal in London.

³⁰ According to the invoice, the truck-tractor was taken to a Peterbilt dealership to “adjust the clutch, replace the jake brake switch in the dash, fix broken unloader air line to the air compressor governor, and set the road speed to 75 mph.”

³¹ (a) Duty hours are estimated from the time the truck driver departed the carrier terminal in London on June 22 at 12:26 p.m. to the time of the crash in Wildwood on June 24 at 9:28 a.m. (b) The Florida Highway Patrol trooper was not a CVSA-certified CMV inspector and did not formally review the driver's records of duty hours.

³² (a) The repairs consisted of replacing the lower radiator hose, pulling the fender away from the right-front tire, and reattaching the passenger-side rear mirror. (b) Under 49 *CFR* 382.303, an employer must test for drugs and alcohol after any CMV crash that includes, for example, a citation and disabling damage requiring the motor vehicle to be transported from the scene. In this case, drug and alcohol testing was not conducted, nor was it required, because the truck-tractor was repaired at the crash location.

³³ Weather data documented near this location in Wildwood showed temperatures near 83°F with 65 percent humidity.

of the semitrailer's refrigeration unit at a constant temperature of 34°F. The driver stated that he slept comfortably with the windows of the sleeper berth open.³⁴

1.4.5.2 Northbound Trip (Florida to Kentucky). After being off duty for about 12 hours, the truck driver began working at 4:30 a.m. on June 25, the day of the crash. He completed delivery of his load in Haines City at 7:45 a.m. and started the return trip to Kentucky. GPS data indicate that the truck-tractor stopped at five locations along the route, as noted in table 4. The duration of these stops ranged from 2 to 28 minutes. The crash occurred about 7:10 p.m. that evening in Chattanooga. At the time of the crash, the driver had traveled more than 500 miles and had been on duty or driving for 14 hours 40 minutes (see section 1.5.6).

1.4.6 Postcrash Interviews

The truck driver reported to NTSB investigators that he had heard mention of road construction but did not see any warning signs. He said that he observed several cars spin out of control, and when the car directly in front of him suddenly stopped, he realized that he could not stop. He reported jerking the steering wheel toward the left, but could not recall if he applied the brakes.

NTSB investigators also interviewed a driver who was traveling north on I-75 just prior to the crash. This witness, driving in the right lane near exit 11, observed the following:

- Truck-tractor approaching from the rear, passing him and moving into the center lane traveling 75–80 mph.
- Female seated in the passenger seat of the passing truck-tractor.
- Truck-tractor making several lane changes, moving to and from the left travel lane.
- Highway signs warning of road construction and stopped traffic ahead.
- On approach to exit 11, the truck-tractor showing no brake lights.

The witness pulled over to the shoulder as he reached the exit ramp, which was when the crash occurred.

1.5 Motor Carrier Operations

Cool Runnings Express, Inc., began operating in 2003 as a for-hire motor carrier, domiciled in London, Kentucky. The company operates with six trucks and seven drivers. It leases parking space for trucks and trailers at a truck stop in London. All trips start and stop at this location. In general, the carrier transports refrigerated food and produce from Florida to Pennsylvania or Ohio. In this case, the truck driver transported goods from London to Haines City, Florida. The carrier used various brokers for backhauls between its dedicated runs.

³⁴ Recorded weather near this location at 4:30 p.m. showed a temperature near 80°F, 70 percent humidity, and no precipitation. Around 11:00 p.m., the weather conditions in Haines City changed to rain and heavy thunderstorms, with wind gusts up to 32 mph, 100 percent humidity, and temperature near 70°F.

Drivers were paid \$0.40 per mile at the end of each trip. The crash occurred when the driver was on his return trip from Haines City to London.

1.5.1 Hiring Process

Cool Runnings Express reported that prospective drivers must have at least 2 years of over-the-road experience. The carrier provided driver information to its insurance company, which obtained and reviewed a copy of the 3-year driver license record. According to the owner of Cool Runnings Express, he did not usually review the driver license record because the insurance company screened each applicant for insurability. The carrier vice president verified employment history and ensured that the driver qualification file included all required documents. Once this process was complete, the owner interviewed the applicant, who was then given a pre-employment drug test.

The truck driver was on his first trip for Cool Runnings Express, having started his employment on June 22—just 3 days before the multivehicle crash. His driver qualification file complied with federal regulations (49 *CFR* 391.51) and contained his application, records of violations, road test, inquiry into previous employment, driving record, a copy of his CDL, and a medical certificate.

1.5.2 Terminal Operations

When interviewing the managers of Cool Runnings Express, NTSB investigators discovered that the carrier did not have written policies and procedures for hiring or firing, training, hours of service, safety, dispatch, drug or alcohol testing, or vehicle maintenance. The carrier did not have a cell phone use policy or a fatigue management program. Nor did it have safety meetings or a person overseeing safety activities. The carrier notified drivers verbally of company procedures and requirements. On occasion, the carrier would distribute safety notices provided by its insurance broker.

1.5.3 Drug and Alcohol Testing Requirements

The pre-employment urine drug test for the driver was administered on June 16, 2015, and the results were negative.³⁵ In accordance with 49 *CFR* 382.303, Cool Runnings Express directed the driver to take a postcrash urine drug test. Although the test was administered about 38 hours following the crash, the carrier did not offer a reason for the delay.³⁶

At the time of the crash, Cool Runnings Express had a random drug and alcohol testing program that complied with 49 *CFR* 382.305. Although 49 *CFR* 382.601 requires that employers also promulgate a policy on the misuse of alcohol or controlled substances, the carrier did not provide such educational materials or have a drug use policy in place.

³⁵ A DOT five-panel drug test at certified laboratories, described in 49 *CFR* Part 40, screens for five categories of drugs: amphetamines, cocaine, marijuana, opiates, and PCP.

³⁶ The postcrash urine drug test was specifically negative for methamphetamine, amphetamine, methylenedioxymethamphetamine (also known as ecstasy), methylenedioxyethylamphetamine, methylenedioxyamphetamine, cocaine, codeine, morphine, PCP, 6-acetylmorphine, and a metabolite of marijuana.

1.5.4 Investigations and Inquiries

Federal regulations require motor carriers to conduct investigations and inquiries for each driver they employ (49 *CFR* 391.23(a)(2)). A motor carrier must make an inquiry of all DOT-regulated carriers that employed a driver within the previous 3 years. Cool Runnings Express received documentation of a positive drug test result for the accident driver from a previous employer. A 12-panel urine drug test had been administered to the driver in June 2013, following a property-damage-only crash. (The crash did not meet the criteria for a DOT postcrash drug test.) The 12-panel test was positive for oxymorphone (level not reported).³⁷ As a result of the positive drug test, that carrier immediately terminated the driver's employment.

According to Cool Runnings Express, it was not aware of the positive drug test until asked about it by NTSB investigators. The owner said that company officials had failed to read the report from the previous employer.

To obtain the driver license history, a carrier is also required to make an inquiry to each state where the driver has had a motor vehicle operator's license during the preceding 3 years, per 49 *CFR* 391.23(a)(1). Cool Runnings Express had obtained a 3-year motor vehicle record from the Kentucky Transportation Cabinet, though the record did not include accident data (see section 1.4.2).

1.5.5 Record-of-Duty Status

Title 49 *CFR* 395.8 requires motor carriers to ensure that each driver maintain a daily record-of-duty status detailing the hours driven and the hours spent off duty. According to the owner of Cool Runnings Express, all drivers recorded their hours of service in paper logbooks. The carrier checked the records only to ensure that the daily entries summed to 24 hours and to verify that they corresponded to the assigned trips. A GPS installed on each truck-tractor was used to monitor the location of drivers. The owner stated that the company did not have a process in place to monitor hours of service or to examine records-of-duty status for falsification. Its drivers were not trained on recording hours of service or on related federal regulations. In reconstructing the truck driver's hours of service (see table 4), NTSB investigators found that his logbook contained false entries and did not accurately reflect his duty status.³⁸

³⁷ Oxymorphone is an opioid and a Schedule II controlled substance. It is also an active metabolite of the more commonly prescribed opioid oxycodone, which is another Schedule II controlled substance.

³⁸ The truck driver had filled out a logbook page dated June 15–25, 2015, as “off duty.” As discussed in section 1.5.6, however, he was on duty or driving on some of those days. He also had a second logbook, with an entry dated June 25, that showed different times.

1.5.6 Hours of Service

Federal regulations, at 49 *CFR* 395.3, require that property-carrying vehicle drivers record the start of their work shift, driving time, and rest breaks. For example, a driver must take 10 consecutive hours off duty before driving up to a total of 11 hours during a period of 14 consecutive hours. The accident driver started the trip to Florida at 12:26 p.m. on June 22 in London, Kentucky. He continued to be on duty or driving for about 52 hours—without 10 consecutive hours off duty—until he reached the delivery destination in Haines City at 4:50 p.m. on June 24. This total driving distance was more than 900 miles. He then had the opportunity for a 10-hour rest break in the sleeper cab.³⁹ He started his workday on June 25 at 4:30 a.m., unloaded the trailer, and departed Haines City at 7:45 a.m. to return to Kentucky. At the time of the I-75 crash, he had driven more than 500 miles and been on duty or driving for 14 hours 40 minutes.

1.5.7 FMCSA Compliance

1.5.7.1 Motor Carrier Management Information System. The Federal Motor Carrier Safety Administration (FMCSA) had conducted two compliance reviews (CR) of Cool Runnings Express since the carrier obtained its US Department of Transportation (USDOT) number in 2003.⁴⁰ The first CR was completed by the commonwealth of Kentucky in April 2007; the second was conducted by the FMCSA in September 2007. Both CRs resulted in a “satisfactory” safety rating.⁴¹

According to the FMCSA Motor Carrier Management Information System (MCMIS) profile, Cool Runnings Express had no behavior analysis and safety improvement categories (BASIC) in alert status at the time of the crash.⁴² To determine alert status, carriers are compared to a peer group of other carriers with similar numbers of inspections using a percentile rating of 0–100, with the 100th percentile indicating the worst performance. The BASICs for the carrier reflected the following statistics:

- Unsafe driving: 0 percent
- Hours-of-service (HOS) compliance: 61 percent
- Driver fitness: 0 percent
- Controlled substances and alcohol: 0 percent

³⁹ Although the truck driver went off duty at a truck stop in Haines City at 4:50 p.m., he sent a text message at 6:22 p.m.

⁴⁰ See 49 *CFR* 385.5, which specifies the safety rating methodology for the CR process.

⁴¹ A “satisfactory” rating indicates that a motor carrier has in-place and functioning adequate safety management controls to meet the safety fitness standard prescribed in 49 *CFR* 385.5.

⁴² The FMCSA uses data from roadside inspections, including all safety-based violations, state-reported crashes, and the Federal Motor Carrier Census, to quantify a carrier’s performance in seven BASICs. These categories are (1) unsafe driving, (2) hours-of-service (HOS) compliance, (3) driver fitness, (4) controlled substances and alcohol, (5) vehicle maintenance, (6) hazardous materials compliance (if applicable), and (7) crash indicator. A carrier’s rating for each BASIC depends on its number of adverse safety events, the severity of its violations or crashes, and when the adverse safety events occurred (more recent events are weighted more heavily).

- Vehicle maintenance: 33 percent
- Crash indicator: <2 percent.⁴³

The carrier profile showed the HOS BASIC to be over the 65 percent intervention threshold for 7 consecutive months, from October 2014 to May 2015.

According to its MCMIS profile, Cool Runnings Express was subject to four driver roadside inspections and one vehicle inspection from June 26, 2014, to June 26, 2015. Both its driver out-of-service (OOS) rate and its vehicle OOS rate were 0.0 percent. The comparable national OOS rates were 5.51 percent for driver and 20.72 percent for vehicle. At the time of the crash, the MCMIS carrier profile indicated that Cool Runnings Express had no recordable accidents year to date.

1.5.7.2 Postcrash Review. As a result of the Chattanooga crash, the FMCSA initiated a postcrash CR, and Cool Runnings Express received an “unsatisfactory” rating.⁴⁴ According to the FMCSA, the carrier has since submitted a safety compliance plan, and its operating status was upgraded to “conditional.”⁴⁵

On August 25, 2015, the FMCSA issued a Notice of Claim (NOC) to Cool Runnings Express for two violations of the *Federal Motor Carrier Safety Regulations* (FMCSRs).⁴⁶ The first violation was for false reports of duty status: 15 counts (49 *CFR* 395.8(e)(1)). The second violation was for using a commercial vehicle not periodically inspected: one count (49 *CFR* 396.17(a)). The NOC resulted in \$13,210 in civil penalties. As a result of the Chattanooga crash, the FMCSA declared the truck driver an “imminent hazard” on July 16, 2015; and the commonwealth of Kentucky suspended his CDL on July 21, 2015.

During the postcrash CR, FMCSA investigators reviewed the carrier’s accident history over the past 12 months. They determined that Cool Runnings Express had two reportable accidents and operated 568,237 miles.⁴⁷

The Tennessee Highway Patrol (THP) conducted a postcrash inspection of the truck-tractor and the driver and identified six deficiencies, four of which were OOS items:

- False reports of records-of-duty status (49 *CFR* 395(e)(1)).
- No or improper tractor protection valve (49 *CFR* 393.43(a)).

⁴³ The FMCSA intervention threshold for unsafe driving, HOS compliance, and crash indicator is 65 percent. For driver fitness, controlled substances and alcohol, and vehicle maintenance, the threshold is 80 percent. See csa.fmcsa.dot.gov/FAQs.aspx?faqid=1561, accessed August 17, 2016.

⁴⁴ An “unsatisfactory” rating indicates that a motor carrier does not have adequate safety management controls in place to ensure compliance with the safety fitness standard, which *has resulted* in the occurrences listed in 49 *CFR* 385.5(a) through (k).

⁴⁵ A “conditional” rating indicates that a motor carrier does not have adequate safety management controls in place to ensure compliance with the safety fitness standard, which *could result* in the occurrences listed in 49 *CFR* 385.5(a) through (k) and 49 *CFR* 385.3.

⁴⁶ An NOC is the initial document issued by the FMCSA to assert a civil penalty for violations of the FMCSRs.

⁴⁷ The accident profile did not include the crashes in Florida and Tennessee in June 2015.

- Brake hose or tubing chafing or kinking, worn-through cordage (49 *CFR* 393.45(b)(2)).
- Right axle 4 supply air hose, and brake hose or tubing chafing or kinking, worn-through outer ply (49 *CFR* 393.45(b)(2)).

The two other deficiencies were operating a CMV without proof of a periodic inspection (49 *CFR* 396.17(c)); and using or equipping a CMV with a radar detector, in possession/not in use, found in sleeper berth (49 *CFR* 392.71(a)). In addition, the FMCSA conducted five carrier vehicle inspections for the postcrash CR. These inspections found eight maintenance deficiencies and five driver deficiencies, one of which was an OOS violation.

1.6 Vehicles

1.6.1 Truck-Tractor

1.6.1.1 Damage. The 2007 Peterbilt truck-tractor in combination with a 2005 Great Dane refrigerated semitrailer was empty at the time of the crash. The combination vehicle weighed 35,900 pounds.⁴⁸ As the crash sequence concluded, the truck-tractor—with the Mazda still engaged at the front—entered the left lane and transitioned partially onto the left shoulder (figure 5). It came to a stop occupying primarily the left shoulder, with the semitrailer at a slight angle into the left lane. At rest, the truck-tractor was located about 448 feet north of the onset of the roadway evidence. It did not make contact with the center median barrier. Contact damage to the front included displacement of the hood and the bumper, and displacement of the radiator into the engine fan and accessory drive belts. Damage continued into the axle 1 steering and suspension systems. The refrigeration unit, mounted on the front of the semitrailer, sustained minor damage.



Figure 5. Truck-tractor and Mazda Tribute at position of rest. (Source: CPD)

⁴⁸ On June 29, 2015, the THP weighed the combination vehicle using certified portable scales on a level asphalt surface.

1.6.1.2 Mechanical Systems. Postcrash examination and testing of the truck-tractor mechanical systems found the steering gear to be in good condition, mechanically functional, and capable of translating movement over its entire intended range. Nearly all of the suspension components on the steering axle (axle 1) exhibited significant collision damage.⁴⁹ All brakes were in adjustment. Tire tread depths were within the requirements for CMV tires. Most of the tires were inflated to acceptable in-service pressures. However, the outside tire on axle 5 right was found to be inflated to less than 50 percent of the maximum inflation pressure.

1.6.1.3 Electronic Systems. The truck-tractor was equipped with an electronically controlled Caterpillar C15 engine. The engine control module (ECM) has the capability of recording vehicle speed, engine rpm, brake circuit status, throttle percentage, and other associated data in the event of sudden deceleration or hard braking. On June 26, 2015, the Georgia Highway Patrol downloaded the ECM data but found that the module's recording function was not enabled for this vehicle. No precrash hard brake application data were recorded. During postcrash examination of the truck-tractor, the cruise control switch was found in the "on" position, which indicated that power had been supplied to the system. Because of the lack of data from the ECM, it could not be determined if the cruise control was set and in use at the time of the crash. Although the carrier had requested that the speed limiter be set to 75 mph, ECM data showed that the engine was configured for a maximum road speed of 80 mph. This feature should limit the speed of the vehicle to within a few miles of the setting.

The truck-tractor was also equipped with a Bendix EC-60 controller, an antilock brake system (ABS) module that monitors brake applications and improves vehicle braking performance. The ABS module was removed from the truck-tractor and forwarded to the NTSB laboratory for further examination and analysis. A history report contained life-cycle data and active/inactive internal faults. When the right front wheel sensor was damaged, it created a fault code, at which point the vehicle velocity was 67 mph. This fault code produced a pressure modulator value fault code.⁵⁰

1.6.1.4 Vehicle Maintenance. The date of the truck-tractor's most recent annual inspection was August 29, 2012. Maintenance records reflected no significant repairs to the engine, clutch, or transmission in the 365 days previous to the crash.⁵¹ The record included documentation for routine and preventative maintenance, such as oil changes, tire replacement, and filter changes.

1.6.2 Other Vehicles

The 2010 Toyota Prius—a four-door hybrid-electric vehicle—exhibited substantial damage and evidence of multiple impacts. Figure 6 summarizes the sequence of collisions that affected the Prius and the resulting damage.

⁴⁹ No damage to the suspension components on axle 1 was documented as a result of the June 24, 2015, crash in Wildwood, Florida.

⁵⁰ (a) A wheel speed sensor fault code can occur when the sensor slowly moves too far away from the wheel and then needs to be repositioned to continue accurate readings. (b) A pressure modulator value fault code can occur when there is a problem with the ABS pressure modulator valve. (c) The recorder cannot distinguish between a defective sensor and crash-induced damage.

⁵¹ See the vehicle factors report in the NTSB public docket for this investigation.

Figure 6. Damage to 2010 Toyota Prius rear and right side.



COLLISION SEQUENCE

Traveling northbound in center lane of I-75

Pre-crash data: Prius was slowing from 13.7 to 5 mph within 5 seconds of crash (brake circuit was activated for 5 seconds preceding initial collision)

First impact: *truck-tractor strikes rear of Prius, and vehicles remain engaged*

Prius rotates counterclockwise for 74 feet, engaging with rear of Scion and rear of GMC for 68 feet; collides with Mazda

Prius disengages from truck-tractor following impact with Mazda, is then redirected across left lane and shoulder, and into a concrete median barrier

One occupant: fatal

EFFECTS

Evidence of multiple impacts, with substantial occupant compartment intrusion

Rear seats displaced forward and into the driver seat

Nickel metal hydride battery exposed and case opened

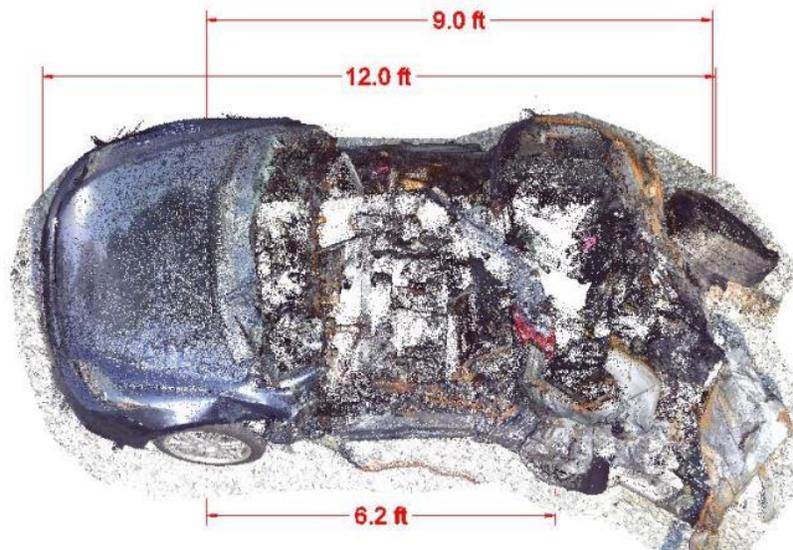
No battery pack leak, short circuit of high-voltage electrical system, or post-crash fire

Air bag control module (ACM) records (1) passenger side impact, resulting in deployment command for passenger side curtain air bag; and (2) front/rear impact, triggered 26 milliseconds before side impact, recording maximum longitudinal change in velocity of 72.7 mph in forward (positive) direction

The manufacturer provides documentation on procedures for immobilizing, disabling, stabilizing, and accessing the Prius in case of emergency, including fire. For electric and hybrid vehicles, NHTSA, SAE, and the National Fire Protection Association have issued guidelines and recommended practices for emergency responders (NHTSA 2012; SAE 2012). NTSB investigators identified no specific actions that were taken to confirm the safety of the Prius when transferring responsibility from the fire responders to the police or during relocation of the vehicle to the impound lot. In interviews, fire and police department personnel described a general awareness of the issues with alternative energy vehicles and stated that appropriate measures would have been taken if required.

Figures 7 through 13 summarize the sequence of collisions that affected the other seven vehicles and the resulting damage.

Figure 7. Overhead image of 2010 Scion tC showing deformation to rear.



COLLISION SEQUENCE

Traveling northbound in center lane of I-75

No precrash data available

First impact: *Prius and truck-tractor strike rear of Scion, which rotates clockwise and engages with front of truck-tractor*

Mazda strikes left side of Scion, redirecting it toward right lane

Scion continues 360° counterclockwise rotation to its position of rest, in gore area, 277 feet north of onset of roadway evidence

Four occupants: fatal (driver ejected)

EFFECTS

Ejection path of driver inconclusive; no deployment command for frontal air bags

Rear impact damage skews toward left

Driver headrest frame displaced from seat frame; significant deformation to front seat frames because of occupant loading in rearward and left-lateral directions

Postcrash fire consumes vehicle interior

No damage to doors or roof, but these components removed for extrication of occupants

ACM records frontal/rear impact with maximum longitudinal change in velocity of 36.8 mph in forward (positive) direction (value underreported due to recording time of ACM)

Figure 8. Damage to 2005 Savana GMC rear and right side.



COLLISION SEQUENCE

Traveling northbound in left lane of I-75

First impact: *Prius, engaged with truck-tractor, strikes rear of GMC, propelling van forward and into gradual counterclockwise rotation*

While engaged with Prius and Scion, GMC involved in collision with Mazda

GMC continues 180° rotation until striking concrete median barrier and coming to rest on left shoulder, parallel to roadway

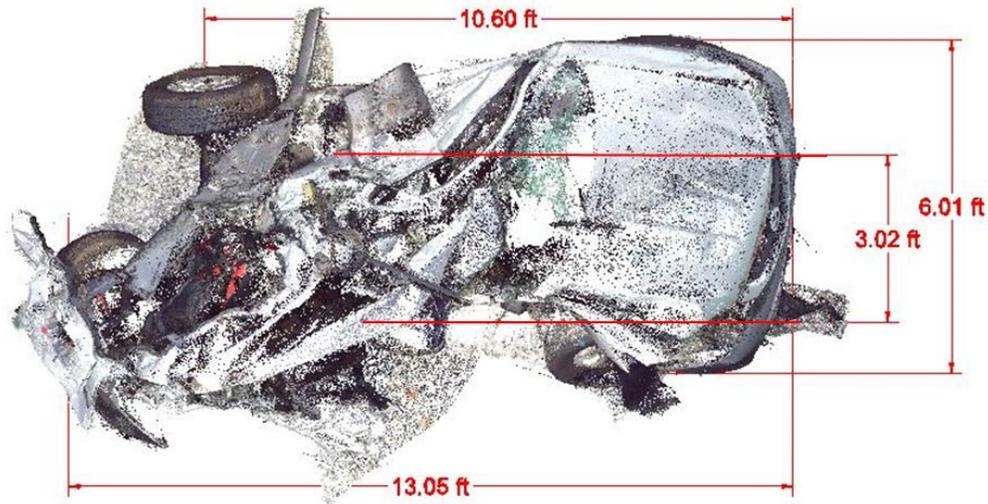
Two occupants: no injury

EFFECTS

No apparent displacement of cargo (supplies and equipment, including ladders secured to roof)

Damage concentrated on right side: right-rear door and bumper crushed forward and to left, quarter panel displaced to right-rear tire

Figure 9. Overhead image of 2003 Mazda Tribute showing deformation to rear.



COLLISION SEQUENCE

Traveling northbound in center lane of I-75

No event or precrash data recorded

First impact: *truck-tractor, Prius, GMC, and Scion—while engaged—strike Mazda*

Mazda collides with Scion, forcing Prius to disengage from truck-tractor and GMC

Mazda rotates counterclockwise and engages with front of truck-tractor; both vehicles transition partially onto left shoulder, with Mazda striking concrete barrier about 94 feet before coming to rest (still engaged with truck-tractor)

One occupant: fatal

EFFECTS

Evidence of multiple impacts

Substantial occupant compartment intrusion, compromised survivable space

Impact evidence from truck-tractor and body deformation at left rear and left side, extending forward and including driver door

Impact evidence and substantial deformation of right side, with red paint (from Ford) observed

Black material (characteristic of tire marks) observed on left side

No deployment of air bags, no available ACM data

Figure 10. Damage to 2001 Ford F-150 left side and rear.



COLLISION SEQUENCE

Traveling northbound in center lane of I-75

First impact: *truck-tractor, while engaged with Mazda, strikes Ford, propelling it forward into clockwise rotation and into Chevrolet*

Ford comes to rest at 250° relative to direction of travel, straddling center and right lanes, 330 feet north of onset of roadway evidence and 260 feet from initial impact with Prius

One occupant: serious injury

EFFECTS

Evidence of multiple impacts

Substantial right-rear impact forces aft corner of rear quarter panel and cargo bed forward and to left

Contact damage and deformation on left side consistent with sideswipe impact

Driver seat deformed and left side and left footwall partially crushed

Restraint control module captures event data most likely associated with subsequent impacts

Both driver and passenger side frontal air bags deploy

Figure 11. Damage to 2007 Chevrolet Uplander rear, right side, and front.



COLLISION SEQUENCE

Traveling northbound in center lane of I-75

First impact: Ford strikes rear of Chevrolet, causing it to accelerate forward into Cadillac

Chevrolet comes to rest within gore area at 126° relative to direction of travel alongside Ford and Cadillac, 315 feet north of onset of roadway evidence

Two occupants: minor injury

EFFECTS

Impacts to front and rear of minivan

Rear damage concentrated on right side but extends across entire vehicle

Frontal damage extends across entire vehicle

Frontal damage includes entangled rear Cadillac bumper cover

No deployment of air bags

Figure 12. Damage to 2014 Cadillac CTS rear and front.



COLLISION SEQUENCE

Traveling northbound in center lane of I-75

Pre-crash data available for 5 seconds before first event trigger, showing active (“on”) brake lamp circuit; and initial speed of 1 mph, with gradual increase to 4 mph and decrease to 3 mph in final second

First impact: *Chevrolet strikes Cadillac at rear, causing it to accelerate forward into Toyota Cadillac comes to rest at 290° relative to direction of travel, alongside Ford and Chevrolet, straddling right and center travel lanes, 330 feet north of onset of roadway evidence*
One occupant: minor injury

EFFECTS

Evidence of multiple impacts at both front and rear

Rear of vehicle exhibits evidence of having been underridden by Chevrolet

ACM records (1) rear impact classified as nondeployment event, resulting in positive change in velocity of 38 mph; and (2) frontal impact, 230 milliseconds later, resulting in negative change in velocity of 17 mph and deployment command for supplemental restraint system (knee bolster and side curtain air bags)

Figure 13. Damage to 2015 Toyota Tundra left rear.



COLLISION SEQUENCE

Traveling northbound in center lane of I-75

Precrash data available for 5 seconds before first event trigger, showing active (“on”) brake lamp circuit

First impact: *Cadillac strikes rear of Toyota*

Toyota comes to controlled stop on right shoulder, 484 feet north of onset of roadway evidence

Four occupants: no injury

EFFECTS

Impact damage to left rear, mostly to cargo bed

Forward displacement of left side of rear bumper and aft portion of rear quarter panel

Evidence of having been underridden by Cadillac

ACM records front/rear impact classified as nondeployment event, resulting in positive change in velocity of 17.7 mph

At event trigger, vehicle speed of 9 mph with accelerator pedal fully engaged (100 percent); data likely sampled immediately following actual impact

1.7 Highway Factors

1.7.1 Geometric Design

The crash occurred in the northbound lanes of I-75, near MP 11.7. In the vicinity of the crash, I-75 is a divided highway, with three travel lanes in each direction. The lanes have a nominal design width of 12 feet. Right shoulders are 6.5 feet wide, and median shoulders are 10 feet wide. Rumble strips are located on both shoulders. A 52.5-inch-tall test level (TL)-5 single slope concrete median barrier separates the northbound and southbound lanes (Transportation Research Board [TRB] 1993).⁵² The initiating event occurred in the center lane, adjacent to the 24-foot-wide gore area that separates the right lane and the entrance ramp from US-11, as shown in figure 14.

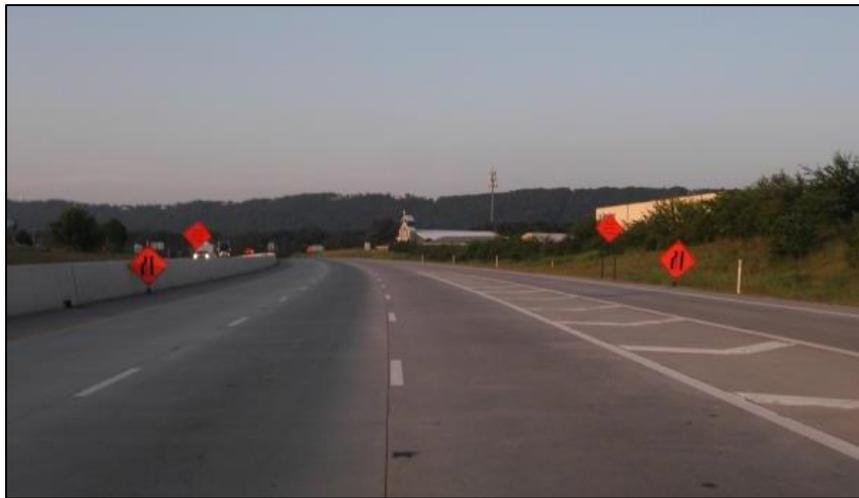


Figure 14. I-75 northbound segment of crash scene travel lanes, including gore area and entrance ramp.

At MP 12, the right lane and entrance ramp drop off, and I-75 becomes a two-lane roadway. On the day of the crash, the left lane was closed at MP 12 for repaving operations, which began at MP 12.8. Only one lane of I-75 was available to accommodate traffic, as shown in figure 15. The 5.82-mile-long resurfacing project had started on May 5, 2015. Daily operations were scheduled from 7:00 p.m. to 6:00 a.m.

⁵² TL-5 barriers are tested in accordance with the impact conditions found in National Cooperative Highway Research Program (NCHRP) Report 350: 50-mph impact using an 80,000-pound truck-tractor semitrailer at a 15 degree impact angle.



Figure 15. I-75 northbound, two-lane approach near MP 12 in advance of work zone.

A crest vertical curve (hill) is present about 1 mile in advance of the crash scene. The hill crest offers a clear line of sight, as shown in figure 16. A 5.1 percent downgrade occurs after the hill crest, followed by a 1.4 percent upgrade and a 1 degree left horizontal curve—which begins about 100 feet before the impact area.



Figure 16. View of crash scene from crest vertical curve 1 mile distant.

1.7.2 Traffic Volume, Speed, and Crash History

According to the Tennessee Department of Transportation (TDOT), on approach to the crash scene, the average daily traffic (ADT) on I-75 exceeds 70,000 vehicles per day before the US-11 interchange and 60,300 vehicles per day after the interchange. Truck traffic accounts for 24 percent of the overall ADT.

The posted speed limit in the area of first impact is 65 mph for cars and 55 mph for trucks. The closest speed limit signs are located on both sides of the northbound roadway about 2.2 miles in advance of the crash scene. At MP 12—1,530 feet north of the area of impact—the posted speed limit is 60 mph regardless of vehicle type. The change in the posted speed is conveyed through advance traffic control signs posted on both sides of the roadway 1,100 feet before the area of impact (Federal Highway Administration [FHWA] 2009).⁵³

According to TDOT, between 2010 and 2014, a total of 541 crashes—including five fatal, 115 injury, and 421 property damage—were reported in a 6-mile area of I-75, from MP 9 to 15. These crashes involved 15 single-unit trucks and 88 truck-tractor semitrailers. In the same period, 68 fatalities occurred in work zones statewide.⁵⁴

1.7.3 Work Zone Oversight and Operations

TDOT used federal aid funding for the resurfacing project. The FHWA oversees federal aid work zone projects, as specified in 23 *CFR* Part 630.⁵⁵ The FHWA requires the development and implementation of an agency-level work zone safety and mobility policy, to include procedures for impact assessments, data analysis, training, and process reviews. The TDOT policies and processes for advanced planning, work zone impact analysis, training, and inspection of work zones are described in its *Work Zone Safety and Mobility Manual* (TDOT 2007).

TDOT held a preconstruction conference for this project on April 2, 2015, to discuss the work zone contract, including the traffic control plan. Participants included TDOT, contractors, and subcontractors. According to the TDOT region 2 director of operations, they did not invite the THP to the conference because key points of contact at both agencies had been reassigned or had retired.

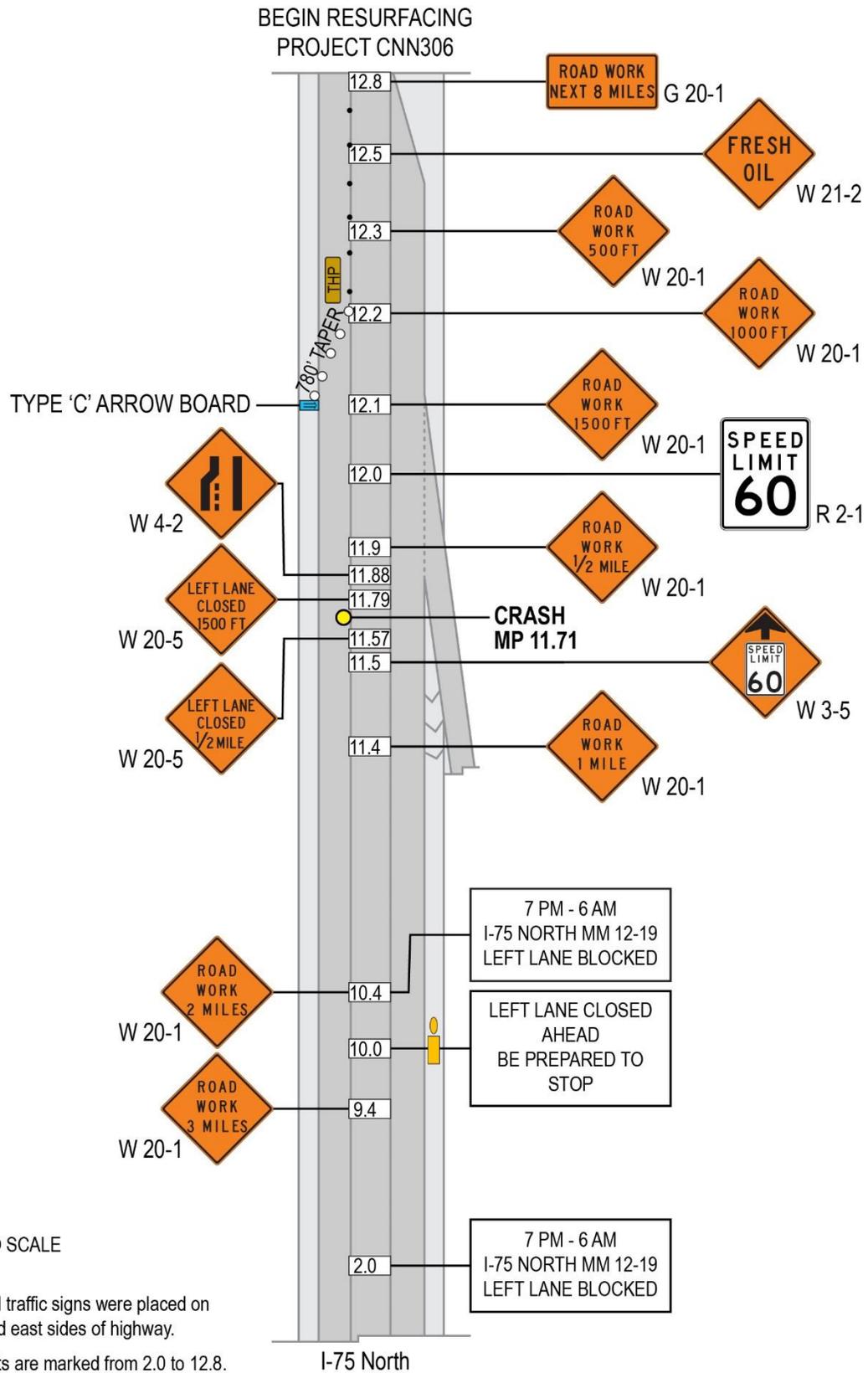
1.7.4 Traffic Control Plan

Figure 17 depicts the TDOT-designed traffic control plan for the I-75 work zone. Advance notice of the work zone was posted about 9 miles before the impact area. A permanent overhead dynamic message sign (DMS) at MP 2 displayed the following three-line message: “7 PM–6 AM | I-75 NORTH MM 12–19 | LEFT LANE BLOCKED.” TDOT activated this message at 7:07 p.m. on June 25. A second DMS, displaying the same message, was located at MP 10.4; it was activated at 7:02 p.m.

⁵³ See *Manual on Uniform Traffic Control Devices* (MUTCD) sign W3-5.

⁵⁴ Crash statistics are provided by the Tennessee Integrated Traffic Analysis Network (TITAN).

⁵⁵ See also 69 *Federal Register* (FR) 54562, September 9, 2004.



NOT TO SCALE

NOTE:
Identical traffic signs were placed on west and east sides of highway.

Mileposts are marked from 2.0 to 12.8.

Figure 17. Traffic control layout for I-75 work zone, adapted from TDOT.

The *Manual on Uniform Traffic Control Devices* (MUTCD), section 6C.04 (Advance Warning Area), provides guidance on sign placement in work zones (FHWA 2009). On highways, signs should extend as far in advance as 0.5 mile or more. The TDOT contract required that warning signs be extended 3 miles in advance of the beginning of the taper for the lane closure.⁵⁶ Accordingly, fixed signs (W20-1; see figure 17) were located on both sides of the road as follows:

- MM 9.4: “ROAD WORK 3 MILES”
- MM 10.4: “ROAD WORK 2 MILES”
- MM 11.4: “ROAD WORK 1 MILE.”

At MP 11.75, temporary signs on both sides of the road warned “LEFT LANE CLOSED ½ MILE.” The crash occurred at MP 11.71.

The TDOT contract required that a queue protection truck, with a portable DMS, be located at the back of all traffic queues. The truck operator was to continuously monitor traffic backups and move the truck as necessary to maintain at least a 0.5-mile warning in advance of slow-moving traffic. According to the TDOT region 2 director of operations, at the time of the crash, traffic was backed up to MP 11.7. The queue protection truck was located at MP 10.0, on the right shoulder. It was equipped with a portable DMS and a crash attenuator. The message displayed read: “LEFT LANE CLOSED AHEAD, BE PREPARED TO STOP.” TDOT activated this message at 6:30 p.m. on June 25.

According to the MUTCD, the minimum taper length in a 60-mph work zone should be 720 feet for channeling traffic from a 12-foot-wide lane (FHWA 2009). The FHWA and the American Traffic Safety Services Association (ATSSA) recommend using longer tapers to help smooth traffic flow at merge locations (ATSSA 2009). The taper used to close the left lane in this work zone was 780 feet long, exceeding the minimum required.

The MUTCD, section 6G.14 (Work Within the Traveled Way of a Freeway or Expressway), addresses lane closures on high-speed freeways and expressways (FHWA 2009). The standard requires that a separate arrow board be used for each closed lane.⁵⁷ For the Chattanooga work zone project, an arrow board was positioned where the taper began, on the shoulder at MP 12.1, about 1,160 feet from the “lane ends” symbol sign.

The MUTCD, section 6G.19 (Temporary Traffic Control During Nighttime Hours), recommends that stationary uniformed law enforcement officers and lighted patrol cars be used at night work locations where there is a concern that high speeds or impaired drivers might result in undue risks for workers or other motorists. The TDOT contract required the use of law enforcement personnel, who worked under the direction of the THP.⁵⁸ TDOT has a memorandum

⁵⁶ Tapers are created by using channelizing devices or pavement markings to move traffic out of the normal path. The appropriate taper length is determined using the criteria in MUTCD tables 6C-3 and 6C-4.

⁵⁷ MUTCD typical application 33 shows an example of the proper placement of an arrow board at the end of the shoulder taper at a specific distance from the “lane ends” symbol sign. For expressways and freeways, this distance corresponds to 1,000 feet from the transition or point of restriction to the first sign.

⁵⁸ On federal aid projects, the FHWA requires state highway agencies to establish policies on the use of law enforcement in work zones.

of understanding with the THP to pay for this service. Troopers are required to complete a 4-hour class in traffic incident management before being assigned to supplemental traffic control in work zones. In this case, a marked patrol car was positioned in the median at MP 12.2, where the left lane was closed. The trooper in this vehicle performed a presence function as opposed to circulating enforcement.⁵⁹

⁵⁹ “Presence” commonly refers to the strategic use of visible law enforcement to control traffic speed. “Circulating enforcement” refers to the use of law enforcement at different locations or moving through the work zone.

2 Analysis

2.1 Introduction

This work zone crash involved a 2007 Peterbilt truck-tractor in combination with a 2005 Great Dane semitrailer operated by Cool Runnings Express, Inc., of London, Kentucky. The collision sequence began on I-75, in Chattanooga, Tennessee, when the truck-tractor collided with a 2010 Toyota Prius that had slowed for traffic. The crash involved nine vehicles and 18 people; of the vehicle occupants, six died and four were injured.

The analysis portion of this report discusses possible reasons why the truck driver failed to respond to salient cues, ultimately striking slow-moving traffic ahead (sections 2.2–2.4). In addition, we discuss the following safety issues:

- Limitations of current drug testing programs (section 2.5)
- Inadequacies of driver license records and background checks (section 2.6)
- Truck overrepresentation in work zone crashes (section 2.7).

NTSB investigators considered and eliminated the following possible causal and contributory factors:

- **Vehicles:** Postcrash examination of the truck-tractor revealed no pre-existing mechanical defects or deficiencies in the major mechanical systems (steering, braking, suspension, and tires) that would have caused or contributed to the crash. Further, NTSB investigators found no evidence of any mechanical problems with the other eight vehicles that would have contributed to the crash.
- **Weather:** The weather was clear, there was no precipitation at or near the time of the crash, and the roadway was dry. The crash occurred during daylight conditions.
- **Visibility:** Line-of-sight observations showed that the roadway near the area of impact was visible from 5,260 feet.⁶⁰
- **Driver licensing:** The truck driver held a current CDL with appropriate endorsements for the vehicle he was operating.⁶¹ He had experience operating truck-tractors, including long-distance operations for about 5 months and local operations for 12 years.
- **Driver medical condition and alcohol use:** A review of the truck driver's medical records showed no evidence of medical conditions that would have caused or

⁶⁰ NTSB investigators took sight line observations from positions within the three travel lanes on the northbound approach to the crash site based on a driver eye height of about 3.5 feet. The line-of-sight for a truck driver could extend a greater distance.

⁶¹ NTSB analysis did not include evaluation of the general appropriateness or efficacy of the licensing rules.

contributed to the crash, and the driver reported that the collision did not occur because of a medical incident. The result of his postcrash test for alcohol was negative.

- **Driver distractions:** NTSB investigators found no potential sources of distraction external to the vehicle. Forensic examination of the driver's cell phone indicated that it was not in use at or near the time of the crash. There was no evidence of distraction related to interaction with his passenger.

The NTSB, therefore, concludes that none of the following were factors in the crash: (1) mechanical condition of any of the nine vehicles involved; (2) weather conditions; (3) visibility of the road hazard; (4) truck driver licensing; or (5) truck driver's medical condition, alcohol use, or distractions.

The Hamilton County 911 call center received the first call reporting this crash about 7:10 p.m., and emergency responders arrived at the crash scene within minutes with adequate resources. Both the triage and the transportation of patients to local hospitals were adequate. The nickel metal hydride battery of the Prius was exposed, but the battery pack did not leak, the high-voltage electrical system did not short circuit, and there was no postcrash fire. Although best practice procedures for safely handling the hybrid-electric vehicle were not closely followed, emergency responders were aware of the procedures had the Prius exhibited any risk factors (NHTSA 2012; SAE 2012). Therefore, the NTSB concludes that the emergency response to the crash was timely and adequate.

2.2 Truck Driver Performance

2.2.1 Visual Cues

TDOT used several means to convey information about the work zone and lane closure. The first DMS was located 9 miles in advance of the crash site. Advance warning signs were located 3 miles before the beginning of the tapered transition area. A queue protection truck equipped with a message board displaying "LEFT LANE CLOSED AHEAD, BE PREPARED TO STOP" was located 1.7 miles in advance of the crash site. Lastly, data indicate that as the Prius slowed into the traffic queue, its brake lights were illuminated for 5 seconds before impact. The NTSB concludes that multiple visual cues were available to warn the truck driver of the work zone and traffic conditions ahead.

2.2.2 Truck Impact Speed

NTSB analyses showed that the truck driver was traveling at an estimated speed of 78–82 mph when the combination vehicle struck the Prius, despite having passed numerous signs denoting roadwork and "LEFT LANE CLOSED AHEAD," and a lighted truck-mounted sign warning traffic to "BE PREPARED TO STOP." The driver's rate of speed exceeded the posted speed limit for trucks by as much as 25 mph. This high speed decreased the time available for him to perceive and react to changing traffic conditions, while significantly increasing the distance required to brake to a stop. The truck-tractor's potential stopping distance was about

80 percent longer than if it had been traveling at the posted speed limit.⁶² Additional analysis showed that had the truck-tractor been traveling 55 mph when it collided with the Prius, the car would have sustained a change in velocity of 46–49 mph (compared with the actual 72.7 mph). Therefore, the NTSB concludes that the truck driver’s operation of the combination vehicle through the work zone at 78–82 mph significantly hindered his ability to react in time to take evasive action to avoid vehicles at the back of the traffic queue and led to a more severe collision.

2.2.3 Driver Response

NTSB analysis of the physical evidence indicated that the truck-tractor’s collisions with the other vehicles and the concrete barrier greatly reduced its speed and played a significant role in bringing the combination vehicle to a stop.⁶³ Although some braking by the driver cannot be ruled out, the lack of physical evidence—such as tire friction marks—indicates that, even if braking did occur, it was not consistent with the type of emergency braking that would be expected of an alert driver.

Examination of the truck-tractor showed evidence of a minor leftward rotation of the steering gear. However, the impact evidence revealed that the truck-tractor did not deviate from its initial heading, and its movement toward the left lane was evident beginning about 170 feet after the first area of impact. There was no evidence of evasive steering by the truck driver despite the traffic signs, the traffic queue, and activation of the brake lights on the Prius. Therefore, the NTSB concludes that the truck driver did not respond to the slow-moving traffic or take evasive action to avoid the crash.

Sections 2.3 and 2.4 discuss the NTSB examination of fatigue and drug use as possible factors affecting the truck driver’s ability to respond to the slow-moving traffic ahead.

2.3 Fatigue Assessment

Fatigue is generally caused by insufficient sleep. It can be influenced by medical factors, waking hours, circadian rhythms, and quality of sleep. Fatigued drivers may experience slower reaction times, inability to process information, loss of concentration and perception, and reduced vigilance.

Information in the truck driver’s medical history shows no indication of a sleep disorder diagnosis. In his most recent commercial driver fitness determination exam, he indicated that he did not have “sleep disorders, pauses in breathing while asleep, daytime sleepiness, or loud snoring.” His body mass index was 28.4, which is not associated with a high risk of adult obstructive sleep apnea.

⁶² From a speed of 80 mph, the total stopping distance of the truck-tractor would be about 529 feet, as compared with 294 feet from a speed of 55 mph—an increase of roughly 80 percent. The calculated distances consider a driver perception–response time of 1.5 seconds, which—at 80 mph—covers about 176 feet. The calculations also consider a brake pressure build time of 0.5 second and a deceleration rate of 21.2 ft/s².

⁶³ The Mazda struck the concrete barrier while engaged with the front of the truck-tractor.

NTSB investigators examined the driver's activities in the days leading up to the crash. On June 23 about 2:26 a.m., he picked up a load in Horse Cave, Kentucky. His next opportunity for sustained rest was 40 hours later—on June 24 at 6:30 p.m.—when he reached Haines City, Florida. During this extended period of wakefulness, the driver had mechanical breakdowns, was involved in a minor traffic crash, and made seven stops. These stops were brief, which eliminated the possibility of obtaining rest. Although the driver stated that he slept well, it is possible that his sleep quality was adversely affected by the temperature inside the truck and the ambient noise from the refrigeration unit on the front of the trailer. The truck's air conditioning unit was not working due to the minor crash the previous day.

Following an overnight rest on June 24, the driver began his workday at 4:30 a.m., delivered his load about 5:30 a.m., and began the return trip to Kentucky at 7:45 a.m. The crash occurred at 7:10 p.m., after the driver had been working for 14.5 hours. Research has shown that a single rest period is insufficient for recovery following severe sleep restriction (Lamond and others 2007). Fatigue-related performance impairment persists even though feelings of subjective sleepiness may subside. Also contributing to the driver's fatigue was the length of time he had been awake and driving when the crash occurred. Cognitive performance becomes progressively worse as the time on a task continues, and this condition is exacerbated by sleep loss (Lamond and others 2007).

NTSB investigators also considered environmental influences on the driver's performance. Weather data near the vicinity and time of the crash showed that the temperature was near 93°F, with a heat index of about 97°F. In a study of high ambient temperature and crash risk, Basagana and others (2015) found that the crash risk increases significantly during periods of high temperature, particularly for crashes involving factors such as distraction, driver error, fatigue, or sleepiness. The NTSB concludes that the truck driver did not take rest breaks as required by HOS regulations; and he was likely experiencing fatigue-related performance decrements because of recent sleep restriction, insufficient sleep recovery, and amount of time awake and driving.

2.4 Truck Driver Drug Use

2.4.1 Toxicology

The DRE officer determined that the truck driver was under the influence of a CNS stimulant and a CNS depressant.⁶⁴ In addition, the toxicology testing of a postcrash blood specimen obtained from the driver on June 25 identified methamphetamine (0.08 µg/mL) and its primary metabolite amphetamine (less than 0.05 µg/mL), which are controlled substances.⁶⁵

⁶⁴ As described in section 1.4.3.3, during the late phase of CNS stimulant drug use, the user may display physiological symptoms of fatigue, sleepiness, and lowered heart rate, among others, which are consistent with a CNS depressant.

⁶⁵ The blood was drawn about 90 minutes following the crash. The driver tested negative for barbiturates, cannabinoids, cocaine, and opiates.

Federal regulations prohibit CMV operators from reporting for duty or remaining on duty when using controlled substances.⁶⁶

In 1990, the NTSB published a safety study on fatigue, alcohol, other drugs, and medical factors in fatal-to-the-driver heavy truck crashes, noting particularly that the use of stimulants such as amphetamines when fatigued is ill-advised for any truck driver. Fatigue, drugs taken to counteract the symptoms of fatigue, and drugs that aggravate fatigue were noted as major factors in crash causation (NTSB 1990).

Drivers under the influence of methamphetamine, with blood concentrations ranging from less than 0.05–2.36 µg/mL (the accident driver's blood concentration was in this range), exhibit such behavior as drive-off-the road type crashes, high speed, failing to stop, diminished divided attention, inattentive driving, impatience, and high-risk driving (NHTSA 2014). NHTSA also reports that methamphetamine has a high potential for abuse and dependence. Abrupt discontinuation of use can produce extreme fatigue and disorientation, among other symptoms.

In this case, there is evidence that the driver was fatigued, a DRE examination concluded that he was under the influence of a CNS stimulant and a CNS depressant, and his postcrash blood test was positive for methamphetamine. Further, he approached a work zone at high speed, did not respond to available visual cues, and did not take evasive maneuvers to avoid the slow-moving traffic ahead. The NTSB concludes that the truck driver had illegally used methamphetamine prior to the crash, and its effects degraded his driving performance.

2.4.2 Drug Use and Driving

The 2014 national survey on drug use and health revealed that 27 million people aged 12 or older had used an illicit drug in the preceding 30 days, which corresponds to about one in 10 Americans (10.2 percent of the population aged 12 or older; Substance Abuse and Mental Health Services Administration [SAMHSA 2015a]).⁶⁷ NHTSA reports that the proportion of fatally injured drivers who tested positive for illegal, prescription, or over-the-counter drugs increased from 13 percent in 2005 to 18 percent in 2009 (NHTSA 2010).⁶⁸ The 2013–2014 national roadside survey found that more than 22 percent of drivers tested positive for illegal, prescription, or over-the-counter drugs (NHTSA 2015).⁶⁹

Data on the prevalence of drug use among the CMV driver population in the United States are limited. In 2014, 3,697 drivers of large trucks were involved in fatal crashes, as

⁶⁶ Certain controlled substances are allowed under medical supervision if the prescribing physician states that they will not affect the driver's ability to safely operate a CMV (49 *CFR* 382.213). In this case, records available to the NTSB for the driver did not include a prescription for any controlled substance.

⁶⁷ SAMHSA is an agency of the US Department of Health and Human Services (DHHS).

⁶⁸ (a) In 2005, 3,710 fatally injured drivers (of a total 27,491) tested positive for drug involvement; in 2009, 3,952 fatally injured drivers (of a total 21,798) tested positive for drug involvement. (b) Drug presence as recorded in the NHTSA Fatality Analysis Reporting System (FARS) includes illegal substances, prescription medications, and over-the-counter medications, which may or may not have been misused.

⁶⁹ The 2013–2014 national roadside survey—which was voluntary and anonymous—employed a sampling technique designed to produce national estimates of alcohol and drug use while driving. The sampled population for the survey was noncommercial drivers who were 16 years or older and spoke English or Spanish.

reported by the Fatality Analysis Reporting System (FARS).⁷⁰ The majority of these drivers—63.1 percent—were not tested for drugs postcrash. Of those truck drivers in fatal crashes who were tested for drugs, 5 percent had at least one positive drug test result (FMCSA 2016b). Drugs reported included narcotics, depressants, stimulants, hallucinogens, cannabinoids, PCP, anabolic steroids, and inhalants. According to MCMIS data, from 2011 to 2015, the FMCSA conducted 2,147,240 traffic enforcement inspections of commercial drivers, of whom 4,911 were found to have drug and alcohol violations, which represents less than 0.23 percent of the total inspections for those 5 years (FMCSA 2016a).⁷¹

By contrast, for an Oregon Department of Transportation (ODOT) study, commercial drivers were asked to complete voluntary drug tests during inspections. Researchers found that nearly one in 10 drivers tested positive for drugs (ODOT 2007a; 2007b).⁷² Overall, it appears that there is some evidence of increased drug use among drivers in general; however, there is very little data on CMV drivers. Furthermore, differences in populations sampled, test protocols used, and types of drugs evaluated likely contributed to the variation in the observed prevalence of drug use among CMV drivers.

2.4.3 Safety Recommendation

Previous NTSB investigations have examined the issue of drug use among CMV operators, where the drug use (such as cocaine or marijuana) was in the probable cause or was a contributing factor (NTSB 2003; 2001; 1994). Most recently, the NTSB investigated a crash in Davis, Oklahoma—with four fatalities—where the CMV driver crossed the median, entered the opposite lanes, and struck a medium-size bus (NTSB 2015b). The probable cause of the Davis crash was the failure of the truck driver to control his vehicle due to incapacitation likely stemming from his use of synthetic cannabinoids.⁷³

As a result of the Davis crash investigation, the NTSB issued Safety Recommendation H-15-38 to the FMCSA, which called on the agency to:

H-15-38

Determine the prevalence of commercial motor vehicle driver use of impairing substances, particularly synthetic cannabinoids, and develop a plan to reduce the use of such substances.

⁷⁰ FARS data originate from police accident reports submitted by the states and do not reflect the drug testing required by 49 *CFR* 382.303. The FMCSA maintains that the large majority of CMV drivers involved in fatal crashes are drug tested as required by the regulations; however, there is no mechanism for the data from those tests to be reported and analyzed in aggregate.

⁷¹ One inspection may result in more than one violation.

⁷² (a) The study included testing for amphetamines, barbiturates, benzodiazepines, cocaine, cannabinoids, methadone, opiates, and propoxyphene. (b) ODOT conducted two other studies with similar results.

⁷³ Synthetic drugs typically affect the same brain receptors as known substances such as methamphetamine, marijuana, or cocaine, but they have altered chemical structure and can have considerably more potent side effects. Examples of synthetic drugs are bath salts (which mimic the effects of methamphetamine or cocaine) and synthetic cannabinoids (which mimic the effects of marijuana).

On April 11, 2016, the FMCSA responded to this recommendation, indicating that it would not expend resources to determine the prevalence of CMV driver use of synthetic cannabinoids because it believes there is no sound methodology for conducting such a study. Further, the FMCSA stated that study results are unnecessary, because it can begin working with stakeholders to develop a plan to discourage and reduce the use of impairing substances, including synthetic cannabinoids. The proposed plan entailed asking an existing subcommittee focused on developing a voluntary driver health and wellness program to “consider addressing the issue of CMV driver use of synthetic cannabinoids in the lifestyle choices segment.”⁷⁴ The wellness subcommittee was established by the FMCSA motor carrier safety and medical advisory committees.

The FMCSA’s intention to include a section on impairment within the driver health and wellness program does not satisfactorily address Safety Recommendation H-15-38. As evidenced by the limited research in this area, very little is known about the use of impairing substances among CMV drivers, especially for those substances that are not part of routine drug test procedures. Feasible methodologies are available to examine the prevalence of CMV driver drug use, as indicated by the examples discussed below. The NTSB continues to maintain that these data are needed to define the scope of the problem, to establish a baseline, to prioritize countermeasures, and to evaluate the effectiveness of countermeasures over time. The Chattanooga investigation provides yet another example of why it is important to determine the prevalence of CMV driver use of impairing substances. Therefore, the NTSB reiterates Safety Recommendation H-15-38 to the FMCSA and classifies it “Open—Unacceptable Response.”

Some organizations have already recognized the need to collect data on the prevalence of the use of impairing substances among CMV drivers. The FMCSA could benefit from lessons learned from these efforts. For example, in 2007, the Oregon State Police, in cooperation with law enforcement partners and the ODOT Motor Carrier Transportation Division, initiated “Operation Trucker Check” to improve transportation safety through detailed truck inspections and detection of impaired drivers (ODOT 2007a; 2007b). ODOT requested voluntary and anonymous urine samples from 491 drivers; only four drivers declined. The urine specimens of 9.65 percent of the drivers (47 of 487) tested positive in at least one drug category.⁷⁵ The ODOT study presents one approach to examining the prevalence of drug use among CMV drivers, though it was not designed to obtain a national representative sample.

In addition, SAMHSA has designed and developed a study protocol that could determine the incidence of various drugs in specimens collected in accordance with 49 *CFR* Part 40. The study protocol consists of testing de-identified specimens using an initial testing procedure at US Department of Health and Human Services (DHHS)-certified laboratories, performing

⁷⁴ This FMCSA program was described as addressing five areas: work conditions, diet and exercise, sleep and fatigue, personal injury, and lifestyle choices.

⁷⁵ The ODOT study reported the results for the following drug types: amphetamines, barbiturates, benzodiazepines, cocaine, cannabinoids, methadone, opiates, and propoxyphene.

confirmatory testing, and completing data analysis to determine the positive rates for each drug.⁷⁶

2.5 Drug Testing Program for Commercial Vehicle Operators

2.5.1 Truck Driver Drug Use History

In reviewing the truck driver's toxicology results from various sources—including a urine test, a hair test, and a postcrash blood test—NTSB investigators identified a pattern of drug use not identified by the DOT drug testing program (49 *CFR* Part 382), as outlined below:

- On July 22, 2013, the driver was involved in a minor crash while employed as a commercial driver. He was administered a 12-panel urine drug test postcrash.⁷⁷ This test was positive for oxymorphone (drug level not reported).⁷⁸
- On May 8, 2015—about 5 weeks before the Chattanooga crash—a hair drug test was performed on the driver as directed by court order for a matter unrelated to this investigation. The driver's hair tested positive for the metabolites of methamphetamine and amphetamine.
- Methamphetamine and amphetamine were found in a postcrash blood specimen obtained from the driver on June 25, 2015.⁷⁹

The DOT urine sample obtained on June 27 tested negative for methamphetamine and amphetamine; however, this test was conducted about 38 hours following the Chattanooga crash, and the drug may have left the urine by this time.⁸⁰ Postcrash, NTSB investigators found a partially empty bottle of a substance advertised as a cleanser in the truck among the driver's personal belongings.

2.5.2 Drug Testing Program Issues

The Office of the Secretary of Transportation manages the DOT drug and alcohol testing program for pre-employment, postaccident, random, reasonable suspicion, and return-to-duty testing. In accordance with 49 *CFR* Part 40, the FMCSA is responsible for compliance and enforcement of the drug and alcohol regulations for the CMV operators under its authority. The DOT program is based on urine testing and incorporates scientific and technical guidance

⁷⁶ The substances include codeine, morphine, and synthetic opiates. This information was obtained through personal communication with the director of the SAMHSA Center for Substance Abuse Prevention, Division of Workplace Programs, in May 2016.

⁷⁷ The driver's employer requested the drug test postcrash. It was a 12-panel test, not the five-panel test described in 49 *CFR* 40.85.

⁷⁸ According to the Drug Enforcement Administration, oxymorphone is an opioid and a Schedule II controlled substance (21 *CFR* 1308.12).

⁷⁹ The driver tested negative for barbiturates, cannabinoids, cocaine, and opiates.

⁸⁰ (a) The DOT test was also negative for 6-acetylmorphine, cocaine, marijuana, opiates, and PCP. (b) Dilution, adulteration, and substitution are methods used to defeat the drug testing program.

established by the DHHS.⁸¹ Its objective is to deter the use of illegal drugs regardless of the pattern and frequency of use.

The Government Accountability Office has reported that some CMV drivers avoid detection during random and postcrash DOT testing, and some have tested positive but continue to drive without completing the required return-to-duty process (GAO 2008). The GAO discusses several issues with the testing program, including the following:

- An unknown number of commercial drivers who use illegal drugs are not part of a drug testing program, which is attributed to limitations in FMCSA oversight resources (for existing carriers) and in enforcement options (when conducting safety audits of new carriers).
- An unknown number of drug users avoid detection even when they go through the testing process. This problem is attributed to the lack of compliance by collectors, inadequate FMCSA oversight of collectors, and availability of products for adulteration or substitution.
- Among the drivers who test positive, an unknown number continue to drive without completing the required return-to-duty process. This issue is associated with incomplete background checks by the motor carrier, drivers failing to report their drug testing history, and loopholes for self-employed drivers, among other factors.

2.5.3 Alternative Testing Methods

The DHHS establishes mandatory guidelines for the scientific and technical aspects of drug testing. It certifies laboratories, determines testing procedures, and determines the drugs for which to test (limited to Schedule I and Schedule II drugs under the Controlled Substances Act).⁸² The department is exploring alternative testing methods to address some of the issues with the current DOT drug testing program. For example, on May 15, 2015, the DHHS published a notice of proposed revisions to the mandatory guidelines to include oral fluid as an alternative specimen; oral fluid would be collected under observation, which would substantially lessen the risk of specimen substitution and adulteration.⁸³

The DHHS also established the SAMHSA drug testing advisory board to examine the “scientific supportability of the hair specimen” for federal workplace drug testing programs. Some companies currently use hair specimens, in addition to the DOT-required urine specimens, for pre-employment testing (TRB 2011). As reported by Pragst and Balikova (2006) and discussed in section 1.4.4.2, hair testing allows for a much longer window of detection. On

⁸¹ Executive Order No. 12564 (51 *FR* 32889, September 17, 1986) directed the DHHS to promulgate scientific and technical guidelines for drug-testing programs for federal employees. The Omnibus Transportation Employee Testing Act of 1991, Public Law 102-143, title V, October 28, 1991, required the Secretary of Transportation to incorporate the DHHS guidelines into the DOT drug testing procedures for its regulated industries.

⁸² Titles II and III, Comprehensive Drug and Abuse Prevention and Control Act of 1970 (Public Law 91-513, as amended through Public Law 114-154, enacted May 16, 2016).

⁸³ See 80 *FR* 28053, May 15, 2015, federalregister.gov/a/2015-11523.

May 29, 2015, the DHHS published a request for information regarding issues related to the collection, specimen preparation, analysis/cutoff, specimen validity, and initial and confirmatory testing of hair specimens.⁸⁴ In August 2015, following 2 years of study, the drug testing advisory board unanimously approved and issued the following recommendation: “Based on the review of the science, DTAB recommends that SAMHSA *pursue* [emphasis added] hair as an alternative specimen in the Mandatory Guidelines for Federal Workplace Drug Testing Programs, including performance standards that sufficiently address external contamination and hair color impact.” (SAMHSA 2015b)

2.5.4 Safety Recommendation

The Fixing America’s Surface Transportation (FAST) Act, section 5402, amends 49 *USC* 31306, requiring the DOT to permit motor carriers to use hair testing as an acceptable alternative to urine testing (1) in conducting pre-employment tests for the use of a controlled substance; and (2) in conducting random tests for the use of a controlled substance, if the operator had received pre-employment hair testing. Section 5402 of the FAST Act also states: “Not later than 1 year after the date of enactment of this Act, the Secretary of Health and Human Services shall issue scientific and technical guidelines for hair testing as a method of detecting the use of a controlled substance for purposes of section 31306 of title 49, United States Code.” Currently, there are no performance standards for hair testing; and the development and implementation of such standards may be delayed due to technical challenges and diverse stakeholder perspectives.

Hair testing may provide some benefits over current drug testing. It allows for a longer detection window—from days to months, and in some instances for up to a year. Hair testing could also have a stronger deterrent effect.⁸⁵ The TRB reports that a large transportation logistics company in the United States—which had been using hair testing for pre-employment—observed a 75 percent decrease in the rate of positive urine drug tests (TRB 2011). The NTSB concludes that had Cool Runnings Express used pre-employment hair drug tests, it would likely have identified the truck driver’s methamphetamine use. Therefore, the NTSB recommends that the FMCSA disseminate information to motor carriers about using hair testing as a method of detecting the use of controlled substances, under the appropriate circumstances.

2.6 Motor Carrier Pre-Employment Investigations and Inquiries

2.6.1 Truck Driver License History

According to CDLIS, the truck driver’s license record for the previous 5 years showed seven crashes (three in a CMV) and one violation (driving 16–25 mph over the speed limit).⁸⁶ This crash history was not known to Cool Runnings Express when it hired the driver. The motor

⁸⁴ See 80 *FR* 30689, May 29, 2015, federalregister.gov/a/2015-12743.

⁸⁵ As indicated in the FAST Act, hair testing is effective for pre-employment drug testing only (and random testing if the driver had been subject to a pre-employment hair drug test). Hair testing is not effective for reasonable suspicion drug tests because it cannot detect very recent drug use.

⁸⁶ Motor carriers can obtain CDLIS data by using a commercial company that provides a clearinghouse service or by contacting the state driver licensing agency.

carrier had obtained a 3-year driver motor vehicle record from the Kentucky Transportation Cabinet, as required by the FMCSRs. However, this record did not provide crash data. NTSB investigators interviewed the carrier and the legal advisor for the insurance company. Both representatives stated that if they had seen the complete driver motor vehicle record, the driver would have not been approved for hire. Following the multivehicle crash on I-75, the FMCSA declared the truck driver an “imminent hazard,” and the commonwealth of Kentucky suspended his CDL on July 21, 2015.⁸⁷

2.6.2 Pre-Employment Review

Title 49 *CFR* 391.23(a) requires a motor carrier to conduct investigations and inquiries with respect to each driver it employs. The carrier must obtain an applicant’s motor vehicle record for the preceding 3 years from the state in which the driver held or holds a CDL. Section 391.23 does not specifically define what must be included in the driver record. In contrast, the annual inquiry and driving record review process, described in 49 *CFR* 391.25, specifies what a motor carrier should consider in determining whether a driver meets minimum requirements for safe driving or is disqualified to drive a CMV. In particular, a motor carrier “must consider any evidence that the driver has violated any applicable Federal Motor Carrier Safety Regulations” and “must consider the driver’s accident record and any evidence that the driver has violated laws governing the operation of motor vehicles, and must give great weight to violations, such as speeding, reckless driving, and operating while under the influence of alcohol or drugs, that indicate that the driver has exhibited a disregard for the safety of the public.”

The carrier is also required to obtain the driver’s safety performance history with DOT-regulated employers for the preceding 3 years. At a minimum, the carrier must investigate accidents, alcohol and controlled substances violations, and rehabilitation efforts (49 *CFR* 382.605 or 49 *CFR* Part 40, subpart O), as applicable.⁸⁸

Title 49 *CFR* 383.35 requires prospective employers of CDL holders to obtain employment information for the 10 years preceding the date of the employment application. They are expected to report to the FMCSA failures of previous employers to respond to an investigation/inquiry and to keep a copy of such reports in the driver investigation file. Employers must document a good faith effort to obtain the required information.

To assist carriers in making more informed hiring decisions, the FMCSA implemented the Pre-Employment Screening Program (PSP) in May 2010.⁸⁹ It is a voluntary program that provides electronic access to a CDL holder’s 5-year crash and 3-year inspection history. The PSP

⁸⁷ The imminent hazard order was issued on July 19, 2015.

⁸⁸ Title 49 *CFR* 390.5 defines “accident” as a CMV crash involving a fatality, bodily injury to a person receiving medical treatment away from the crash scene, or disabling damage requiring the motor vehicle(s) to be transported from the scene.

⁸⁹ The Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users, Public Law 109-59, section 4117 (49 *USC* 31150), mandates the development of a system to make safety performance information electronically available for pre-employment screening.

data come from the MCMIS database and are updated about once a month. Motor carriers can access the PSP data for a fee, provided that they receive the driver's consent.⁹⁰

2.6.3 Historical Review of CMV Driver Record Issues

The NTSB has examined various issues related to the detection and compliance of problem CMV operators. In fact, many drivers are licensed despite unsafe driving records (NTSB 1980). As a result of a safety study on this subject, the NTSB issued Safety Recommendation H-80-20 to the FHWA, requesting that it:⁹¹

H-80-20

Define fully, in the Federal Motor Carrier Safety Regulations, the information that a motor carrier must request from an applicant driver's former employer(s) when making the investigations and inquiries required by the regulations.

The FHWA responded that it had no evidence that the information being transferred from one carrier to another was insufficient to determine if an applicant should be employed. Safety Recommendation H-80-20 is classified "Closed—Unacceptable Action."

Since then, the NTSB has investigated multiple crashes in which commercial driver licensing or employment history was at issue. In 2011, the NTSB investigated a crash in New York City in which the motor carrier did not have sufficient safety-related information prior to hiring drivers (NTSB 2012b). The investigation concluded that a 3-year driving history is insufficient to make an informed hiring decision and that the states could better assist carriers in identifying problem CMV drivers by providing a 10-year driving history. Consequently, the NTSB issued Safety Recommendations H-12-15 and -16 to the FMCSA, asking that it:

H-12-15

Revise 49 *Code of Federal Regulations* 391.23 to require that motor carriers obtain a 10-year driving history for all prospective commercial vehicle drivers.

H-12-16

Revise 49 *Code of Federal Regulations* 384.225 to require that states retain on the Commercial Driver's License Information System driver record all convictions, disqualifications, and other licensing actions for violations during the prior 10 years.

In responding to these recommendations in 2013, the FMCSA stated that the requirements of 49 *CFR* 383.35(c) and 49 *CFR* 391.23(a)(2) on the safety performance history of CDL holders, in combination with the voluntary PSP, provide effective means for carriers to prevent hiring high-risk drivers. The FMCSA indicated that a rulemaking on this topic would be

⁹⁰ See www.psp.fmcsa.dot.gov/psp/default.aspx, accessed June 28, 2016.

⁹¹ Safety Recommendation H-80-20 was issued to the FHWA, predecessor to the FMCSA.

inappropriate because it does not have data to quantify the safety benefits of a new requirement to review a 10-year driving history for non-CDL holders. The agency also reported that it was working on a plan for a national driver notification system to alert motor carriers of changes in the status of employee driver licenses. The Moving Ahead for Progress in the 21st Century Act, section 32303, includes a requirement to establish a driver record notification system.⁹²

In September 2015, the FMCSA issued a report to Congress on the national driver record notification system. According to the report, the FMCSA planned to publish a best practice guide in fiscal year 2016 and initiate a cost-benefit analysis of options; in 2017, it plans to consider issuing a corresponding notice of proposed rulemaking (FMCSA 2015). The FMCSA did not publish the guidance, nor has it initiated rulemaking. In April 2016, the FMCSA reiterated its position on Safety Recommendation H-12-15. This recommendation is classified “Closed—Unacceptable Action.”

Regarding Safety Recommendation H-12-16, the FMCSA stated that “the decision of how long to retain information about convictions, qualifications, and other licensing actions of CDL holders should be left to the discretion of the States once the minimum requirements of 49 *CFR* 384.225 have been satisfied.” The FMCSA mentioned that the states are required to retain this information for at least 3 years and to keep records for as long as needed to support enforcement of the convictions. In 2013, the NTSB classified Safety Recommendation H-12-16 “Open—Unacceptable Response.” In April 2016, the FMCSA reiterated its position, stating that it does not believe it is necessary to adopt a blanket requirement to retain all convictions for 10 years given the comprehensive list of convictions and provisions listed in the existing regulations. Safety Recommendation H-12-16 is classified “Closed—Unacceptable Action.”

In 2011, the NTSB investigated a crash in Miriam, Nevada, in which the accident driver failed to disclose all previous employers in his job application (NTSB 2012a). There is no means by which a motor carrier can verify the completeness of information provided by a driver applicant—which significantly affects its ability to conduct an effective pre-employment investigation. In this case, the 3-year driving history record for the truck driver was incomplete. In contrast, the CDLIS for that driver included information on multiple violations and 14 license suspensions. The NTSB concluded that requiring motor carriers to access the comprehensive driving history in CDLIS and the NDR is crucial to improving the evaluation of driver applicants. As result of the Miriam investigation, the NTSB issued Safety Recommendations H-12-54, -55, and -56 to the FMCSA, calling on the agency to:

H-12-54

Create a mechanism to gather and record commercial driving-related employment history information about all drivers who have a commercial driver’s license, and make this information available to all prospective motor carrier employers.

⁹² (a) Public Law 112-141, July 6, 2012. (b) The term “driver record notification system” refers to a system that automatically furnishes an employer with a report, generated by the appropriate state agency, on the change in status of an employee’s driver’s license due to a conviction for a moving violation, a failure to appear, an accident, a driver license suspension or revocation, or any other action taken against the driving privilege.

H-12-55

Using the mechanism developed in Safety Recommendation H-12-54, require motor carriers to conduct and document investigations into the employment records of prospective drivers for the 10 years that precede the application date.

H-12-56

Require motor carriers to retrieve records from the Commercial Driver's License Information System and the National Driver Register for all driver applicants so that they can obtain a complete driving and license history of prospective drivers.

The FMCSA responded in June 2013, acknowledging the NTSB concerns with regard to Safety Recommendations H-12-54 and -55, but maintaining that existing regulatory and nonregulatory alternatives provide adequate background information for motor carrier managers to make informed hiring decisions. For example, the agency stated that its PSP allows prospective employers to obtain a 5-year driver crash record and a 3-year roadside inspection violation history from MCMIS. The agency also mentioned that carriers could use private entities to conduct employment history and background investigations. Furthermore, the FMCSA stated that implementing these recommendations would divert its enforcement resources, which could be detrimental to safety. Because the FMCSA indicated no intent to implement either Safety Recommendation H-12-54 or -55, each is classified "Closed—Unacceptable Action."

For Safety Recommendation H-12-56, the FMCSA indicated that CDLIS and the NDR lack the functionality to provide motor carriers with complete driving and license histories for prospective CDL drivers. A CDLIS query, for example, directs the carrier to the state driver licensing agency it is already required to query. Again, because the FMCSA indicated no intent to take further action, Safety Recommendation H-12-56 is classified "Closed—Unacceptable Action."

2.6.4 Safety Recommendations

The NTSB maintains that motor carriers with access to comprehensive driving histories of applicants can identify risky CMV drivers and reduce the risk of CMV crashes. Research has shown that a driver's history of crash involvement or traffic violations is closely related to future crash risk (TRB 2004). Obtaining a driver motor vehicle record that includes driver status, license expiration, driving restrictions, violations, and crashes is critical during the pre-employment process to assess safety performance and potential risk.

In this crash investigation, the motor carrier obtained the applicant's 3-year driver license record from the Kentucky Transportation Cabinet, in accordance with the FMCSRs. However, the 3-year record provided no crash data. A review of driver records provided by the 50 states and the District of Columbia shows that Kentucky and Idaho are the only two jurisdictions that do not automatically provide crash data in the driver motor vehicle records available for employer review.⁹³ The NTSB concludes that the driver motor vehicle records provided for

⁹³ In both Kentucky and Idaho, a separate record request is required to obtain crash data.

employer review by both Kentucky and Idaho are insufficient because they do not automatically include crash data. In addition, the NTSB concludes that Cool Runnings Express did not have crash data for the truck driver, which limited its ability to assess his safety performance and potential risk. Thus, the NTSB recommends that the Kentucky Transportation Cabinet and the Idaho Transportation Department include driver status, license expiration, driving restrictions, violations, and crashes in the 3-year driver motor vehicle record.

Cool Runnings Express had obtained the driver's 3-year motor vehicle record, as required by 49 *CFR* 391.23(a). However, as noted earlier, section 391.23(a) does not specifically define what must be included in the motor vehicle record. Whereas, the annual inquiry and review process, described in 49 *CFR* 391.25, specifies that an employer should consider the driver's accident record; evidence of violation of the FMCSRs; and evidence of violation of laws governing the operation of motor vehicles, emphasizing speeding, reckless driving, and operating while under the influence of alcohol or drugs.

The NTSB concludes that the pre-employment review process can be improved by providing motor carriers with additional guidelines to determine whether a driver meets the minimum requirements for safe driving or is disqualified to drive a CMV consistent with the annual inquiry and review process. Therefore, the NTSB recommends that the FMCSA modify 49 *CFR* 391.23(a) to include the requirements described in 49 *CFR* 391.25(b)(2); that is, to specify that the motor carrier must (1) consider the driver's crash record; (2) consider any evidence that the driver has violated laws governing the operation of motor vehicles; and (3) give great weight to violations—such as speeding, reckless driving, and operating while under the influence of alcohol or drugs—that indicate the driver has exhibited a disregard for public safety.

The FMCSA has maintained that a motor carrier could use the PSP to make a more informed hiring decision. An FMCSA study on the safety and industry impacts of the PSP reviews data for 5,476 motor carriers that actively used the program during the analysis period (FMCSA 2013). The study compared the crash rate and the OOS rate for the 12 months before and after the start of using the PSP. Carriers not using the PSP were included as the control group, which numbered 424,943. The study found that both PSP and non-PSP groups experienced a reduction in crashes during the two analysis periods, which is consistent with the overall decrease in total CMV crashes during that time. However, motor carriers using the PSP experienced statistically significant improvements over the non-PSP group. When considering the aggregate data, motor carriers using the PSP to screen new employees lowered their crash rates by 8.0 percent and driver-related OOS rates by 17.2 percent, on average.

As reported in the study, 5,476 carriers were consistently using the PSP during each 12-month period. According to the FMCSA, however, 529,103 interstate motor carriers and intrastate hazardous materials carriers were actively operating in the United States in 2011 (FMCSA 2016a). In 2015, this number increased to 551,150. Using this information, the proportion of all motor carriers consistently using the PSP is estimated as 1 percent.

NTSB investigators examined the PSP record for the truck driver on May 13, 2016. PSP data originate from MCMIS and, therefore, are limited, and—in this case—inconsistent with CDLIS. For example, the PSP record shows only three FMCSA reportable crashes, including the Chattanooga crash. It does not include citation data for the driver except for the violations found

in the postcrash inspection. The PSP does not provide license status information, and there is no indication that the truck driver had been declared an “imminent hazard” or that Kentucky had suspended his CDL.

NTSB investigations have found that CDLIS is typically more detailed and comprehensive than the driver history supplied by the states. Although motor carriers are allowed to use a third party to access CDLIS and NDR records, many do not do so for pre-employment screening. The PSP provides a framework that could facilitate access to driving and employment history. However, the program data are limited to roadside inspection information, and only a small portion of motor carriers use the PSP. The NTSB concludes that the PSP is an effective, yet underutilized, tool to improve pre-employment reviews. Therefore, the NTSB recommends that the FMCSA evaluate motor carrier use of, and perspectives on, its PSP, and identify and address barriers affecting the use of the PSP, examining issues such as the value, accuracy, and timeliness of the information, and the cost of, and incentives for, using the program. The NTSB also recommends that the FMCSA collect and publish best practices for pre-employment investigations and inquiries within the trucking industry.

2.7 Work Zone Safety

2.7.1 Traffic Control and Speed Management

The crash occurred in the center lane of I-75 northbound, near MP 11.7 and adjacent to the gore area that separates the right lane and the entrance ramp from US-11. A traffic queue had developed as I-75 transitioned from three lanes to two. The left lane of the two-lane section was closed at MP 12.8 because of a TDOT pavement improvement project, at which point only one lane was available for northbound traffic. The posted speed limit was 65 mph for cars and 55 mph for trucks. About 1,530 feet north of the area of impact, at MP 12.0, the posted speed limit was 60 mph for all vehicles. According to NTSB analysis, the truck driver was traveling about 80 mph, 25 mph above the posted speed limit.

Special provisions in the construction contract included the use of law enforcement personnel. A THP vehicle was positioned in the median, near MP 12.2 just forward of the taper, to serve as a traffic-calming device. The THP has a policy to not occupy a travel lane while providing warning in a work zone. THP troopers are trained and certified in traffic incident management. There were no specific directives on law enforcement positioning to slow traffic to protect workers or the rear of the queue. As discussed earlier, the THP had not been present at the preconstruction conference for this work zone.⁹⁴

2.7.2 Trucks in Work Zone Crashes

According to FARS data, 3,541 fatal crashes involving at least one large truck occurred in 2014. Speeding (7.1 percent), distraction/inattention (6.2 percent), and impairment (3.9 percent) were the top three driver-related factors for large trucks in fatal crashes. From 2009

⁹⁴ The TDOT region 2 director of operations had neglected to invite the THP to the preconstruction conference. Although it was a routine function to extend this invitation, it had been overlooked because of the reassignment and retirement of key points of contact at both agencies.

to 2014, large truck occupant fatalities increased from 499 to 657 (TRB 2016). In 2014, 11.4 percent of all fatal crashes, 5 percent of all injury crashes, and 7.4 percent of all property-damage crashes involved at least one large truck. In contrast, 30.1 percent of work zone fatal crashes, 9.1 percent of work zone injury crashes, and 20.7 percent of work zone property-damage crashes involved at least one large truck (FMCSA 2016b, table 26).

2.7.3 Historical Review of Work Zone Crashes

The NTSB has investigated several multivehicle work zone crashes involving heavy vehicles. Less-than-optimal work zone traffic control devices, driver inattention, and driver fatigue contributed to a nine-fatal rear-end crash involving a heavy truck near Sutton, West Virginia (NTSB 1991). As a result of that investigation, the NTSB issued Safety Recommendation H-91-28 to the FHWA, urging it to:

H-91-28

Encourage the use of work zone safety devices and procedures, such as “rumble strips,” that alert the various senses.

The FHWA conducted a symposium on work zone traffic control, issued a report from the symposium, worked with the Strategic Highway Research Program to develop portable rumble strips, and stated that it would continue to encourage the development and implementation of devices that interact with the human senses (FHWA 1991). The FHWA also sponsored regional work zone safety workshops and pursued work zone safety topics with state highway departments through both meetings and correspondence. In 1992, the NTSB classified Safety Recommendation H-91-28 “Closed—Acceptable Action.”

In 2000, the NTSB investigated a fatal work zone collision between a truck-tractor semitrailer and a THP vehicle on I-40 near Jackson, Tennessee (NTSB 2002). The NTSB concluded that the lack of planning and coordination among TDOT, its contractors, and the THP contributed to the crash. As a result of this investigation, the NTSB issued Safety Recommendation H-02-5 to TDOT, calling on it to:

H-02-5

Conduct preconstruction conferences with all parties involved in a work zone project. As a result of such conferences, produce a written traffic control plan or project plan agreed to by all parties that defines the lines of authority and how traffic control and enforcement will be performed for all types of work zone configurations to be utilized.

TDOT has taken several actions to address this recommendation, including the following:

- Updates to *Circular Letter 105.06-03: Notification of Local Officials and Law Enforcement Regarding Construction Projects*, instructing TDOT staff to invite the THP and local law enforcement to preconstruction meetings on all interstate projects.
- Training for law enforcement personnel prior to work zone assignments.

- Distribution of a “flip book” reference guide.
- Emergency responder training for TDOT and TDP personnel.

In 2014, the NTSB classified Safety Recommendation H-02-5 “Closed—Acceptable Alternate Action.” *Circular Letter 105.06-01: Preconstruction Notices and Starting Notices*, revised October 2, 2015, directs that “The Highway Patrol and/or local law enforcement shall be invited to the preconstruction meeting on all projects on the interstate system.”

The NTSB recently investigated a crash in Cranbury, New Jersey, where a truck driver’s fatigue and speeding in a work zone were causal factors (NTSB 2015a). As a result of this investigation, the NTSB issued the following recommendation to the FHWA, requesting that it:

H-15-16

Amend the Manual on Uniform Traffic Control Devices “Guidance” for work zone projects on freeways and expressways to advise traffic engineers on the use of supplemental traffic control strategies and devices to mitigate crash events involving heavy commercial vehicles.

Safety Recommendation H-15-16 is classified “Open—Acceptable Response.”

The FHWA has indicated that it will “review Part 6 of the MUTCD to clarify or add provisions regarding freeway and expressway work zones and the possibility of queuing due to reduced capacity created by lane closures and the relative placement of the advance warning devices.” The proposed changes are to be included in the notice of proposed amendments for the next edition of the MUTCD, which has a tentative completion date of June 2018. The FHWA stated that it has issued or funded several publications on this subject, including the following.⁹⁵

- *Mitigating Work Zone Safety and Mobility Challenges Through Intelligent Transportation Systems: Case Studies* (FHWA 2014).
- *Safe Trucking Through Work Zones* (FHWA 2003).
- *Guidance for the Use of Temporary Rumble Strips in Work Zones* (ATSSA 2013).⁹⁶
- *Innovative End-of-Queue Warning System Reduces Crashes Up to 45%* (FHWA 2015).

Further, the FHWA smarter work zones initiative, promoted by its 2015–2016 Every Day Counts program, encourages project coordination and technology applications to improve safety and reduce travel delays. Some of the technologies highlighted include variable speed limit systems and dynamically managed work zone traffic based on real-time conditions.

⁹⁵ FHWA reports are available at www.ops.fhwa.dot.gov/wz/its, accessed July 20, 2016.

⁹⁶ This guidance was issued in September 2013. It examines the results of recent studies and provides guidelines on the use of temporary rumble strips in work zones. At least 22 states are known to have experience with portable reusable rumble strips.

On April 13, 2015, the FHWA, the FMCSA, and the CVSA conducted a national symposium on work zones and large trucks. Representatives from state departments of transportation, NHTSA, the American Association of State Highway and Transportation Officials, law enforcement, academia, and industry participated. The stakeholders developed a draft work plan with potential recommendations to improve work zone safety, including the following (FHWA–FMCSA–CVSA 2015):

- Identify best practices through optimal use of law enforcement and commercial trucking resources, assets, and personnel.
- Promote the use of work zone safety devices and strategies (truck-mounted attenuators, large truck ingress/egress signs and alert systems, and temporary/portable rumble strips).
- Determine technology solutions for work zone and large truck safety (back-of-queue advance warning systems, next generation real-time traveler information systems, roadside/connected vehicle/vehicle-to-infrastructure options, and onboard equipment options).
- Identify key research efforts that inform or affect work zone and large truck safety.
- Develop and conduct human factors research on effective strategies to reduce distracted driving and speed for drivers of large trucks and to alert motorists of work zones.
- Create a group to spur collaboration on a work zone and large truck safety initiative.
- Develop a communications and outreach plan to support symposium actions.

2.7.4 Safety Recommendations

2.7.4.1 Traffic Control Plan. TDOT had established procedures for executing impact analyses and developing transportation management plans (TDOT 2007). The Chattanooga work zone project included provisions for greater advance warning, end-of-queue protection, transportation management center monitoring, use of law enforcement personnel, increased inspections, training of personnel, and nighttime work.⁹⁷ The color, dimensions, selection, and placement of traffic control devices in the work zone met MUTCD requirements. The advance warning area had the minimum required 0.5-mile warning distance sign for the left lane closure. “ROAD WORK AHEAD” signs at 3 miles, 2 miles, 1 mile, 1,500 feet, and 500 feet supplemented the required warning distance signs. Overhead DMSs further supplemented the advance warning signs. TDOT special contract provisions required the additional warning distance for interstate lane closures and the use of queue trucks. The transition area had arrow boards to taper the traffic; and the taper distance was 780 feet, which exceeded the minimum distance required.

⁹⁷ See 23 *CFR* Part 630, subpart J, Work Zone Safety and Mobility, which establishes requirements and provides guidance for systematically addressing the safety and mobility impacts of work zones, and for developing strategies to help manage these impacts on all federal aid highway projects.

Although the TDOT traffic control plan included features beyond the minimum requirements established in the MUTCD, it could be improved by implementing speed management strategies to avoid sudden speed reduction and significant speed variance. The MUTCD, section 6C.01 (Temporary Traffic Control Plans), also indicates that temporary traffic control:

. . . should be designed so that vehicles can travel through the temporary traffic control zone with a speed limit reduction of no more than 10 mph. . . . Where restrictive features justify a speed reduction of more than 10 mph, additional driver notification should be provided. The speed limit should be stepped down in advance of the location requiring the lowest speed, and additional temporary traffic control warning devices should be used. (FHWA 2009)

The NTSB concludes that TDOT processes and procedures were consistent with the work zone safety and mobility requirements of 23 *CFR* Part 630, and its traffic control plan followed the requirements and most guidance in the MUTCD, but the agency and other state departments of transportation would benefit from additional FHWA guidance on the use of supplemental traffic control strategies and devices to mitigate crash events involving heavy commercial vehicles. Therefore, the NTSB reiterates Safety Recommendation H-15-16 to the FHWA.

2.7.4.2 Law Enforcement Personnel. The THP patrol car was located at MP 12.2. NTSB investigators were unable to determine whether a different positioning of law enforcement personnel within the work zone would have prevented the truck driver from speeding. However, the back of the queue is considered to be the most hazardous area in a work zone—and it is the location of many fatal rear-end crashes involving heavy trucks. ATSSA and the FHWA have issued a pocket guide on safe practices for law enforcement personnel operating in highway work zones, which includes guidance for establishing a presence function (ATSSA 2015).

The MUTCD typical application for stationary lane closure on a divided highway includes the following commentary: “Consider on the shoulder (or beyond the shoulder if practical) in between the second and third sign. The first warning sign will tell drivers to look for you and the work operation” (FHWA 2009, figure 6H-33). In the example, the third sign is “ROAD WORK 1 MILE,” and the second sign is “RIGHT LANE CLOSED ½ MILE.” Applying this suggested guidance to the Chattanooga work zone would have placed the patrol vehicle on the shoulder or on the roadside between the third and second signs, which were: “ROAD WORK 3 MILES AHEAD” and “ROAD WORK 2 MILES AHEAD.” Although this location was near the queue protection truck and would have been a more effective position from which to reduce speed variability and to observe the rear of the queue, it was more than 2 miles from the roadwork.

Law enforcement positioning should be a discussion item at preconstruction conferences. As discussed in section 2.7.3, TDOT Circular Letter 105.06-01 requires that law enforcement be invited to the preconstruction meeting on all projects on the interstate system. Additionally, TDOT Circular Letter 712.04-04, *Guidelines for Law Enforcement Use on TDOT Projects*, states, for example, that law enforcement personnel may be positioned on high-speed roadways in advance of traffic queues to alert approaching motorists of stopped traffic. Although TDOT has procedures and guidance in place with regard to law enforcement participation in preconference meetings and its function in work zone projects, the NTSB concludes that these

procedures were not followed. Therefore, the NTSB recommends that TDOT and the THP take steps to ensure that law enforcement personnel attend and participate in preconstruction conferences on work zone projects on the interstate system. The NTSB also recommends that TDOT and the THP establish requirements for their personnel to complete recurring training on law enforcement presence and control functions in highway work zones that follows such current guidance as the ATSSA–FHWA *Safety Practices for Law Enforcement Personnel Operating in Highway Work Zones: A Pocket Guide*.

3 Conclusions

3.1 Findings

1. None of the following were factors in the crash: (1) mechanical condition of any of the nine vehicles involved; (2) weather conditions; (3) visibility of the road hazard; (4) truck driver licensing; or (5) truck driver's medical condition, alcohol use, or distractions.
2. The emergency response to the crash was timely and adequate.
3. Multiple visual cues were available to warn the truck driver of the work zone and traffic conditions ahead.
4. The truck driver's operation of the combination vehicle through the work zone at 78–82 mph significantly hindered his ability to react in time to take evasive action to avoid vehicles at the back of the traffic queue and led to a more severe collision.
5. The truck driver did not respond to the slow-moving traffic or take evasive action to avoid the crash.
6. The truck driver did not take rest breaks as required by hours-of-service regulations; and he was likely experiencing fatigue-related performance decrements because of recent sleep restriction, insufficient sleep recovery, and amount of time awake and driving.
7. The truck driver had illegally used methamphetamine prior to the crash, and its effects degraded his driving performance.
8. Had Cool Runnings Express, Inc., used pre-employment hair drug tests, it would likely have identified the truck driver's methamphetamine use.
9. The driver motor vehicle records provided for employer review by both Kentucky and Idaho are insufficient because they do not automatically include crash data.
10. Cool Runnings Express, Inc., did not have crash data for the truck driver, which limited its ability to assess his safety performance and potential risk.
11. The pre-employment review process can be improved by providing motor carriers with additional guidelines to determine whether a driver meets the minimum requirements for safe driving or is disqualified to drive a commercial motor vehicle consistent with the annual inquiry and review process.
12. The Pre-Employment Screening Program is an effective, yet underutilized, tool to improve pre-employment reviews.
13. Tennessee Department of Transportation processes and procedures were consistent with the work zone safety and mobility requirements of 23 *Code of Federal Regulations* Part 630, and its traffic control plan followed the requirements and most guidance in the

Manual on Uniform Traffic Control Devices, but the agency and other state departments of transportation would benefit from additional Federal Highway Administration guidance on the use of supplemental traffic control strategies and devices to mitigate crash events involving heavy commercial vehicles.

14. Although the Tennessee Department of Transportation has procedures and guidance in place with regard to law enforcement participation in preconference meetings and its function in work zone projects, these procedures were not followed.

3.2 Probable Cause

The National Transportation Safety Board determines that the probable cause of the Chattanooga, Tennessee, crash was the truck driver's failure to respond to the slow-moving traffic within a work zone because of performance decrements likely associated with his fatigue and methamphetamine use. Contributing to the crash was the failure of the pre-employment screening process to identify driver risk factors. Contributing to the severity of the crash was the truck-tractor's high impact speed.

4 Recommendations

4.1 New Recommendations

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

To the Federal Motor Carrier Safety Administration:

Disseminate information to motor carriers about using hair testing as a method of detecting the use of controlled substances, under the appropriate circumstances. (H-16-8)

Modify 49 *Code of Federal Regulations (CFR)* 391.23(a) to include the requirements described in 49 *CFR* 391.25(b)(2); that is, to specify that the motor carrier must (1) consider the driver's crash record; (2) consider any evidence that the driver has violated laws governing the operation of motor vehicles; and (3) give great weight to violations—such as speeding, reckless driving, and operating while under the influence of alcohol or drugs—that indicate the driver has exhibited a disregard for public safety. (H-16-9)

Evaluate motor carrier use of, and perspectives on, your Pre-Employment Screening Program (PSP), and identify and address barriers affecting the use of the PSP, examining issues such as the value, accuracy, and timeliness of the information, and the cost of, and incentives for, using the program. (H-16-10)

Collect and publish best practices for pre-employment investigations and inquiries within the trucking industry. (H-16-11)

To the Kentucky Transportation Cabinet and the Idaho Transportation Department:

Include driver status, license expiration, driving restrictions, violations, and crashes in the 3-year driver motor vehicle record. (H-16-12)

To the Tennessee Department of Transportation and the Tennessee Highway Patrol:

Take steps to ensure that law enforcement personnel attend and participate in preconstruction conferences on work zone projects on the interstate system. (H-16-13)

Establish requirements for your personnel to complete recurring training on law enforcement presence and control functions in highway work zones that follows such current guidance as the American Traffic Safety Services Association–Federal Highway Administration *Safety Practices for Law Enforcement Personnel Operating in Highway Work Zones: A Pocket Guide*. (H-16-14)

4.2 Previously Issued Recommendation Reiterated in This Report

As a result of its investigation, the National Transportation Safety Board reiterates the following safety recommendation:

To the Federal Highway Administration:

Amend the *Manual on Uniform Traffic Control Devices* “Guidance” for work zone projects on freeways and expressways to advise traffic engineers on the use of supplemental traffic control strategies and devices to mitigate crash events involving heavy commercial vehicles. (H-15-16)

4.3 Previously Issued Recommendation Reiterated and Reclassified in This Report

As a result of its investigation, the National Transportation Safety Board reiterates and reclassifies Safety Recommendation H-15-38 from its current classification of “Open—Initial Response Received” to “Open—Unacceptable Response” in section 2.4.3 of this report:

To the Federal Motor Carrier Safety Administration:

Determine the prevalence of commercial motor vehicle driver use of impairing substances, particularly synthetic cannabinoids, and develop a plan to reduce the use of such substances. (H-15-38)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

CHRISTOPHER A. HART
Chairman

ROBERT L. SUMWALT
Member

T. BELLA DINH-ZARR
Vice Chairman

EARL F. WEENER
Member

Adopted: October 17, 2016

Vice Chairman Dinh-Zarr and Member Weener filed the following statements.

Notation 8730A: Multivehicle Work Zone Crash on Interstate 75, Chattanooga, TN, June 25, 2015**Vice Chairman T. Bella Dinh-Zarr, Concurring**

October 11, 2016

I concur with the findings, probable cause, and recommendations in this investigative report on the multivehicle work zone crash on Interstate 75. I commend the staff on their excellent work and submit this concurring statement.

This crash highlights NTSB's longstanding concerns regarding drug impairment involving heavy truck drivers. In 1990, the Board recognized that fatigue, alcohol and *other drugs* were a problem in heavy truck crashes and published a lengthy two volume study on this issue. The 1990 study examined 182 case summaries from crashes occurring over a one-year period in eight states, including Tennessee. The Board found 33 percent of the fatally injured heavy truck drivers in the study tested positive for alcohol and other drugs of abuse. Methamphetamine, as was present in the Chattanooga crash, was the fourth most prevalent drug. And stimulants, as a whole, were the most frequently identified drug class in the study. Unfortunately, this crash, once again, highlights that drug impairment involving drivers of heavy trucks still exists today and is one of the reasons that Ending Substance Impairment in Transportation is on the NTSB's Most Wanted List of Safety Improvements for 2016.

In addition to the recurring issue of drug impairment, I likewise find it concerning that the Board has seen this sort of highway crash time and time again, involving a driver who has been involved in a series of prior crashes and yet legally maintains a commercial driver's license (CDL). The Board, the highway staff, highway safety advocacy groups, and indeed safe truckers themselves are frustrated by the stalled Federal Motor Carrier Safety Administration (FMCSA) rulemakings on truck safety that could take some of these dangerous drivers off the road. While we must continue to put pressure on the Federal government to finally move forward with these rulemakings, as the Board does in its recommendations in this report, perhaps it is also time for us to look to the States to help head off these issues, before we reach this sad stage and it has to appear before the NTSB.

While this report did not address appropriateness or efficacy of licensing rules, perhaps it is time to think outside the box and look at crashes where we can do just that. A simple start to assist the States would be for the National Highway Traffic Safety Administration to add a question – “Do you have a CDL?” – to their current roadside survey. This question could help States start to gather the much needed data to implement change in licensing. As the Federal regulators are not adequately addressing these safety concerns, perhaps we can work with the States to redefine commercial driver licensing rules as another way to work to keep these dangerous drivers off the road. It seems clear that a driver, such as this accident driver, who had been involved in seven crashes, four of which occurred in commercial motor vehicles, should not be on the road in this type of vehicle. As we saw in this crash, the results are terrible and catastrophic.

Member Earl F. Weener
Concurring Statement
October 11, 2016

This circumstances leading up to this crash are very disturbing. Despite the thorough investigation of the staff, one critical question remains unanswered. Why did this driver possess a valid commercial driver's license (CDL)? While I appreciate the need for employers to screen potential applicants, the first step towards employment is possession of a CDL. The state driver licensing authority is responsible for screening applicants and ensuring their appropriateness for commercial vehicle operation. If the current licensing application and recertification processes are insufficient, that is an issue worthy of consideration by this Board. The unfortunate likelihood is that similar accidents will come before us. In those investigations, it is worth considering whether any other predictive behavior, such as drug-related criminal convictions or at-fault crash involvement, should impact a driver's license status. And, if so, we should look at how these behaviors can become connected to easily understood driver records.

Several key points were brought forth in the Board hearing. Fatigue and work-zone related crashes have become increasingly urgent issues in recent years. This report thoroughly explains the extreme fatigue that can result from the use of stimulants such as methamphetamine. While it is important to enforce hours-of-service regulations, even mandated rest breaks will do no good if intoxicants interrupt the body's natural need for or ability to get proper sleep. Therefore, I cannot over emphasize the importance of addressing drug impaired vehicle operation, particularly in large commercial vehicles that are passing through work zones. I believe that the driver's use of stimulants was both a cause of the crash and his fatigue.

As the Vice Chairman said, the causes of this accident are far from being new issues. For decades this Board has worked to address the serious problem of drug impaired driving in commercial and non-commercial drivers. A significant impediment to finding answers to this problem is the dearth of data regarding the use of impairing substances by the nation's commercial vehicle drivers. I agree with the Vice Chairman's point regarding the ability of NHTSA to add one or two questions to its existing Roadside Survey process. This is an excellent suggestion. Any data related to the use of impairing substances by drivers who hold CDLs will support other agencies attempting to address this serious issue.

As staff pointed out, the work zone safety measures employed by the State of Tennessee exceeded recommendations. In fact, Tennessee worked with the National Transportation Safety Board on our 1990 safety study regarding large trucks and crash causes. For decades safety stakeholders, like the State of Tennessee, have tried to reduce commercial vehicle involved crashes, struggled with the issue of drug and fatigued drivers and tried to strengthen work zone safety. I think that this Board must continue to explore new ideas to prevent crashes such as the use of haptic warnings for all drivers approaching work zones. While nothing may have worked to slow or stop the driver in this accident, the reality is that drivers impaired by distractions, medical conditions, drug use and fatigue and drugs are on the roads. Any actions that can be taken to intervene with these drivers before crashes occur should be considered.

I particularly appreciated staff's remarks regarding the importance of recorders. In aviation, we have seen the significant benefits that recorders can bring to an investigation. The data they provide has been employed by the NTSB to determine probable cause and make recommendations in numerous accidents. It is this type of scientific investigation that enables our mission to prevent accidents in every mode of transportation. Every year thousands die in commercial motor vehicle involved crashes. We need operators to use cameras and recorders in their vehicles to provide us with the information necessary to move commercial vehicle safety forward.

This accident is, at its core, about missed opportunities and unused information. Crashes like this one are foreseeable and preventable. They must also become unacceptable. Real change will require the cooperative efforts of licensing authorities, federal regulators, law enforcement, employers, vehicle manufacturers, operators, drivers and citizens. Driving, even in a large truck or bus, is too often seen as a routine activity instead of a complex activity with potentially deadly consequences. I hope that the facts and circumstances surrounding these events will be disseminated to every stakeholder so that they can understand the immediate need to take action.

Appendix A: Investigation

The National Transportation Safety Board (NTSB) received notification of this crash on June 26, 2015, and launched investigators to address human performance; motor carrier operations; onboard recorders; and highway, vehicle, and survival factors. The NTSB team also included staff from the Office of Research and Engineering and the Office of Safety Recommendations and Communications.

The Federal Motor Carrier Safety Administration, the Tennessee Department of Transportation, the Tennessee Highway Patrol, and the Chattanooga Police Department were parties to the investigation.

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