



# National Transportation Safety Board

## LESSONS LEARNED FROM NTSB BUS CRASH INVESTIGATIONS

Stephanie Shaw

Safety Advocate

Alabama School Transportation Association Conference

June 6, 2019

# OVERVIEW

- About us
- Ongoing investigations
- School bus occupant protection
- Report on school bus safety
  - Baltimore, MD & Chattanooga, TN crashes
- Other school transportation-related investigations
- Final thoughts

AVIATION



HIGHWAY



MARINE



RAILROAD



PIPELINE



## Our Mission

The NTSB is an independent Federal agency charged by Congress with **investigating** every civil aviation accident in the United States and significant accidents in the other modes of transportation – highway, marine, railroad and pipeline – and **issuing safety recommendations** aimed at preventing future accidents.

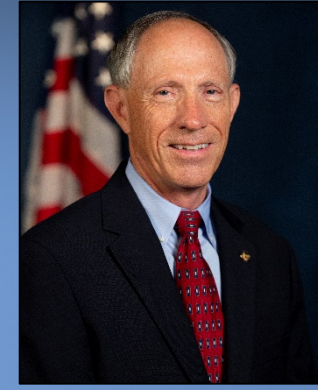
# BOARD MEMBERS AND STAFF

## 5 Board Members (1 vacant)

- Chairman Robert L. Sumwalt
  - Vice Chairman Bruce Landsberg
  - Earl F. Weener, Ph.D.
  - Jennifer Homendy
- 
- 400 staff (HQ, 4 Regional Offices, Training Center)



Chairman  
Robert Sumwalt



Vice Chairman  
Bruce Landsberg



Member  
Earl Weener



Member  
Jennifer Homendy

# OFFICE OF HIGHWAY SAFETY

- Total staff of about 30 - managers, investigators, writers, and support staff
- Crashes monitored 24-7 from NTSB's Response Operations Center
- Ready to "Launch" at a moment's notice



# NTSB INVESTIGATIONS

- NTSB's three teams of highway investigators launch to about 21 crashes per year
- Launch selection criteria
  - **High public interest?**
  - New or emerging issues?
  - Can we make a difference?
  - Do we have the resources?



# ASPECTS OF THE INVESTIGATION

- Human Performance
- Survival Factors
- Highway Factors
- Vehicle Factors



# TYPES OF HIGHWAY INVESTIGATIONS



Valhalla, NY 2/3/15



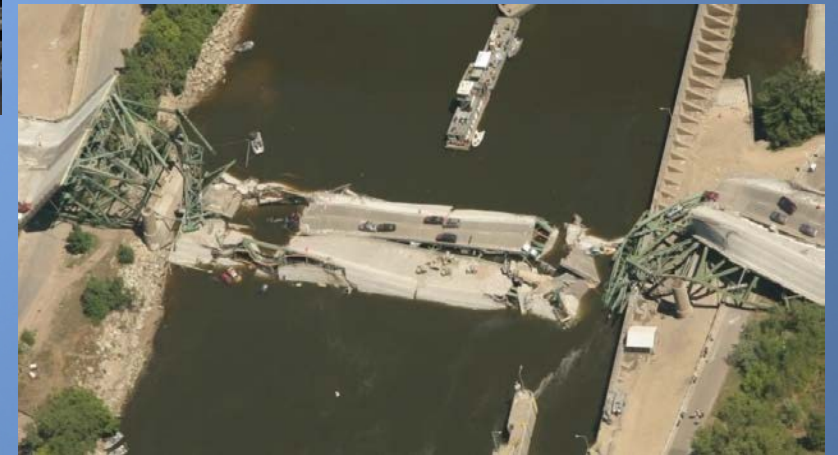
Gray Summit, MO 8/5/10



Williston, FL 5/7/16



Orland, CA 4/10/14

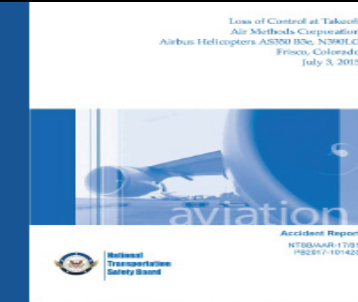


Minneapolis, MN 8/1/07





<p><b>Operator Does Business As:</b> Trans-Pacific Jets</p> <p><b>Weatherological Information and Flight Plans</b></p> <p><b>Altitude at Accident Site:</b> Visual Conditions</p> <p><b>Location Facility, Elevation:</b> TLR, 8 ft and</p> <p><b>Distance from Accident Site:</b> 1 Statistical Miles</p> <p><b>Wind Cloud Conditions:</b> Scattered / 4500 ft agl</p> <p><b>Alt Ceiling:</b> None</p> <p><b>Water Setting:</b> 26.75 inches Hg</p> <p><b>Pressure Point:</b> Philadelphia, PA (PHL)</p> <p><b>Package and Impact Information</b></p> <p><b>Injuries:</b> 2 Fatal</p> <p><b>Engine Injuries:</b> N/A</p> <p><b>Wing Injuries:</b> N/A</p> <p><b>Other Injuries:</b> 2 Fatal</p> <p><b>Administrative Information</b></p> <p><b>Investigator in Charge (IC):</b> James P. Millman</p> <p><b>Other Participating Persons:</b> Dennis Brown, Teterboro FSDO, Teterboro, NJ Michael Lewis, Southfield, Hazelwood, DC David Stults, Houston, Houston, TX</p>	<p><b>Aircraft Category:</b> Jet</p> <p><b>Manufacturer:</b> Airbus Helicopters</p> <p><b>Model:</b> AS350 B3e</p> <p><b>Operator Designation:</b> Air Carrier Operator Certificate</p> <p><b>Condition of Light:</b> Observation Time</p> <p><b>Temperature/Deviation:</b> Wind Speed/Dir</p> <p><b>Direction:</b> Visibility</p> <p><b>Type of Flight Plan:</b> Destination:</p> <p><b>Aircraft Damage:</b></p> <p><b>Aircraft Part:</b></p> <p><b>Aircraft Explosions:</b></p> <p><b>Latitude, Longitude:</b></p>
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**On-scene Investigation**

**Preliminary Report**

**Public Hearing**

**Board Meeting**

**Final Report**

## NTSB process at a glance

Organizational meeting

Groups & parties

Progress meetings

Media briefings

Press releases

Factual information

Fact finding

Depositions

Witnesses

Docket

Docket

Findings

Conclusions

Probable cause

Safety recommendations

**NTSB**

**GOVERNMENT IN THE SUNSHINE ACT**

# BOARD MEETING

- Public meeting in Washington, DC
- Webcast
- Staff presentations
- Board member deliberations
- Official adoption of:
  - Report
  - Findings
  - Probable cause
  - Safety recommendations



# NTSB SAFETY RECOMMENDATIONS

- Safety recommendations are the Board's most important product
- Developed to remedy system, hardware, operational or policy failures identified during investigations or safety studies

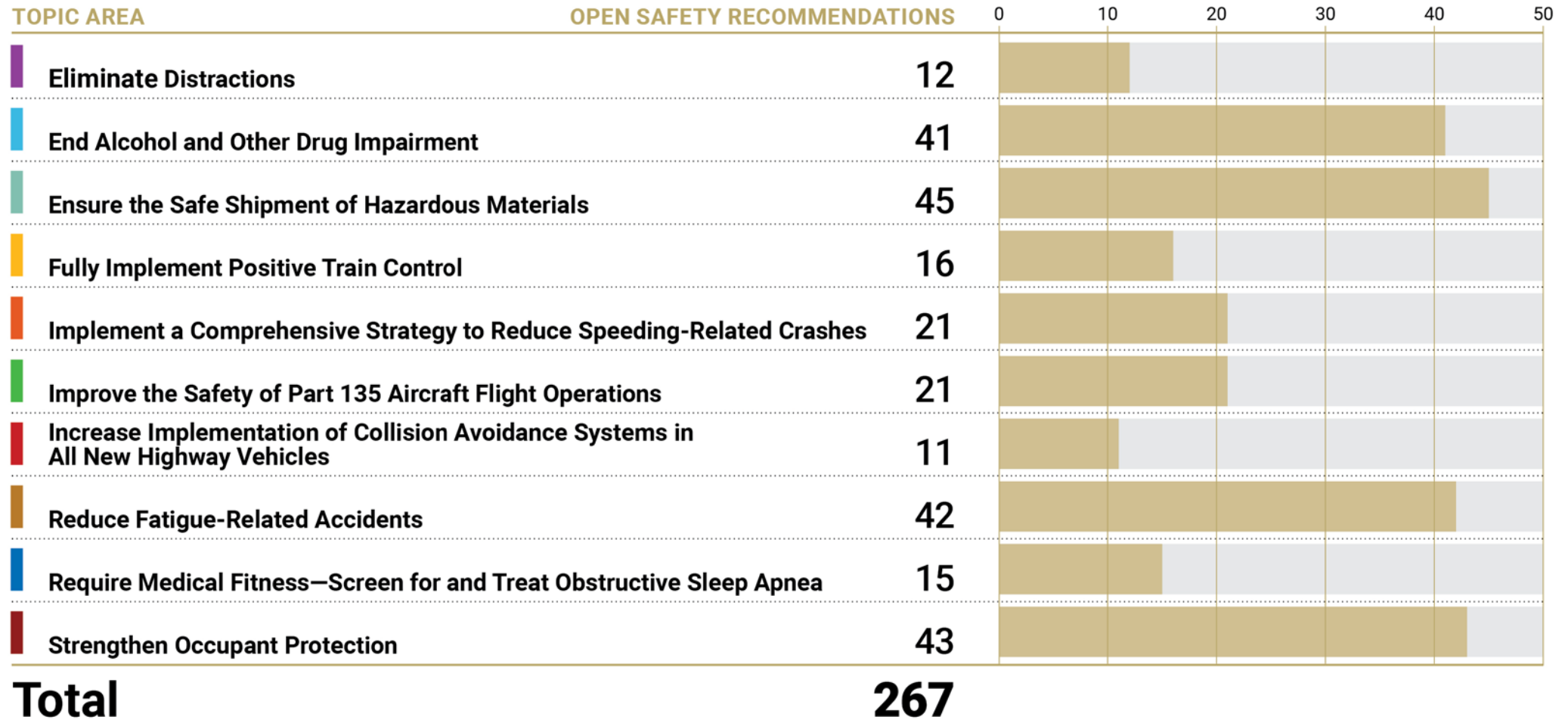


“These safety recommendations, if acted upon, would prevent future tragedies similar to these.”



- Increase Implementation of Collision Avoidance Systems in All New Highway Vehicles
- Ensure the Safe Shipment of Hazardous Materials
- Improve the Safety of Part 135 Aircraft Flight Operations
- Strengthen Occupant Protection
- Implement a Comprehensive Strategy to Reduce Speeding-Related Crashes
- Eliminate Distractions
- Reduce Fatigue-Related Accidents
- End Alcohol and Other Drug Impairment
- Require Medical Fitness – Screen for and Treat Obstructive Sleep Apnea
- Fully Implement Positive Train Control
- Improve the Safety of Part 135 Aircraft Flight Operations

# Summary Table of 2019–2020 MWL-associated Open Safety Recommendations (as of December 11, 2018)



# RECENT NTSB INVESTIGATIONS



# ONGOING: OAKLAND, IOWA

- December 12, 2017 about 6:52 a.m.
- 2004 International school bus
  - 74 year-old driver
  - 16 year-old passenger
- 2 fatal



# ONGOING: MESQUITE, TEXAS

- October 3, 2018 about 3:56 p.m.
- 2019 IC Bus (lap/shoulder belts)
- Run-off-road, rollover with postcrash fire



Source: Star Telegram



# NTSB BOARD MEETING

## Fatal Oakland, Iowa, School Bus Fire

Tuesday, June 18, 2019, 9:30 a.m. (EDT)  
NTSB Boardroom and Conference Center  
420 10th St., SW, Washington, DC

The public meeting will also be webcast  
at <http://ntsb.windrosemedia.com/>.

The public docket for this investigation is available from the  
NTSB website at <https://go.usa.gov/xmVnE>.

# NTSB INVESTIGATIONS OF SEAT BELT-EQUIPPED SCHOOL BUSES



Central Bridge, NY - 1999



Conasauga, TN - 2000



Milton, FL - 2008



Chesterfield, NJ - 2012



Port Saint Lucie, FL - 2012



Anaheim, CA - 2014

# ANAHEIM, CALIFORNIA

- April 24, 2014, about 3:37 p.m.
- School bus departed roadway at about 43 mph, struck pole and trees climbing a ~30 degree embankment
- Partial roll onto embankment, sliding/lateral impact
- 5 serious injuries, including driver, 5 minor, 2 uninjured
- Lap/shoulder belts
- On-board video



# NTSB SCHOOL BUS SAFETY VIDEO

Available on the NTSB YouTube channel  
<https://www.youtube.com/watch?v=ksw67zFnuAE>

# SAFETY RECOMMENDATIONS

To NAPT, NASDPT, NSTA:

Inform drivers of the importance of their health for safe transportation, their responsibility to report health history, and the legal consequences of dishonesty on medical examination reports (H-16-7)

# REITERATED SAFETY RECOMMENDATIONS

To FMCSA:

Develop a comprehensive medical oversight program, including specific guidance for medical examiners (reiterating H-01-20)

To the State of California:

Develop a handout for parents and students regarding the proper use of belts; and develop training procedures to show students how to wear belts properly (reiterating H-13-32)

To NASDPTS:

Encourage members to ensure that on-board video systems have the appropriate view and are functioning properly (reiterating H-15-2)

To NAAPT, NASDPT, NSTA:

Provide members with educational materials on the benefits of lap/shoulder belts, and advise them to consider the safety benefit when purchasing belt-equipped buses (reiterating H-13-36)

# HELENA, MONTANA

- November 27, 2017, about 7:13 a.m.
- 2011 Chevrolet Express school bus (lap/shoulder belt equipped)
- Helena School District (driver, adult aide, 3 students all belted)
- Stop sign intersection, left side impact



Source: Independent Record

# SPECIAL INVESTIGATION REPORT: SELECTIVE ISSUES IN SCHOOL BUS TRANSPORTATION SAFETY

## Crashes in Baltimore, Maryland and Chattanooga, Tennessee





Crashes shared one common factor:

*Poor driver oversight by both the school districts  
and the contracted carriers*

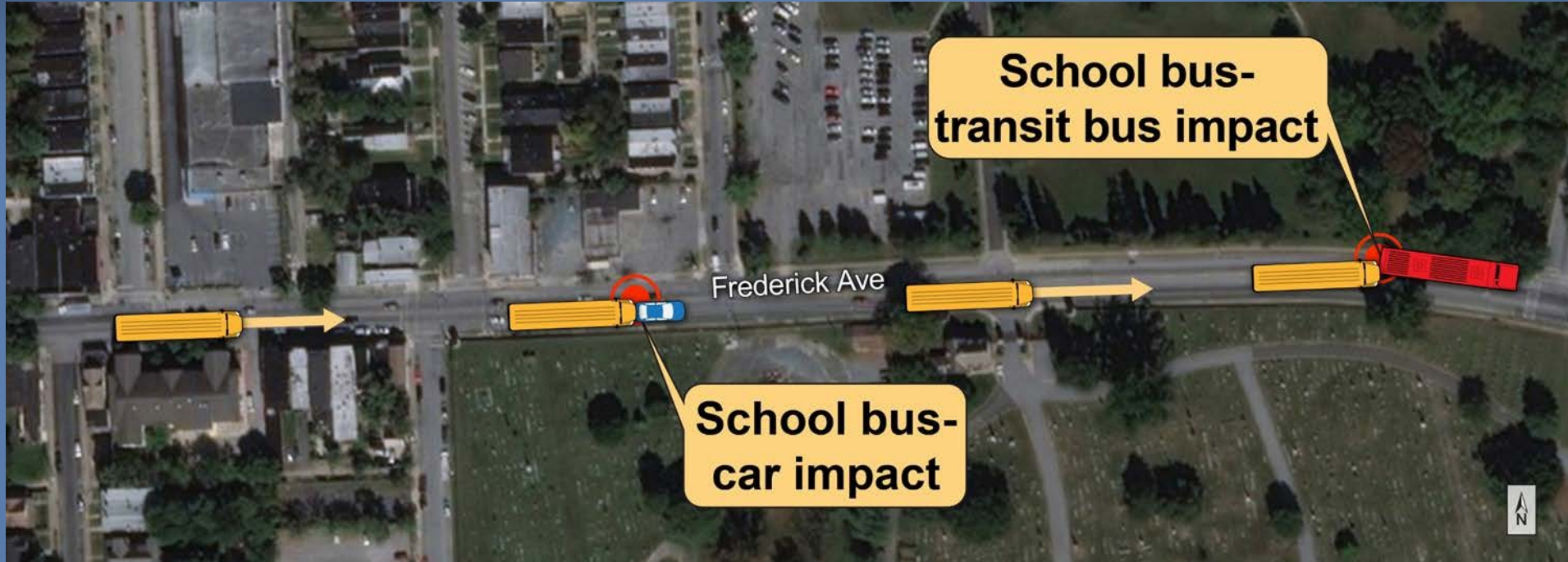
# SAFETY ISSUES

- School districts' lack of oversight of student transportation providers (Baltimore, Chattanooga)
- Poor management of unsafe school bus drivers by the motor carriers and school districts (Baltimore, Chattanooga)
- Medically unfit school bus drivers (Baltimore)
- Commercial driver license fraud (Baltimore)
- Occupant protection (Chattanooga)
- Benefits of ESC, AEB and event data recorders (Baltimore, Chattanooga)

# BALTIMORE, MARYLAND

- November 1, 2016, 6:30 a.m.
- 2015 IC school bus
  - 67-year-old driver, bus aide
- 2012 Ford Mustang
  - 51-year-old driver
- 2005 New Flyer transit bus
  - 33-year-old driver,  
13 passengers





# CRASH SCENE & INJURY INFORMATION



Source: Maryland Transportation Authority Police



Source: Maryland Transportation Authority Police

- **Fatalities** (2 bus drivers, 4 transit passengers)
- **Serious injuries** (5 transit passengers)
- **Minor injuries** (school bus attendant, 4 transit passengers, car driver)

# BALTIMORE SCHOOL BUS DRIVER

- Seizures since childhood
  - Sudden, unpredictable, neurologic episodes
  - Loss of consciousness, uncontrolled movements
- Incapacitated by a seizure led to crash
- Denied seizures to get medical card
- Fraudulently obtained CDLs
- Additional effort needed to increase referral of medically unfit drivers to MVA

# AAAFORDABLE TRANSPORTATION

- Hired in May 2014 (left in April 2016)
- Reliable Transportation April–May 2016
  - Staff witnessed seizure
- AAAfordable rehired driver in August 2016
  - No background check
- Had seizure October 24 (1 week prior to crash)
  - Witnessed by dispatcher and co-workers (**no one reported the incident**)
- Dispatched for 5 days until crash without doctor's release

# BALTIMORE CITY PUBLIC SCHOOLS (BCPS)

- Heavily involved with daily operations
- Maintained all documentation
- 2008–2016 driver worked for 5 contractors
- 5 school bus crashes
  - October 2011 “*passed out*”
  - No followup or action taken



# AAAFORDABLE & BCPS OVERSIGHT

- AAAffordable allowed medically unfit driver to operate school bus
- BCPS failed to recognize driver high risk
  - Failed to follow its own SOPs
  - Crash reports incomplete
  - Lacked threshold for crashes
  - Failed to follow COMAR

# EARLY SAFETY RECOMMENDATIONS

## To the Baltimore City Public Schools:

Request that the Maryland State Department of Education have an independent and neutral third party conduct a performance audit of your transportation department that includes a review of crash reports and of disqualifying conditions for school bus drivers under *Code of Maryland Regulations* section 13A.06.07.07. (H-17-013)  
(Urgent)

# EARLY SAFETY RECOMMENDATIONS

## To the Baltimore City Public Schools:

- As soon as the performance audit referenced in Safety Recommendation H-17-13 is complete, take the corrective actions recommended to improve internal controls and ensure that all school bus drivers meet the qualification standards under *Code of Maryland Regulations* sections 13A.06.07.06–.07 and that they do not pose any safety risks. (H-17-14)

## To the Maryland State Department of Education:

- Review and modify the *Code of Maryland Regulations* section 13A.06.07.07, “School Vehicle Driver Disqualifying Conditions and Termination,” to clarify the definitions of disqualifying conditions, and to require notification to the Maryland cation of all drivers who are determined to be not qualified during pre-employment screening. (H-17-15)

# CHATTANOOGA, TENNESSEE



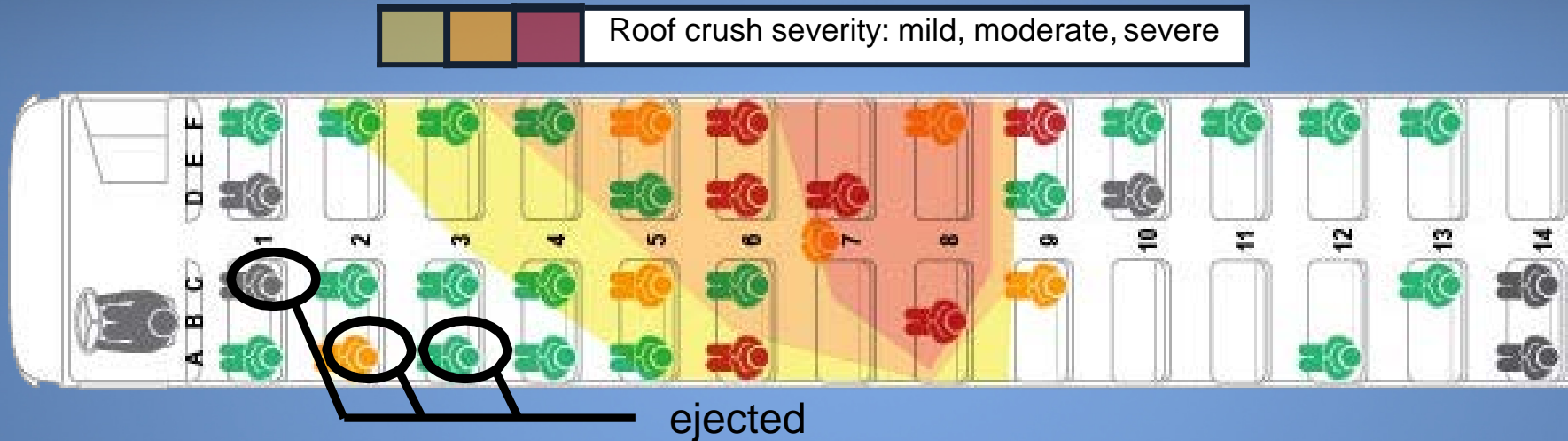
- November 21, 2016
- Single-vehicle school bus crash, rolled onto right side, impacted tree
- 2008 Thomas Built school bus
  - 24-year-old driver
  - 37 students
- 6 students killed, 26 serious to minor injuries
- School bus equipped with multiple systems capable of recording and transmitting event-related data

# VIDEO ANALYSIS, CRASH SIMULATION

- Bus at 52 mph
- 30-mph speed limit zone
- On cell phone
- Excessive speed resulted in loss of control



# CHATTANOOGA SCHOOL BUS



Injury severity: fatal (red), serious (orange), minor (green), none (gray)

37 passengers: 6 fatal, 6 serious, 20 minor, 5 uninjured

# CHATTANOOGA SCHOOL BUS DRIVER

- Driver experience
  - Hired in 2016, had driven few weeks total before crash
- Job performance
  - Previous crashes, numerous complaints

Date	Complaint	Source
August 11	Speeding	Durham School Services
August 12	Speeding	Durham School Services
August 18	Crash in bus (not reported)	Durham School Services
September 20	Crash in bus	Durham School Services
September 28	Intentionally makes students fall by erratic driving	Woodmore Elementary School (parents)
October 27	Speeding	Durham School Services
October 28	Speeding	Durham School Services
November 8	Speeding	Durham School Services
November 16	Erratic driving	Woodmore Elementary School (students)
November 18	Speeding	Woodmore Elementary School (principal)

# CHATTANOOGA OVERSIGHT

- Hamilton County Dept. of Education
  - Contracted Durham but had limited oversight
  - Forwarded all complaints to Durham
- Durham School Services
  - Lacked systematic complaint tracking
  - Failed to provide adequate driver oversight
- Durham and Hamilton County School District
  - Lack of documentation and resolution
  - Failed to remove unsafe driver



# CRASH PREVENTION TECHNOLOGIES

In both the Baltimore and Chattanooga investigations we determined that crash prevention technologies could have assisted the drivers and could have mitigated or prevented these crashes.

# BALTIMORE CRASH PREVENTION

- Collision avoidance systems mitigate or prevent crashes by detecting vehicles ahead
- Automatic emergency braking intervenes regardless of driver vigilance
- *With CAS and AEB, the school buses impact with the transit bus would not have occurred*



# CHATTANOOGA CRASH PREVENTION

- Electronic stability control evaluates and intervenes in loss of control events and ensures automatic emergency braking benefits
- 2015 FMVSS 136
  - **excludes school buses**
- 2017 Canadian CMVSS
  - **includes school buses**
- *ESC could have assisted in maintaining control & mitigated crash severity*



# SPECIAL INVESTIGATION REPORT: SAFETY RECOMMENDATIONS

- 16 new safety recommendations
- 7 reiterated safety recommendations
- Issued to FMCSA, NHTSA, states, manufacturers, medical professionals, NASDPTS, NAAPT, NSTA, ASBC related to:
  - Driver oversight
  - Driver licensing and qualifications
  - Collision avoidance technology
  - Event data recorders
  - Occupant protection
  - Medical conditions and reporting

# POSITIVE ACTIONS

- Code of Maryland Regulations modified
- Durham and National Express
  - Improved driver monitoring (camera systems, training)
  - Database for complaint resolution
- Tennessee
  - Law enacted for oversight of contracted transportation service providers by local education authorities and school districts
  - Annual training for transportation supervisors
  - Formal policy for bus safety complaint resolution
- Some states, school districts have enacted legislation requiring lap/shoulder belts on new buses and others have pending legislation

# OTHER SCHOOL TRANSPORTATION- AND BUS-RELATED INVESTIGATIONS

# ORLAND, CALIFORNIA

- April 10, 2014, about 5:40 p.m.
- 2014 Sentra motorcoach (lap/shoulder belt equipped)
- 2007 Volvo truck-tractor double trailer
- Truck and motorcoach driver and 8 motorcoach passengers died
- Passengers were not wearing available seat belts at the time of the crash



Truck-Tractor Double Trailer Median Crossover  
Collision with Motorcoach and Postcrash Fire  
Orland, California  
April 10, 2014

Simulation available on the NTSB YouTube  
channel

<https://www.youtube.com/watch?v=j0Zjx9Qiybl>



# DAVIS, OKLAHOMA

- September 26, 2014, about 9:05 p.m.
- 2013 Peterbilt truck-tractor combination unit
- 2008 Champion medium-size bus (lap belt equipped)
- 4 bus passengers died
- All 15 bus passengers were not wearing available seat belts at the time of the crash

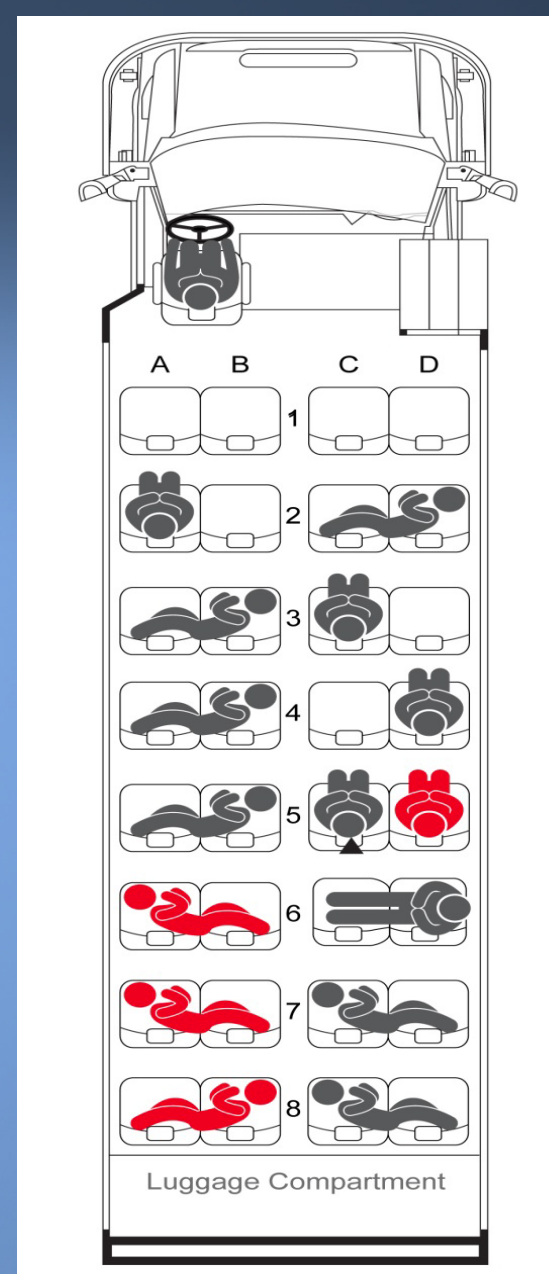


Truck-Tractor Semitrailer  
Median Crossover Collision with  
Medium-Size Bus on Interstate  
Davis, Oklahoma  
September 26, 2014

Simulation available on the NTSB YouTube channel  
[https://www.youtube.com/watch?v=MGdFz\\_V5EwI](https://www.youtube.com/watch?v=MGdFz_V5EwI)

# SEATING CHART

- Medium-size buses
  - No federal requirements for:
    - Roof strength
    - Sidewall structure
    - Window retention
    - Occupant protection



# CONCAN, TEXAS

- March 29, 2017, about 12:20 p.m.
- 2007 Dodge Ram 3500 pickup truck
- 2004 Ford E350 Turtle Top Van Terra medium-size bus (lap/shoulder and lap belt equipped)
- The bus driver and 12 passengers died



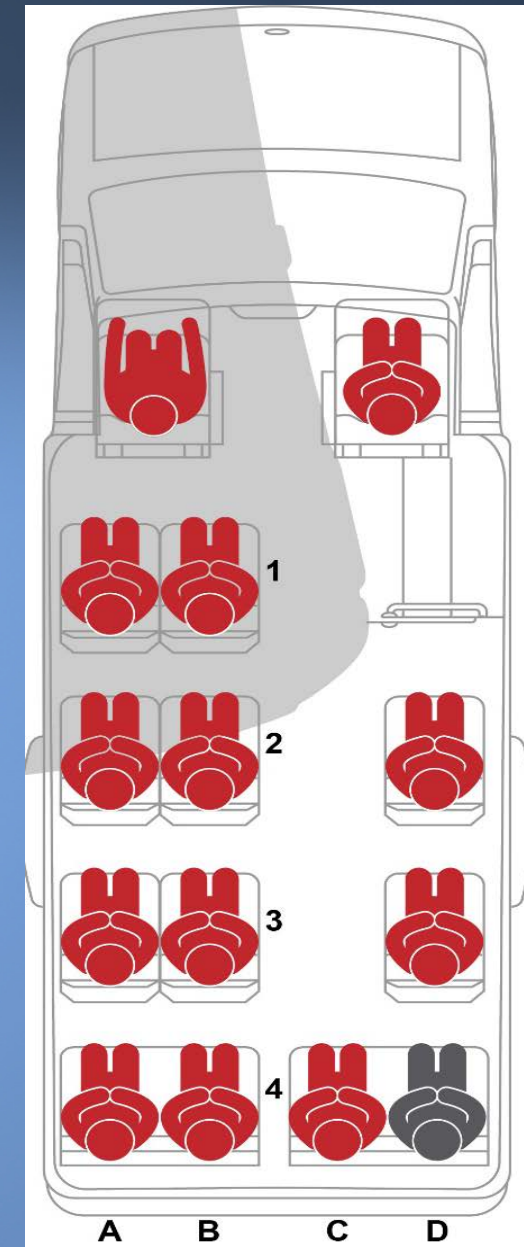
Source: Texas Department of Public Safety

Witness Video  
Pickup Truck Centerline Crossover Collision  
with Medium-Size Bus on US Highway 83  
Concan, Texas  
March 29, 2017

Video available on NTSB YouTube channel  
<https://www.youtube.com/watch?v=jsGsbYTwwbM>

# OCCUPANT INJURIES

- Lap/shoulder belts worn by driver and front passenger
- Lap belts worn by bus passengers
- Intrusion zone: blunt force trauma
- Outside intrusion zone: head, neck, abdomen, and pelvis injuries
- Severe injuries due to upper body flailing



# LOXLEY, ALABAMA

- March 13, 2018
- Motorcoach roadway departure and crash into ravine
- Transporting high school students on a return trip to Houston from Disney World in Orlando, Florida
- 1 fatality and 46 injuries



# LOXLEY, ALABAMA

- 56-passenger motorcoach equipped with lap/shoulder belts



*44 of the passenger belts showed no evidence of use*





# NTSB SCHOOL BUS SAFETY WEB PAGE

www.nts.gov/schoolbuses

NATIONAL TRANSPORTATION SAFETY BOARD

HOME NEWS & EVENTS SAFETY ADVOCACY INVESTIGATIONS DISASTER ASSISTANCE LEGAL ABOUT SEARCH NEW PUBLICATIONS

NTSB School Bus Safety

Every day across the country, nearly 500,000 buses carry more than 25 million students to and from school and activities.

School buses are the safest vehicles on the road, and one of the safest modes of transportation overall. In fact, children are much safer traveling in school buses than in any other vehicle, whether they're going to or from school, a field trip, or a sporting event. They're even safer riding in a school bus than in a car with their parents.

School buses use a unique technology called compartmentalization—a energy-absorbing steel inner structure and high, padded seat backs, are secured to the school bus floor. Students are protected within the seating compartment much like eggs in a carton.

Although school buses are extremely safe, we have investigated school bus crashes in which children were injured and even killed. These were typically side-impact crashes or high-speed rollovers. In these accidents, compartmentalization was not enough to prevent all injuries; for some of the children involved, a seat belt could have lessened their injuries or even saved their lives. As a result of our school bus crash investigations, we believe—and have recommended—that, when investing in new school buses, the purchased vehicles should provide children with the best protection available, which includes 3-point seat belts.

Below are school bus safety resources and our investigation reports of school bus crashes involving both seat belted and non-belted passengers.

School Bus Safety Video

NTSB Presents - School Bus Safety

School Bus Crash Animations (NTSB YouTube Channel)

Recent Investigations:

- Rochester, IN
- Chattanooga, TN
- Baltimore, MD

Summary Documents:

- Anaheim, CA
- Chesterfield, NJ
- Gray Summit, MO

Related School Bus Crash Briefs/Reports:

- Thief River Falls, MN - HWY17SH002
- Special Investigation Report: Pedestrian Safety
- Special Investigation Report: Selective Issues in School Bus Transportation Safety: Crashes in Baltimore, Maryland, and Chattanooga, Tennessee
- Anaheim, CA - HWY14EH010
- Chesterfield, NJ - HWY12MH007
- Knoxville, TN - HWY15FH002

NATIONAL TRANSPORTATION SAFETY BOARD

NTSB Highway Report Summary

Anaheim, California: School Bus Single-Vehicle Crash

Proper use of lap/shoulder belts on the school bus reduced passenger injuries.

WHAT HAPPENED: A 24-year-old male school bus driver was in the process of completing his afternoon route driving middle school-aged children home from school when he lost consciousness as a result of a medical condition. The unconscious driver lost control of the school bus on a downhill graded and leftward curving roadway in a 35-mile per hour zone. The school bus departed the roadway to the right at a video estimated speed of 43-miles per hour. The school bus then mounted the curb, where it struck and dislodged a concrete light post. The bus continued up the embankment where the front of the bus struck and uprooted a tree. The bus also scraped along a large tree on the left side of the bus from the front axle backward to the rear axle. The bus came to rest at an angle on the embankment, leaning onto the large tree. The tree caused extensive intrusion into the school bus especially in the region near the left side emergency exit door.

LOCATION
Anaheim, California

DATE, TIME
April 24, 2014 / 3:37 pm

VEHICLE(S)
2012 Bluebird 78-passenger School Bus

FATALITIES / INJURIES / EJECTIONS
0 Fatal
5 Serious, 5 Minor, 2 Uninjured
0 Ejections

MAIN FINDINGS: In addition to passenger lap/shoulder belts, the school bus was also equipped with a continuous audio and video recording system. The videos showed that the driver was not wearing his seat belt at the time of the crash and that about three-fourths of the students visible in the recordings were wearing the lap/shoulder belts while the bus was in motion. Importantly, two students seated in the area of maximum crush were wearing their seatbelts at the time of the crash. An occupant kinematics simulation study characterized potential outcomes for these two students comparing three simulated configurations: unbelted, lap-only belted, and lap/shoulder belted.

PROBABLE CAUSE: The probable cause of the crash was the driver's loss of consciousness, resulting in his loss of control of the school bus, which departed the roadway and collided with a light pole and trees. Reducing the severity of passenger injuries in the area of maximum intrusion was the proper use of the available lap/shoulder belts by the student passengers seated in this area.

You should know:

Injuries were reduced in the area of maximum intrusion because students wore the passenger lap/shoulder belts properly.

Lap/shoulder belts provide the highest level of protection for school bus passengers; states and school districts should consider lap/shoulder belts when purchasing seat belt-equipped school buses.

Students and parents should be educated about the importance of the proper use of all seat belts on school buses.

Any onboard video system in a school bus should provide visibility of the driver and of each occupant seating location and visibility forward of the vehicle.

The full report can be found at: <http://www.nts.gov/schoolbuses>

# LESSONS LEARNED

- School buses are still *the safest* means of transportation to and from school
- There is always room for improvement, and more can be done
- Safety recommendations can benefit everyone, not just the recipient

*From tragedy we draw knowledge to improve the safety of us all*

# ADVOCACY DIGITAL & SOCIAL TOOLS USED



@NTSB



NTSB Podcast



@NTSBgov



NTSB Blog – Safety Compass



@NTSBgov



[youtube.com/user/NTSBgov](https://youtube.com/user/NTSBgov)



[linkedin.com/company/NTSB](https://linkedin.com/company/NTSB)



Constant Contact

# CONTACT INFORMATION

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