



# Omaha, Nebraska School Bus Run Off Bridge

October 13, 2001

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# Parties to the Investigation

Federal Highway Administration

Nebraska Department of Roads

Nebraska State Patrol

Thomas Built Buses, Inc.

Douglas County Sheriff's Office

Omaha Fire Department

Elkhorn Suburban Fire Department

Seward School District

Norfolk School District



# Seward High School Trip

- Returning from band competition in Omaha
- Westbound on U.S. 6
- 2000 Thomas Built transit-style, 78-passenger school bus
- 22-year-old driver with 2+ years experience driving school buses
- 27 high school students and 3 adult chaperones





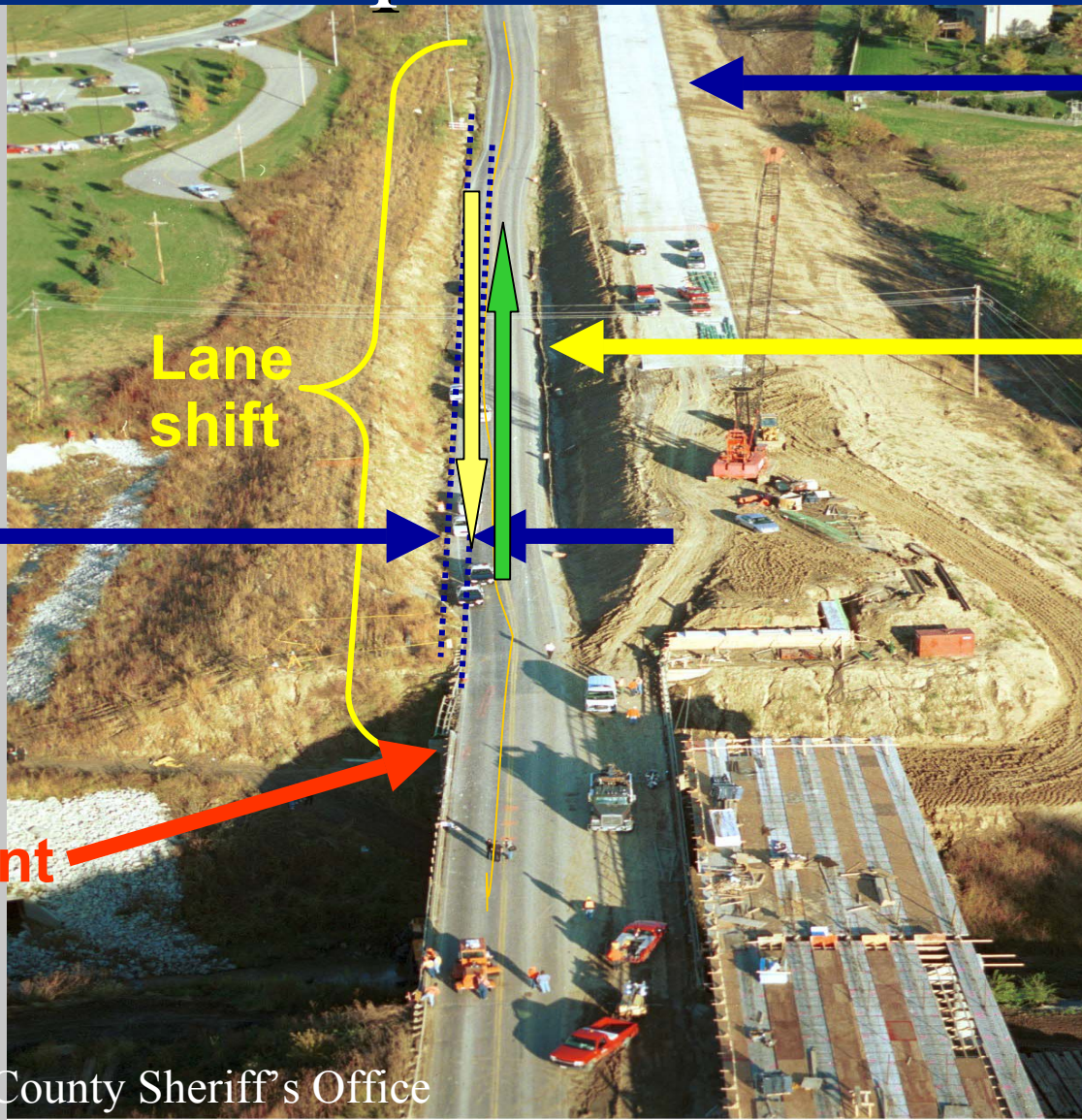
# Norfolk High School Trip

- Eastbound on U.S. 6
- Heading to band competition in Omaha
- 1986 MCI motorcoach
- MCI motorcoach
- 1997 Thomas Built school bus



# U.S. 6 at East End of West Papillion Creek Bridge

←North



Lane shift

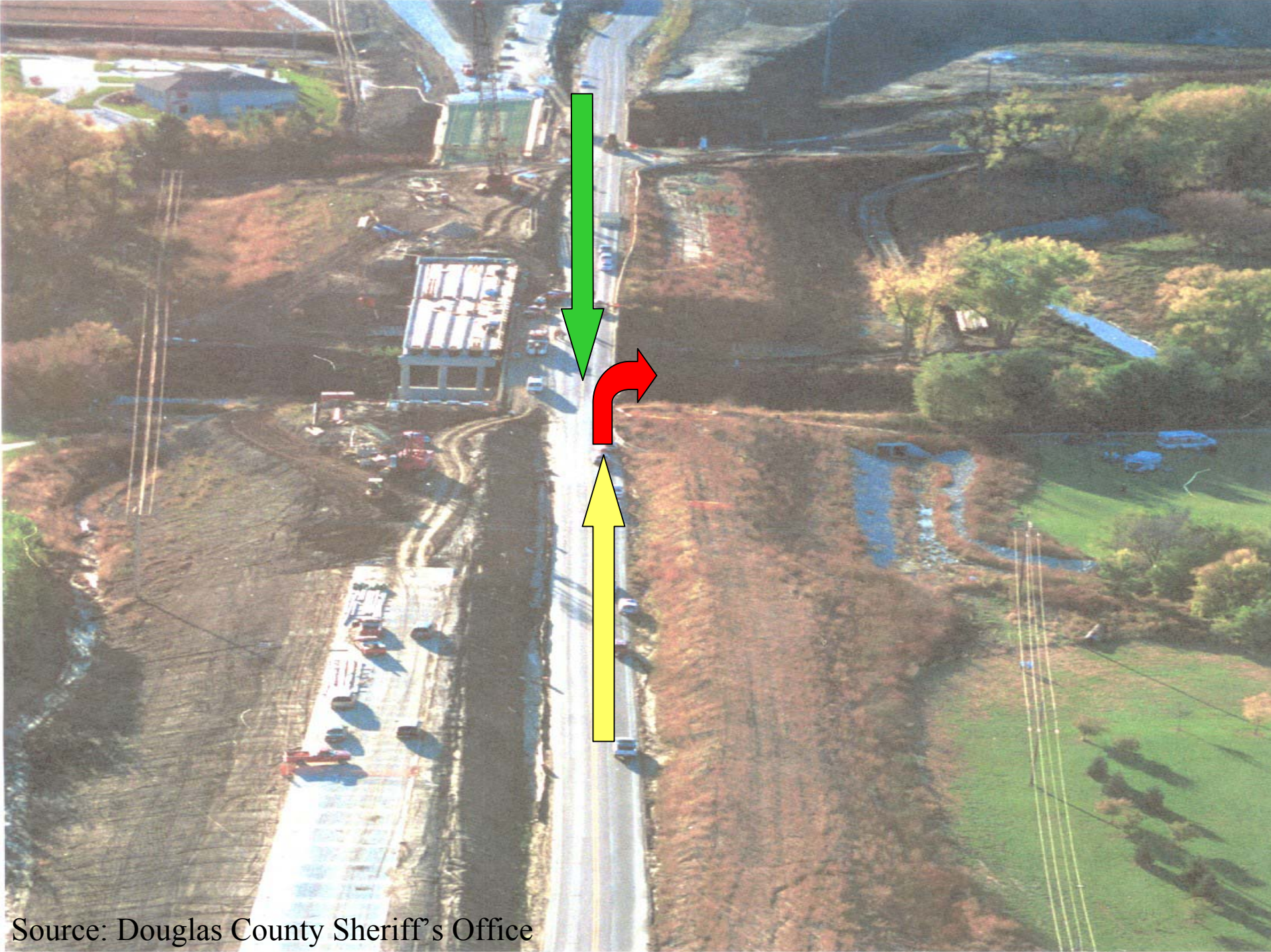
Offset  
5½ ft.

Accident  
site

New  
lanes

Begin  
3%  
grade





Source: Douglas County Sheriff's Office









Source: Douglas County Sheriff's Office



# Issues

- Effect of highway design and vehicle handling characteristics on driver performance
- Adequacy of work zone safety management
- Lack of emergency preparedness of students
- School bus emergency signage and exit door lever visibility
- Passenger extrication





# Proposed Recommendation Recipients

- Federal Highway Administration
- Nebraska Department of Roads
- Omaha Fire Department
- National Association of State Directors of Pupil Transportation Services
- Thomas Built Buses, Inc.





# Human Performance





# Exclusions

- Toxicological impairment
- Sleep loss and fatigue
- Driver's age and qualifications



# Issues

- Perceived threat of frontal collision by accident vehicle driver
- Possible impingement of motorcoach on accident vehicle's travel lane
- Drivers' ability to maintain lane



# Perception of Depth/Distance



paula\_bridge.mpg

Motion parallax:  
*Objects near an observer appear to move faster and opposite in direction, compared with moving objects that are farther away*

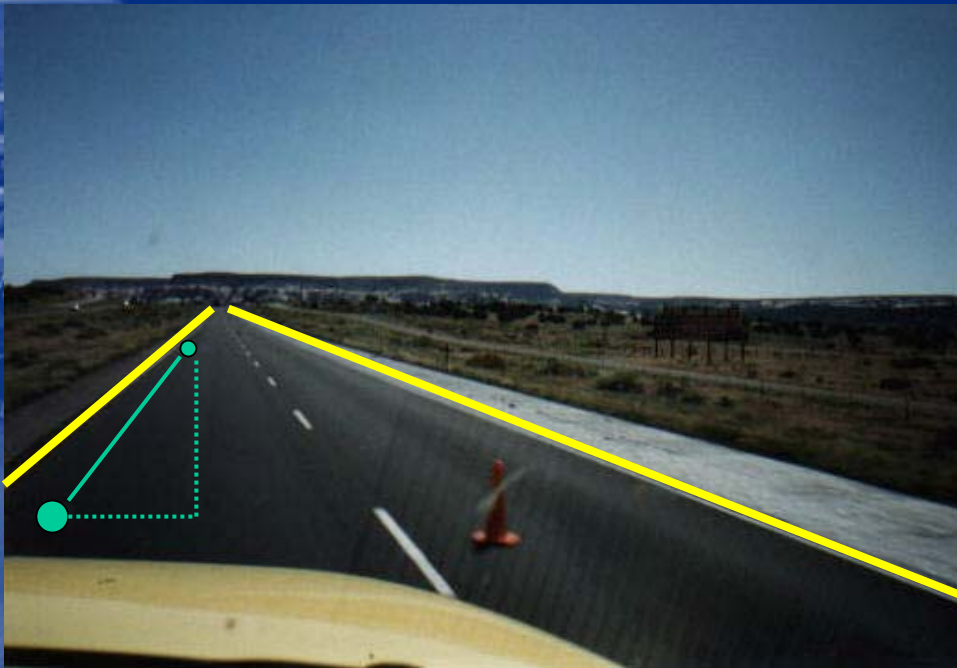




# Perception of Depth/Distance

Linear perspective:

- *Parallel lines appear to converge at a distance*
- *Lateral displacement of an object near an observer is greater than objects at a distance*



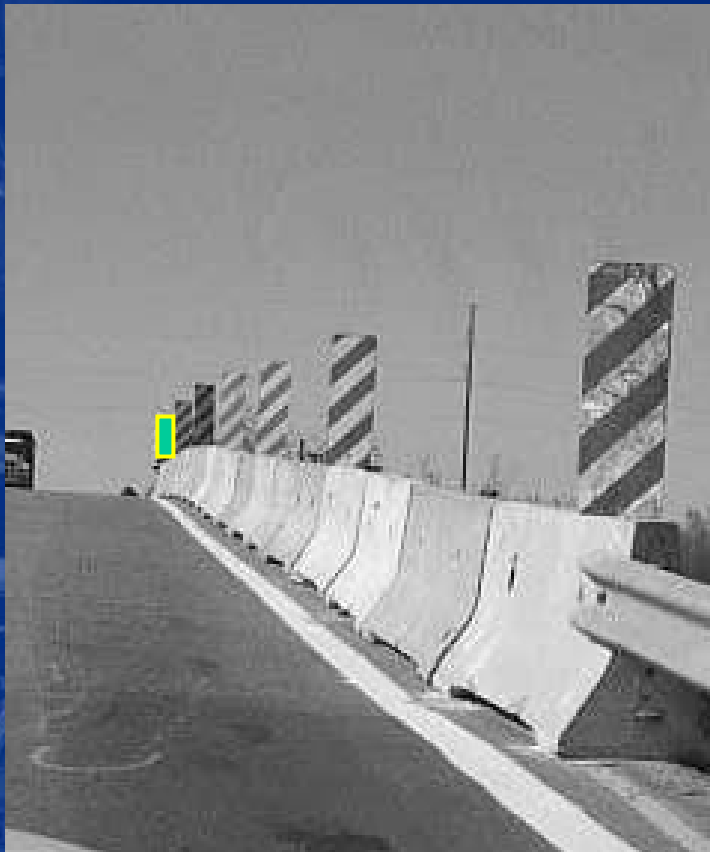
# Perception of Depth/Distance

Interposition:

*Objects that are nearer to an observer obscure objects that are farther away*



# Perception of Depth/Distance



Size constancy:

*We recognize that it is our perception of an object's size that changes, rather than the actual size of the object*





# Approach to Accident Location





# Simulations





# Purpose

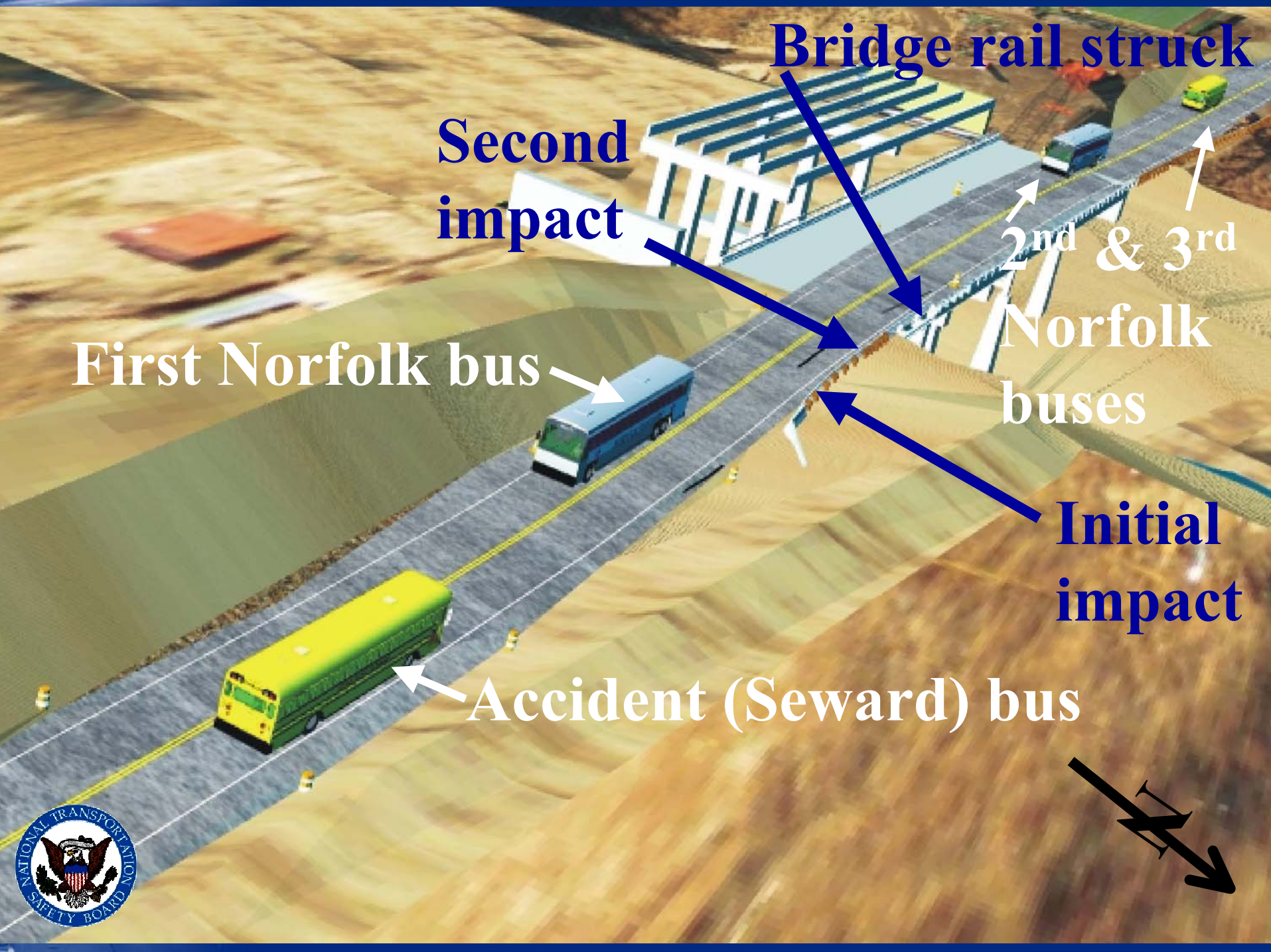
- To provide an approximation of the potential Seward bus driver's view
- To determine if a visual illusion may have existed



# Simulation Strategy

- Include the roadway changes in alignment
- Simulate the three oncoming Norfolk buses with the relative movement of approaching Seward bus
- Simulate similar ambient light conditions
- HVE, SIMON, EDSMAC4, EDGEN





**Bridge rail struck**

**Second impact**

**First Norfolk bus**

**2nd & 3rd Norfolk buses**

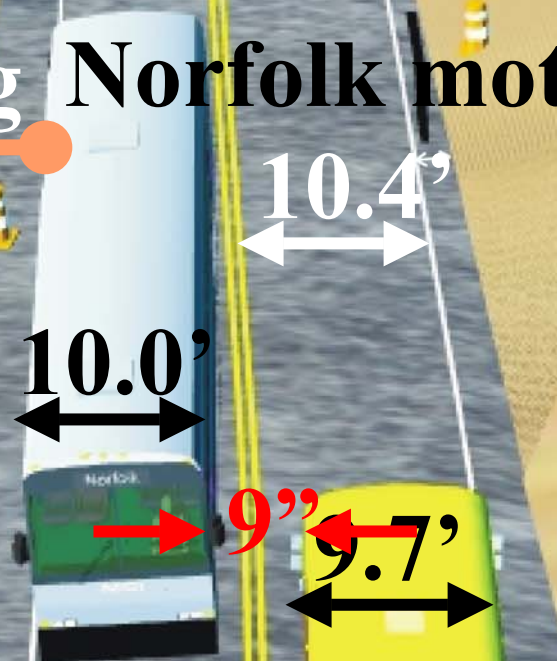
**Initial impact**

**Accident (Seward) bus**





**Off-tracking Norfolk motorcoach**  
3 inches



**Seward schoolbus**

**Off-tracking**  
4 inches



# Results of Simulations

## 3 Possible Illusions

1. First Norfolk motorcoach appears headed toward Seward bus
2. Second and third Norfolk buses appear to be in oncoming lane
3. Seward bus strikes guardrail and appears headed toward second Norfolk motorcoach



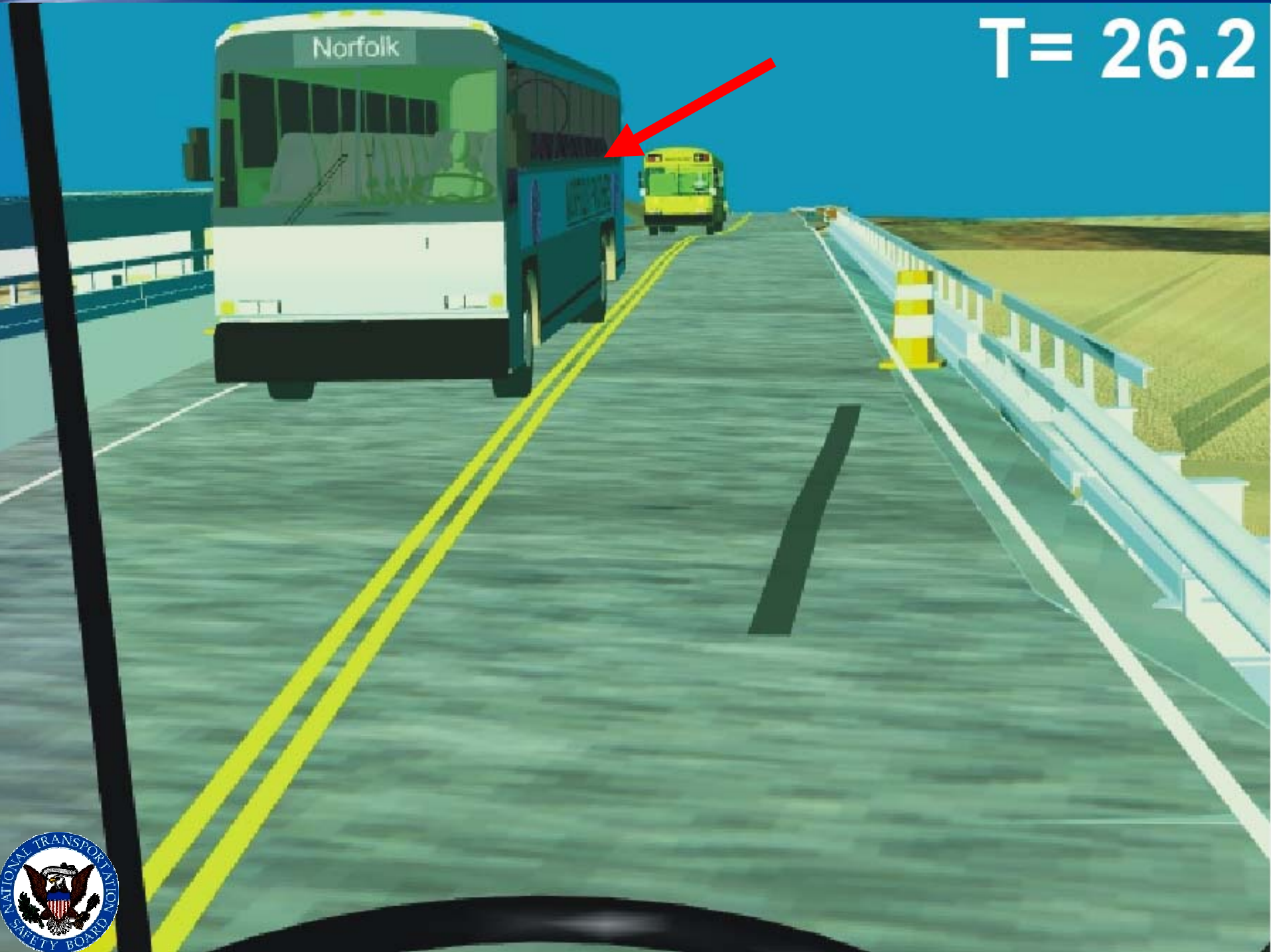
# Simulations

- Best fit to physical evidence
- Representative of accident sequence but does not show actual accident
- Similar lighting conditions
- Bridge departure and rail are animated





T = 26.2





# Show Simulations



# Simulation Summary

Three illusions may have affected Seward driver

- Norfolk buses could have been in their lanes
- Norfolk buses appeared to be in opposing lane
- Little clearance for large vehicles



# Visual Illusions

- Norfolk buses may or may not have crossed the centerline
- Appeared to be headed toward school bus
- School bus driver took evasive maneuver to right to avoid head-on collision





# Highway Design and Driver Performance

- Roadway width
- Horizontal and vertical alignment
- Posted speed
- Preparation/expectations
- Failsafe design





# Highway Factors

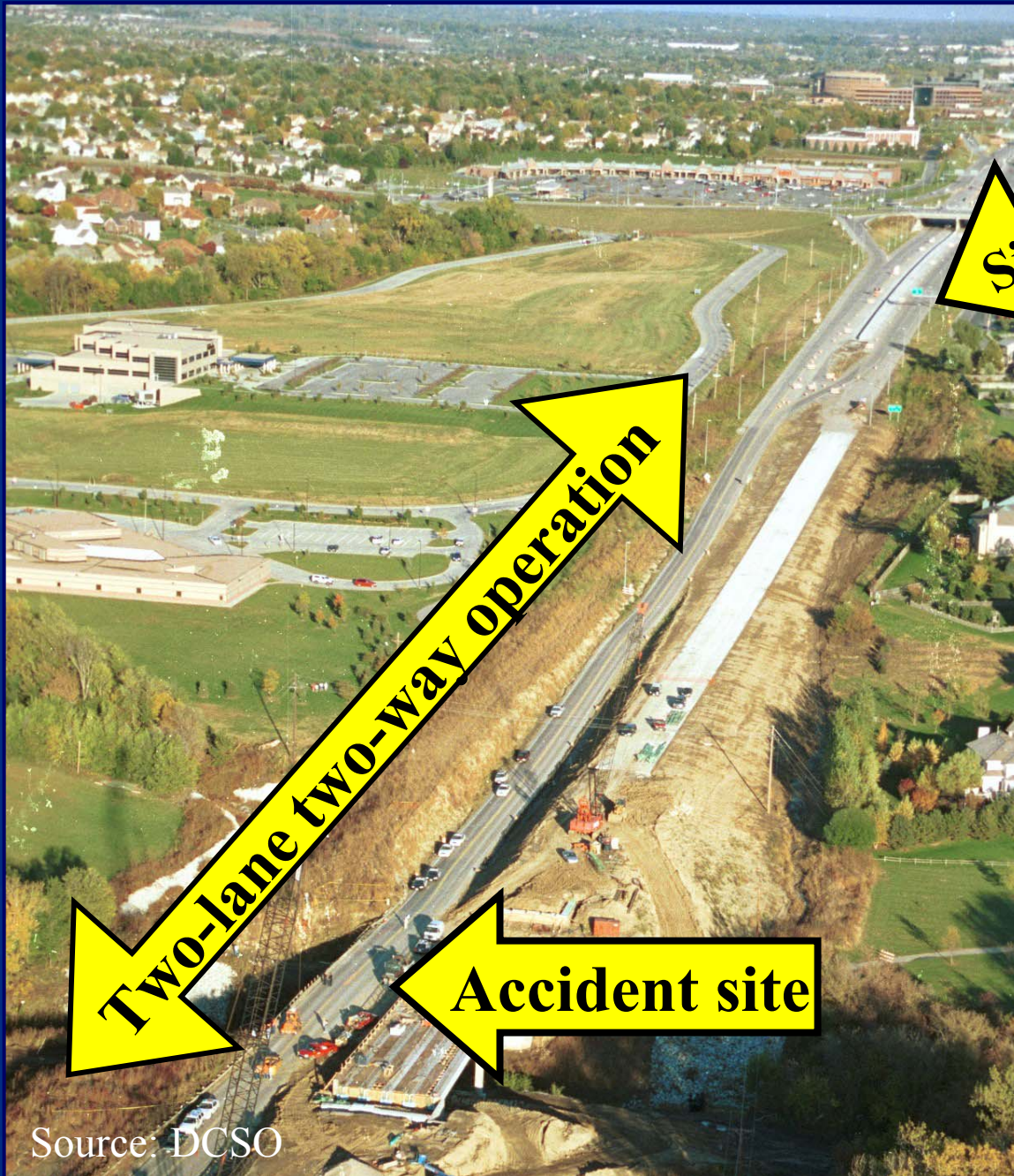


# Traffic Control Plan

- FHWA requirement
- Detail depends on size and complexity
- Generic plan chosen for this site
  - Not site specific
  - Standard diagrams
- Insufficient for site-specific elements at this site







**Six-lane freeway**

**Two-lane two-way operation**

**Accident site**

Source: DCSO



# Two-Lane Two-Way Operation

- Shall separate opposing traffic
- Used only after consideration of other alternatives
- Method of separation
  - Portable barriers
  - Channelizing devices
- Striping, pavement markers, signing alone not acceptable





# Lane Shift at Bridge



**Bus first contact**

**Lane shift**





# Accident Site with Separation





# Bridge Work Area



Source: DCSO



# Barrier Systems Before Project

USH 2 DOBDO - 350 10  
REGULAR DOB 179





# Barrier After 2001 Damage

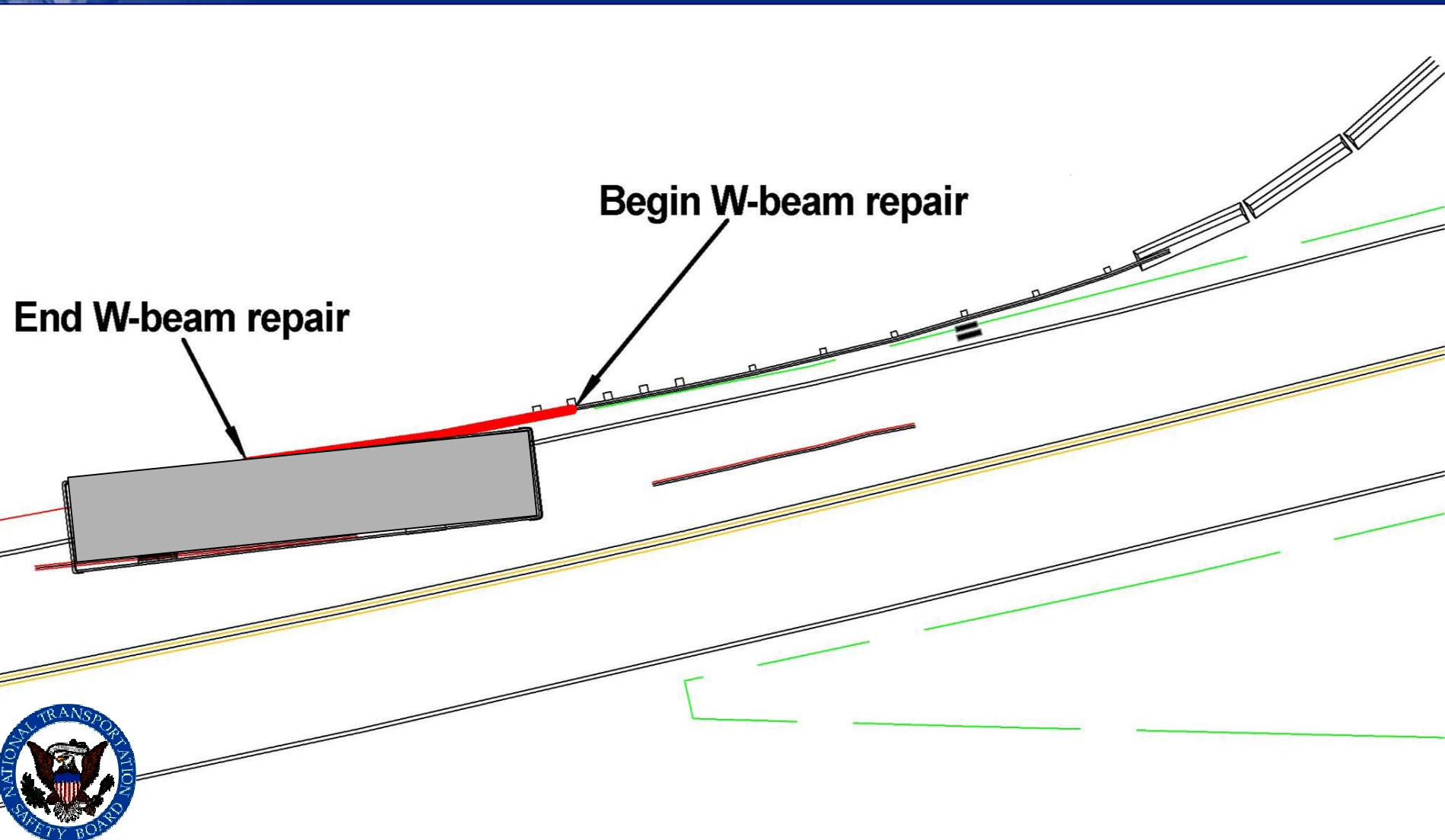


**Damaged three-rail  
barrier**

**Unsecured  
W-beam**



# Barrier Repair and Collision



# Barrier Maintenance

- No Federal guidance
- Important in work zones
- Contractor reportedly repaired barrier  
Did not meet accepted standards
- NDOR staff did not detect inadequate repair
- Review did not document damage



# Barrier When Inspection Occurred



# Use of Guidelines

- Traffic control and hazards change frequently





# NE Corner of Bridge 1996 and 2001



# Use of Guidelines

- Traffic control and hazards change frequently
- Did not comply with
  - *Federal-Aid Policy Guide*
  - *Manual for Uniform Traffic Control Devices*
- Both should be used





**Part VI  
Standards and Guides for Traffic  
Controls for Street and Highway  
Construction, Maintenance, Utility,  
and Incident Management  
Operations.**

Part VI of the Manual on  
Uniform Traffic Control Devices (MUTCD)

1988 Edition of MUTCD, Revision 3  
September 3, 1993



# Code of Federal Regulations

23

Revised as of April 1, 2003

Highways









# Occupant Safety



# Occupant Safety Issues

- Emergency preparedness of students
- Obscured emergency exit signage
- Extrication of students from school bus



# Emergency Evacuation Drills

- Federal Guidelines
- Nebraska Department of Education
  - 2 per year
  - Self-certification
- Only 1 student said he had participated
- Students not familiar with operation of roof hatches





# Emergency Evacuation Drills

- NASDPTS State Directors' survey
  - 42 responses
  - 15 require pretrip safety information on activity trips
- Pretrip safety briefings and emergency evacuation drills



# Overhead Luggage Racks Obscured Emergency Exit Signage



# School Bus Extrication

- Lack of knowledge concerning school bus construction
- Improper extrication tools
- Training available





