On Site Child Safety Seat Investigation / Vehicle to Vehicle
Dynamic Science, Inc. / Case Number: DS03031
1995 Ford Windstar
Arizona
August, 2003

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The crash investigation process is an inexact science which requires that physical evidence such as skid marks, vehicular damage measurements, and occupant contact points be coupled with the investigator's expert knowledge and experience of vehicle dynamics and occupant kinematics in order to determine the pre-crash, crash, and post-crash movements of involved vehicles and occupants.

Because each crash is a unique sequence of events, generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicle(s) or their safety systems.

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16. Abstract

This two vehicle crash occurred in August, 2003 at 2015 hours. The crash involves three fatalities in the case vehicle (both front seat adults and a rear seat child seated in an infant safety seat). The crash occurred in a rural area of Arizona. The crash occurred on an interstate highway. The speed limit is 121 km/h (75 mph).

The case vehicle is a 1995 Ford Windstar GL 4x2 minivan driven by an unrestrained 29-year-old female. The case vehicle was traveling eastbound. The case vehicle was equipped with dual front air bags. There were a total of seven occupants in the vehicle, including the driver. The front right seat was occupied by a 21-year-old female. The second row left seat was occupied by a 4-month-old male who was seated in an Evenflo Discovery rear facing infant safety seat. The second row middle seat was occupied by a 5-year-old female. The third row left and right seat positions were occupied by two 2-year-old female children. Both of the 2-year-old children were in child safety seats. There was one additional occupant, a 9-year-old male. His seat position could not be determined. He may have been seated between the third seat occupants. The other vehicle is a 1999 Ford F250 4x4 pickup driven by a 48-year-old male. The front right seat was occupied by a 44-year-old female.

The Ford F250 was traveling westbound. The driver reported that his vehicle began to vibrate. At this point he lost control of the vehicle. The vehicle veered onto the median then entered the eastbound travel lanes at approximately a 45 degree angle. The right front of the Ford F250 struck the left front of the Ford Windstar. After impact, both vehicles rotated in a counterclockwise direction. Both vehicles came to rest side by side on the off ramp area with the case vehicle facing west and the other vehicle facing east. Both front occupants of the case vehicle were fatally injured. The second row left child occupant was also fatally injured.

17. Key Words	18. Distribution Statement
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Dynamic Science, Inc.
Crash Investigation
Case Number: DS03031

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BACKGROUND:

Description:	This Child Safety Seat case was initially identified by a NHTSA review of General Estimates System police reports. DSI was notified on September 23, 2003 with instructions to determine if both the case vehicle and the child safety seats would be available for inspection. On September 27, 2003, DSI spoke with the investigating officer who indicated that the case vehicle and the child seats were on police hold. Permission was given to inspect the vehicle. This was an on-scene investigation. Field work was completed on October 29, 2003.
Investigation Type:	Child Safety Seat
Crash Location:	Arizona
Crash Date:	August, 2003
Notification Date:	September 23, 2003
Field Work Completed:	October 29, 2003

SUMMARY

Crash Site

This two vehicle crash occurred in August, 2003 at 2015 hours. The crash involves three fatalities in the case vehicle (both front seat adults and a second row child seated in an infant safety seat). The crash occurred in a rural area of Arizona. The crash occurred on an interstate highway. It was dark at the time of the crash and there were no streetlights available. The weather was cloudy. The roadway consists of two eastbound and two westbound travel lanes. The travel lanes are separated by a 24 m (80 ft) depressed median. The travel lanes were dry and free of defects. The speed limit is 121 km/h (75 mph).

Figure 1. Area of impact (SE)

Figure 2. Area of final rest (SE).

Pre-Crash

The case vehicle is a 1995 Ford Windstar GL 4x2 minivan (VIN: 2FMDA51426bxxxxxx) driven by an unrestrained[1] 29-year-old female (165 cm/65 in, 87 kg/192 lbs). The case vehicle was traveling eastbound at a minimum speed of 108 km/h (67 mph)[2]. The case vehicle was equipped with dual front air bags. There were a total of seven occupants in the vehicle, including the driver. The front right seat was occupied by a restrained 21-year-old female (147 cm/58 in, 51 kg/112 lbs), [02]. The second row left seat was occupied by a 4-month-old male (59 cm/23 in, 4 kg/9 lbs) [03] who was seated in an Evenflo Discovery rear facing infant safety seat (ISS). The second row middle seat was occupied by a restrained 5-year-old female (unknown height/weight) [04]. The third row left seat was occupied by a 2-year-old female (unknown height, 14 kg (31 lbs)) [05] who was seated in a Cosco Alpha Omega convertible child safety seat that was being used in the forward facing mode. The third row right seat was occupied by a 2-year-old female (unknown height/weight) [06] who was seated in a Graco Century 1500 STE convertible child safety seat that was being used in the forward facing mode. There was one additional occupant, a 9-year-old male [07]. His seat position could not be determined. He may have been seated between the third row occupants.

The other vehicle is a 1999 Ford F250 4x4 Supercab pickup (VIN: 1FTNX21F2XExxxxxx) driven by a 48-year-old male. The front right seat was occupied by a 44-year-old female.

The Ford F250 was traveling westbound and had just passed another vehicle. The driver reported that his vehicle began to vibrate. At this point he lost control of the vehicle. Police investigators indicated that the front left tire blew out. The vehicle veered onto the median then entered the eastbound travel lanes at approximately a 45 degree angle. The case vehicle was traveling eastbound.

Crash

As the other vehicle entered the case vehicle's path of travel the front right of the other vehicle (82FDEW3) engaged the front left of the case vehicle (11FDEW6). The total velocity change calculated by the WinSmash collision model for the case vehicle was 76.0 km/h (47.2 mph). The longitudinal and lateral delta v components were -71.4 km/h (-44.4 mph) and 26.0 km/h (16.2 mph), respectively.

Figure 3. Final rest (NW)

[1]Seat belt found to be locked in stowed position

[2]Speedometer needle position

Both front air bags in the case vehicle deployed at this point. The total velocity change for the other vehicle was 48.0 km/h (29.8 mph). The longitudinal and lateral delta v components were -30.9 km/h (-19.2 mph) and -36.8 km/h (-22.8 mph), respectively. Both front air bags in the other vehicle also deployed.

Figure 4. Front left, case vehicle

After impact, both vehicles rotated in a counterclockwise direction. There was a second, side slap type impact between the right rear of the Windstar (03RBEW1) and the right rear side of the F250 (09RBEW1). Both vehicles came to rest side by side on the off ramp area with the case vehicle facing west and the other vehicle facing east.

Post-Crash

The driver of the case vehicle was fatally injured. She was pronounced dead at the scene by the responding paramedics at 2100 hours. She sustained a complete thoracic aortic transection, laceration of the pons-medullary junction, liver and bladder lacerations, multiple lacerations of the mesentery, cervical and lumbar spine fractures, rib fractures, and multiple contusion / lacerations / abrasions. She was removed from the scene by the medical examiner's office.

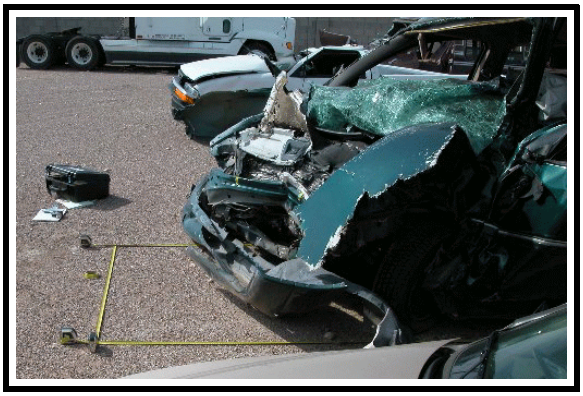

Figure 5. Left side, case vehicle

The front right seat occupant (02) was fatally injured. She was pronounced dead at the scene by the responding paramedics at 2100 hours. She sustained a pons medullary laceration, subarachnoid hemorrhages, a C1 fracture, multiple pulmonary contusions, multiple splenar lacerations, multiple liver lacerations, rib fractures, and multiple contusion, lacerations, and abrasions. She was removed from the scene by the medical examiner's office.

The second seat left occupant (03) was fatally injured. He was pronounced dead at the scene by the responding paramedics at 2100 hours. He sustained multiple comminuted skull fractures with accompanying brain lacerations. In addition, he sustained multiple abrasions/contusions to the face and head. He was removed from the scene by the medical examiner's office. He remained in the infant seat during the transport.

The second seat right occupant (04) sustained a Chance lumbar spine fracture (L3) with retrolisthesis [3] of L3 on L4 and extensive hematoma. She also sustained T3 and T7 spinal cord contusions. She had no motor function below T6. She had a splenic laceration and a jejunal perforation. There was a large abrasion/contusion with ecchymoses that begins at her umbilicus and continues to her left all the way to the lumbar spine. She was transported by helicopter to a local trauma center where she arrived with a Glasgow Coma Scale (GCS) score = 14 and was admitted into the pediatric intensive care unit. She was hospitalized for 15 days and then transferred to an area hospital where she was to receive intensive, long-term physical therapy.

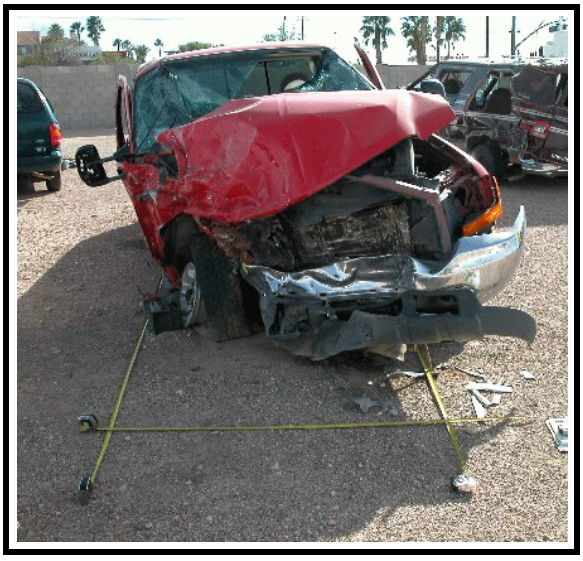

Figure 6. Front, other vehicle

The third seat left occupant (05) sustained an abrasion near her left clavicle, a chest wall contusion, a contusion to her forehead, a palm contusion, and an abrasion to the left side of her neck. She was transported to a local trauma center by ambulance where she arrived with a GCS = 15. She was evaluated for a possible closed head injury. A CT scan did not reveal any head injuries other than the forehead contusion. She was treated and then released early the following morning.

Figure 7. Right side, other vehicle

The third seat right occupant (06) sustained bilateral shoulder abrasions and an abrasion below her right eye. She arrived at the hospital at 2320 hours and was treated and then released at 0530 hours the following morning.

[3]Posterior slippage of one vertebra onto another.

The 9-year-old occupant (07) sustained bilateral frontal lobe shear injuries that extended into the brain stem, a large extracalvarial hematoma, bilateral lung contusions with right lower lobe atelectasis[4] and a possible rib fracture, a 4.0 cm (1.5 in) liver laceration, and a 6.0-8.0 cm (2.4-3.1 in) laceration extending from the hairline on left frontal forehead posteriorly almost all the way to the occipital region. There was one mention of a bilateral nasal fractures, but this was not verified. He was transported by helicopter to a local trauma center where he was admitted with a GCS of 7 (he had no eye response). He was hospitalized for 11 days.

The driver of the Ford F250 sustained a right leg fracture. He was transported to a local trauma center by helicopter. He was treated and later admitted to the hospital.

The front right occupant of the F250 sustained bilateral knee abrasions, bilateral tibial contusions, 7.6 cm (3.0 in) contusion over right lateral malleolus, a right ankle sprain, and chest wall contusions. She was transported from the scene by ground ambulance to a local trauma center where she was treated and then released that evening.

Both vehicles were towed from the scene due to damage and placed on a police hold that was still in place at the time of the vehicle inspections.

[4]Collapse of part or all of a lung by blockage of the air passages.

VEHICLE DATA -1995 Ford Windstar GL 4x2 minivan

The 1995 Ford Windstar was a minivan with two front doors, a sliding right rear door, and a one-piece rear liftgate. The vehicle was equipped with an automatic transmission, front wheel drive, anti-lock brakes, and seating for seven.

VIN:	2FMDA5142SBAxxxxx
Odometer:	Unknown
Engine:	6 cylinder, 3.8L
Reported Defects:	None related to this crash
Cargo:	Two child safety seats, one infant safety seat

The 1995 Ford Windstar was equipped Douglas Touring tires for the front tires and Douglas XTRA TRAC P205/70R15 for the rear tires. The specific tire data is as follows:

Tire	Tread	Pressure	Recommended pressure
LF	12 mm (15/32 in)	Tire flat	241 kPa (35.0 psi)
LR	5 mm (6/32 in)	214 kPa (31.0 psi)	241 kPa (35.0 psi)
RF	12 mm (15/32 in)	Tire flat	241 kPa (35.0 psi)
RR	5 mm (6/32 in)	207 kPa (30.0 psi)	241 kPa (35.0 psi)

The front seating positions in the 1995 Ford Windstar were configured with bucket seats with integral head restraints. The second row was configured with a bench seat with a folding back. The seat was in the full down position at the time of inspection but was in the full up position at the time of the crash. The third row was configured with a bench seat with a folding back. The seat back had been cut off by rescue personnel to facilitate extrication efforts.

VEHICLE DAMAGE

Exterior Damage - 1995 Ford Windstar

Damage Description:	Major front end damage. Driver and front right seating area intrusion.	
CDC:	Impact 1: 11FDEW6 Impact 2: 03RBEW1	
Delta V (impact 1):	Total	76.0 km/h (47.2 mph)
	Longitudinal	-71.4 km/h (-44.4 mph)
	Latitudinal	26.0 km/h (16.2 mph)
	Energy	698,612 joules (515,270 ft lbs)

The frontal impact with the Ford pickup resulted in major frontal damage to the 1995 Ford Windstar. The direct damage began at the front left corner and extended across the entire front end. The front bumper fascia was broken away. The upper and lower radiator supports and metal bumper backing bar were crushed rearward. The left front wheel was displaced rearward and the left wheelbase was shortened by 82 cm (32 in). The front right wheel was dislodged and separated from the axle. Four crush measurements were taken along the metal bumper backing bar and were as follows: C1=114 cm (45 in), C2=115 cm (45 in), C3=83 cm (33 in), C4=62 cm (24 in).

Figure 8. Front left, Ford Windstar

Figure 9. Right side, Ford Windstar

Interior Damage - 1995 Ford Windstar

Interior damage to the 1995 Ford Windstar was extensive and attributed to occupant contact and passenger compartment intrusion. The entire windshield was fractured from impact forces. The right and left side glazing was disintegrated. The entire instrument panel and toe pan were intruded rearward. There was extensive knee contact damage to the left lower instrument panel. The bottom of the steering wheel was deformed upward from occupant contact. The steering column was rotated upward. Both front doors and the right rear door were jammed shut.

MANUAL RESTRAINT SYSTEMS - 1995 Ford Windstar

Figure 10. Overview of Ford Windstar interior

The 1995 Ford Windstar was configured with manual 3-point lap and shoulder belts with sliding latch plates and emergency locking retractors (ELRs) for the front outboard seat positions. The front seat restraints were configured with adjustable D-rings; the left was in the full down position, the right in the full up position. The driver's seat belt was not used during the crash and was found locked in the stowed position. The front right seat belt was being used at the time of the crash. There were loading marks found on the belt. The belt webbing was jammed into the latch and locked in place. The second row seat had two seat positions and was configured with 3-point lap and shoulder belts with sliding latch plates and ELR retractors. The left seat belt was being used with a child seat. It was cut off by rescue personnel. The third row seat had three seat positions and was configured with 3-point lap and shoulder belts with sliding latch plates and ELR retractors at the outboard positions and a manual lap belt in the center seat position. The two outboard seating positions were being used with child seats. There were loading marks found on both belts and load bearing cracks found at the D pillars.

FRONTAL AIR BAG SYSTEM - 1995 Ford Windstar

The 1995 Ford Windstar was equipped with frontal air bags for the driver and front right passenger positions that deployed as a result of the frontal impact with the other vehicle. The driver's air bag was housed in the steering wheel hub with symmetrical H-configuration module cover flaps. The top flap measured 30.0 cm (11.8 in) wide by 13.0 cm (5.1 in) high. The lower flap measured 30.0 cm (11.8 in) wide by 10.0 cm (3.9 in) high. The driver's air bag was circular in shape and measured 60.0 cm (23.6 in) in diameter in its deflated state. The air bag was vented by two circular ports that were located at the 11 and 1 o'clock positions on the rear aspect. The air bag was tethered by a single internal strap. The air bag face had seven vertical folds that were 7.0 cm (2.75 in) apart from one another. There were no visible contacts or damage to the air bag or the module covers.

Figure 11. Driver's air bag, top view

The front right passenger's air bag was housed in the mid instrument panel with a single cover flap. The flap measured 34.0 cm (13.8 in) wide by 12.0 cm (4.7 in) high. The front right passenger's air bag was vaguely rectangular in shape and measured 50.0 cm (19.7 in) high by 66.0 cm (25.9 in) wide. The bag was internally vented and there were no tethers. There was no contacts or damage to the air bag or the module cover.

Figure 12. Side view of front right passenger's air bag

CHILD SAFETY SEATS - 1995 Ford Wndstar

The second row left seat was occupied by a 4-month-old male (03) who was seated in an Evenflo Discovery rear facing infant safety seat (ISS), model #33161356P1 with a manufacture date of 04/04/03. The seat was designed to be used in a rear facing fashion for infants weighing between 2-9 kg (5-20 lbs). Police photos show that the child was restrained using the 3-point harness. The investigating officer indicated that the seat was properly anchored to the case vehicle using the available lap and shoulder belt. This does not appear to be the case. The left rear seat position was equipped with an emergency locking retractor, which would have necessitated the use of a locking clip. There are no indications that a locking clip was used.

Figure 13. Exemplar view of Evenflo infant safety seat

Figure 14. Police photo of infant safety seat

Figure 15. Second row left seat position, shows belt cut by EMS personnel

The third row left seat was occupied by one of the 2-year-old females. The child was seated in a Cosco Alpha Omega convertible child safety seat, model #02-0332 ROR, with a manufacture date of 10/2002. The manufacturer indicates that the seat was designed to be used:

> (1) as a rear-facing infant seat for children 2 to 16 kg (5 to 35 lbs),
> (2) as a forward facing toddler seat for children 10 to 18 kg (22 to 40 lbs), or
> (3) as a belt positioning booster seat for children 14 to 36 kg (30 to 80 lbs).

The harness and shield are to be removed when being used as a belt positioning booster. In this crash, the seat was being used as a forward facing toddler seat. The seat was anchored to the vehicle using the available lap and shoulder belt. The child seat harness was routed through the top slots. The third row left rear seat position was equipped with an emergency locking retractor, which would have necessitated the use of a locking clip. There are no indications that a locking clip was used.

Figure 16. Cosco Alpha Omega child safety seat

There were indications of loading to the child seat harness, the lap and shoulder belt routing guide on the right side of the child seat, to the lap and shoulder belt itself, and to the D pillar lap and shoulder attachment. Both sides of the tray shield mounting fractured and came free during the crash.

Figure 17. Loading to lap and shoulder belt, left side, third row

Figure 18. Cracks in D pillar from seat belt loading (third row left)

Figure 19. Loading marks to right side of Cosco seat

The third row right seat was occupied by the other 2-year-old female. The child was seated in a Graco Century 1500 STE convertible car seat. The manufacturer recommends that the seat be used in the rear facing mode until children weigh at least 9 kg (20 lbs) and are one year of age. For children over 10 kg (22 lbs), the car seat should be used in the forward facing until the child reaches 20 kg (40 lbs). In this case the seat was being used as a forward facing toddler seat. The seat was anchored to the vehicle using the available lap and shoulder belt. The child seat harness was routed through the top slots. The third row right rear seat position was equipped with an emergency locking retractor, which would have necessitated the use of a locking clip. There are no indications that a locking clip was used. There were indications of loading to the lap and shoulder belt itself and to the D pillar lap and shoulder attachment.

Figure 20. Graco Century 1500 STE convertible car seat

Figure 21. Cracks in D pillar from seat belt loading (third row right)

VEHICLE DATA - 1999 Ford F250 pickup

Description:	1999 Ford F250 XLT Super Duty pickup	
VIN:	1FTNX21F2XECxxxxx	
Odometer:	91,447 km (56,823 miles)	
Engine:	7.3L / V8	
Reported Defects:	Left front tire blowout	
Cargo:	Add on fifth wheel	
Damage Description:	Major front end damage. Damage to bumper, grille, hood, both fenders. Vehicle towed from the scene.	
CDC:	Impact 1: 82FDEW3 Impact 2: 03RBEW1	
Delta V:	Total	48.0 km/h (29.8 mph)
	Longitudinal	-30.9 km/h (-19.2 mph)
	Latitudinal	-36.8 km/h (-22.8 mph)
	Energy	281,014 joules (207,265 ft lbs)

Figure 22. Front right, Ford F250

Exterior Damage - 1999 Ford F250 pickup

The 1999 Ford F250 pickup sustained major frontal damage as a result of the impact with the Ford Windstar. Damage began at the front right corner and extended 114.0 cm (44.8 in) laterally across the bumper. The front end was shifted 62.0 cm (24.4 in) to the left. The right front wheel was displaced rearward and the right wheelbase was shortened by 23.0 cm (9.1 in). The left wheelbase was shorted by 7.0 cm (2.8 in). Six crush measurements were taken along the bumper and were as follows: C1=11.0 cm (4.3 in), C2=6.0 cm (2 in), C3=27.0 cm (11 in), C4=48.0 cm (19 in), C5=58.0 cm (23 in), C6=80.0 cm (31 in).

Figure 23. Impact 2, right rear

OCCUPANT DEMOGRAPHICS - 1995 Ford Windstar

	Occupant 1	Occupant 2
Age/Sex:	29/Female	21/Female
Seated Position:	Front left	Front right
Seat Type:	Fabric covered bucket seat, unknown seat track position	Fabric covered bucket seat, seat track in full forward position
Height:	165 cm (65 in)	147 cm (58 in)
Weight:	87 kg (192 lbs)	51 kg (112 lbs)
Occupation:	Unknown	Unknown
Pre-existing Medical Condition:	None noted	None noted
Alcohol/Drug Involvement:	None	NA
Driving Experience:	Presumed to be > 10 years	NA
Body Posture:	Presumed to be upright, normal	Presumed to be upright, normal
Hand Position:	Unknown	Unknown
Foot Position:	Right foot on accelerator, left on floor	Legs crossed, right over left
Restraint Usage:	Lap and shoulder belt available, not used.	Lap and shoulder belt available, used
Air bag:	Driver's air bag available, deployed	Front right passenger air bag available, deployed.

OCCUPANT DEMOGRAPHICS - 1995 Ford Windstar

	Occupant 3	Occupant 4
Age/Sex:	4 month/Male	5/Female
Seated Position:	Second seat left	Second seat right
Seat Type:	Fabric covered bench seat with folding back	Fabric covered bench seat with folding back
Height:	58 cm (23 in)[5]	Unknown
Weight:	4 kg (9 lbs)	Unknown
Occupation:	NA	NA
Pre-existing Medical Condition:	None noted	None noted
Alcohol/Drug Involvement:	None	None
Driving Experience:	NA	NA
Body Posture:	Supine, in child seat	Unknown
Hand Position:	Unknown	Unknown
Foot Position:	Unknown	Unknown
Restraint Usage:	Lap and shoulder belt available, used with child safety seat	Lap and shoulder belt available, lap belt used

[5]Additional measurements from medical examiner: head circumference = 40.0 cm (15.7 in), chest circumference=38.0 cm (54.3 in), abdominal circumference=36.0 cm (14.2 in), crown-rump length=41.0 cm (16.1 in)

OCCUPANT DEMOGRAPHICS - 1995 Ford Windstar

	Occupant 5	Occupant 6	Occupant 7
Age/Sex:	2/Female	2/Female	9/Male
Seated Position:	Third row left	Third row right	Unknown, possibly third row middle
Seat Type:	Fabric covered bench seat with folding back	Fabric covered bench seat with folding back	Fabric covered bench seat with folding back
Height:	Unknown	Unknown	Unknown
Weight:	14 kg (31 lbs)	Unknown	Unknown
Occupation:	NA	NA	NA
Pre-existing Medical Condition:	None noted	None noted	None noted
Alcohol/Drug Involvement:	NA	NA	NA
Driving Experience:	NA	NA	NA
Body Posture:	Upright in child seat	Upright in child seat	Unknown
Hand Position:	Unknown	Unknown	Unknown
Foot Position:	Unknown	Unknown	Unknown
Restraint Usage:	Lap and shoulder belt available, used with child safety seat	Lap and shoulder belt available, used with child safety seat	None used

OCCUPANT DEMOGRAPHICS -1995 Ford F250

	Driver	Occupant 2
Age/Sex:	48/Male	44/Female
Seated Position:	Front left	Front right
Seat Type:	40-20-40 fabric covered split bench seat	40-20-40 fabric covered split bench seat
Height:	Unknown	Unknown
Weight:	Unknown	Unknown
Occupation:	Unknown	Unknown
Pre-existing Medical Condition:	None noted	None noted
Alcohol/Drug Involvement:	None	NA
Driving Experience:	Unknown	NA
Body Posture:	Unknown	Unknown
Hand Position:	Unknown	Unknown
Foot Position:	Right foot on brake, left on floor	Unknown
Restraint Usage:	Lap and shoulder belt available, used	Lap and shoulder belt available, used
Air bag:	Driver's air bag available, deployed	Front right passenger air bag available, deployed. Air bag suppression switch in "ON" position.

OCCUPANT INJURIES -1995 Ford Windstar

Driver: Injuries obtained from autopsy report.

Injury	OIC Code	Injury Mechanism	Confidence Level
Complete thoracic aorta transection	420210.5,4	Steering wheel hub	Probable
Laceration of the pons-medullary junction	140212.6,8	Steering wheel, indirect hyperflexion	Probable
Multiple mesentery lacerations	542020.2,8	Lower steering wheel rim	Probable
Subgaleal hemorrhage of left parietal bone of the skull	190402.1,2	A-pillar	Possible
Bilateral lung contusions	441499.3,3	Steering wheel hub	Probable
Liver lacerations	541820.2,1	Steering wheel	Probable
Multiple bladder lacerations	540620.2,8	Steering wheel	Probable
Left pelvis fracture	852600.2,2	Lower instrument panel, indirect	Certain
T2/T3 fracture	650416.2,7 650416.2,7	Steering wheel, indirect hyperflexion	Probable
C2/C3 fracture	650216.2,6 650216.2,6	Steering wheel, indirect hyperflexion	Probable
Rib fractures, left, 7th through 10th. Rib fractures, right, 1st-3rd, 2nd-5th, 9th, hemothorax	450242.5,3	Steering wheel hub	Certain
Bilateral femur fractures	851800.3,1 851800.3,2	Lower instrument panel, indirect	Certain
Right tibia/fibula fracture (unknown location)	853404.2,1 851605.2,1	Floor, indirect	Probable

Contusion, bridge of nose, 2.0 x 2.0 cm (0.8 x 0.8 in)	290402.1,4	Driver's air bag	Probable
Contusion, chin, 3.0 x 3.0 cm (1.2 x 1.2 in)	290402.1,8	Driver's air bag	Probable
Abrasion, left anterior neck, 10.0 x 3.0 cm (3.9 x 1.2 in)	390202.1,2	Driver's air bag	Probable
Abrasion/contusion, left upper chest and anterior arm, 15.0 x 10.0 cm (5.9 x 3.9 in)	490202.1,2 490402.1,2	Driver's air bag	Probable
Bilateral contusions/abrasions breasts	490202.1,3 490402.1,3	Driver's air bag	Probable
Multiple abdominal abrasions	590202.1,9	Lower steering wheel rim	Probable
Laceration, abdomen, 13.0 cm (5.1 in)	590600.1,9	Unknown	Unknown
Abrasions/contusions right lower extremity	890202.1,1 890402.1,1	Unknown	Unknown
Abrasions/contusions left upper extremity	790202.1,2 790402.1,2	Unknown	Unknown
Laceration, left leg, 6.0 cm (2.4 in)	890600.1,2	Unknown	Unknown
Abrasions/contusions left lower extremity	890202.1,2 890402.1,2	Unknown	Unknown
Laceration, right posterior thigh	890600.1,1	Unknown	Unknown

Front right occupant (02): Injuries obtained from autopsy report.

Injury	OIC Code	Injury Mechanism	Confidence Level
Laceration, pons medullary	140212.6,8	Shoulder belt, hyperflexion	Probable
Multiple pulmonary contusions	441402.,3	Shoulder belt	Probable
Multiple splenar lacerations	544220.2,2	Shoulder belt	Probable
C1 fracture	650216.2,6	Shoulder belt, hyperflexion	Probable
Subgaleal hemorrhage over occipital bone	190402.1,9	Shoulder belt, hyperflexion	Probable
Multiple liver lacerations	541820.2,1	Lap belt	Probable
Rib fractures, right, 1st - 3rd posteriorly, 2nd laterally, 3rd through 7th anteriorly, hemothorax	450232.4,1	Shoulder belt	Probable
Fracture, right femur	851800.3,1	Glove box	Probable
Abrasions, right side of face	290202.1,1	Air bag	Possible
Abrasions, right neck and shoulder	390202.1,1 790202.1,1	Shoulder belt	Probable
Abrasions, abdomen	590202.1,9	Lap belt	Probable
Abrasions, chest	490202.1,9	Shoulder belt	Probable
Multiple upper extremity abrasions	790202.1,1 790202.1,2	Unknown	Unknown
Multiple lower extremity abrasions and contusions	890202.1,3 890402.1,3	Right instrument panel	Probable
Abrasion, left lateral back	690202.1,2	Seat back	Possible

Second row left occupant (03): Injuries obtained from autopsy report.

Injury	OIC Code	Injury Mechanism	Confidence Level
Multiple brain lacerations	140688.4,6	Occupant 4	Probable
Fractures of sagittal, right coronal and right lambdoid sutures, left parietal bone, comminuted fractures of occipital bone	150406.4,9	Occupant 4	Probable
Diffuse subscalpular hematoma	190402.1,0	Occupant 4	Probable
Diffuse subarachnoid hemorrhage	140466.3,6	Occupant 4	Probable
Abrasion/contusion, right side of face, the ear, and right side of head, 7.0 x 2.0 cm (2.8 x 0.8 in)	290202.1,1 290402.1,1	Occupant 4	Probable
Abrasion/contusion right side of forehead and head, 7.0 x 7.0 cm (2.8 x 2.8 in)	290202.1,7 290402.1,7	Occupant 4	Probable
Abrasion/contusion back of head 3.5 x 2.0 cm (1.4 x 0.8 in)	190202.1,6 190402.1,6	Child seat shell	Certain
Contusion/abrasion left side of scalp, 11.0 x 6.0 cm (4.3 x 2.4 in)	190202.1,2 190402.1,2	Occupant 4	Probable
Contusion, top of left shoulder, 2.0 x 1.5 cm (0.8 x 0.6 in)	790402.1,2	Unknown	Unknown

Second row right occupant (04): Injuries obtained from discharge summary and radiology report.

Injury	OIC Code	Injury Mechanism	Confidence Level
Chance fracture, L3. Horizontal fracture through vertebral body, facets, and transverse processes.	650626.3,8	Lap belt, flexion	Probable
T3/T7 cord contusions with loss of motor function. Paraplegia.	640422.5,7	Lap belt, flexion	Probable
Splenar laceration	544220.2,2	Lap belt	Certain
Jejunal perforation	541424.3,8	Lap belt	Certain
Large abrasion/contusion with ecchymoses that begins at umbilicus and continues to the left all the way to the lumbar spine	590202.1,2 590402.1,2	Lap belt	Certain
Left hand x-rayed. Showed normal alignment with no evidence of fracture.			

Third row left occupant (05): Injuries obtained from discharge summary and radiology report.

Injury	OIC Code	Injury Mechanism	Confidence Level
Abrasion, left clavicle	790202.1,2	Child seat harness	Certain
Contusion, chest wall	490402.1,9	Child seat harness	Probable
Contusion, forehead	290402.1,7	Unknown	Unknown
Abrasion, left side of neck	390202.1,2	Child seat harness	Certain
Contusion, palm	790402.1,9	Unknown	Unknown

Third row right occupant (06): Injuries obtained from emergency department records and radiology report.

Injury	OIC Code	Injury Mechanism	Confidence Level
Bilateral shoulder abrasions	790202.1,1 790202.1,2	Child seat harness	Certain
Abrasion below right eye	290202.1,1	Unknown	Unknown
Bilateral upper chest abrasions	490202.1,3	Child seat harness	Probable
Chest wall contusions	490402.1,9	Unknown	Unknown

Third row middle occupant (07): Injuries obtained from discharge summary and radiology reports.

Injury	OIC Code	Injury Mechanism	Confidence Level
Bilateral frontal lobe shear injuries extending into brain stem	140206.5,8 140628.5,3	Unknown	Unknown
Large extracalvarial hematoma	140629.4,9	Unknown	Unknown
Bilateral lung contusions with right lower lobe atelectasis	441410.4,3	Seat back	Possible
4.0 cm (1.5 in) liver laceration	541822.2,1	Unknown	Unknown
6.0-8.0 cm (2.3-3.1 in) laceration extending from hair line on left frontal forehead posteriorly almost all the way to the occipital region	290602.1,7	Unknown	Unknown
Nasal fractures, bilaterally	251000.1,4	Unknown	Unknown

OCCUPANT INJURIES - 1995 Ford F250

Driver: Injuries obtained from police report.

Injury	OIC Code	Injury Mechanism	Confidence Level
Right leg fracture	852002.2,1	Unknown	

Front right occupant: Injuries obtained from emergency room records.

Injury	OIC Code	Injury Mechanism	Confidence Level
Bilateral knee abrasions	890202.1,1 890202.1,2	Lower instrument panel	Certain
Bilateral tibial contusions	890402.1,1 890402.1,2	Lower instrument panel	Certain
Contusion, right lateral malleolus	890402.1,1	Unknown	
Right ankle sprain	850206.1,1	Floor	
Chest wall contusions	490402.1,9	Shoulder harness	

OCCUPANT KINEMATICS - 1995 Ford Windstar

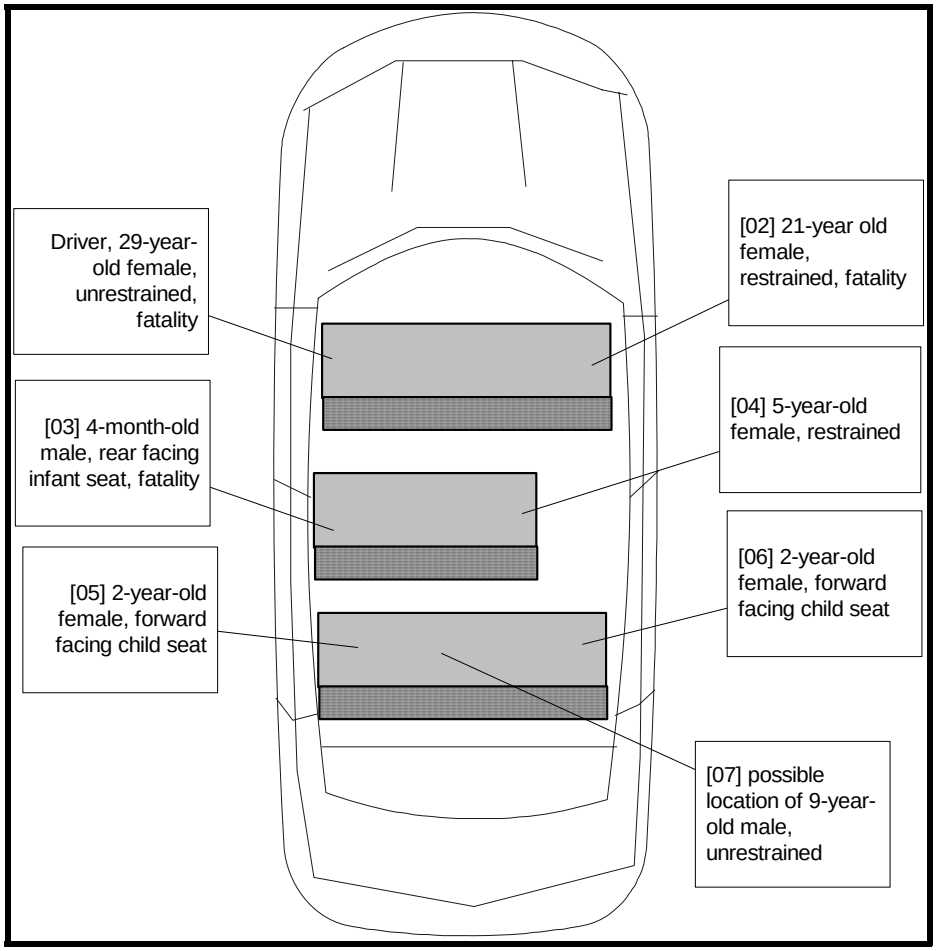

Figure 24. Seating diagram

The 29-year-old female driver of the case vehicle was seated in a forward facing fashion on a fabric covered bucket seat. The seat track position is not known. She was not using the available 3-point lap and shoulder belt. A steering wheel hub mounted frontal air bag was available. At impact, the driver responded to the 11 o'clock direction of force by pitching forward sharply and over-loading the deployed driver's air bag. Her abdomen compressed and deformed the lower steering wheel rim. This action likely caused the aortic transection, mesentery lacerations, liver and bladder lacerations. Her torso engaged the middle and top of the steering wheel. This caused the lung contusions and rib fractures. This also served as a

Figure 25. Deformation to bottom of steering wheel rim

pivot point. The driver's head pitched forward, hyper-flexing over the steering wheel. This movement likely caused the pons-medullary junction laceration and the cervical fractures. Both of the driver's knees struck the lower instrument panel, indirectly causing bilateral femur fractures and a left pelvis fracture.

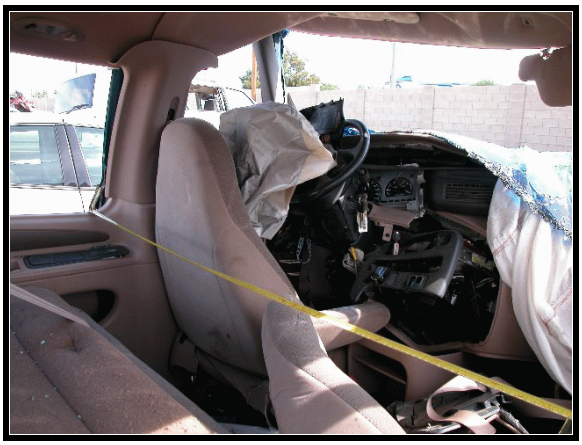

Figure 26. Driver's position

The 21-year-old female front right occupant (02) was seated in a normal upright fashion on a fabric covered bucket seat. Based on location of abrasion injuries to her face, she was facing left prior to impact. Based on post-crash photos, it appears that her legs were crossed–left leg over right. The seat had been adjusted to the full forward track position. She was wearing the available 3-point lap and shoulder belt. The seat belt anchorage was in the full down position. A front right passenger air bag was available. At impact, this occupant responded to the 11 o'clock direction of force by pitching forward and to the left. She engaged the loaded torso belt causing the multiple rib fractures and pulmonary contusion. Her abdomen engaged and loaded the lap belt–causing the liver and spleen lacerations. There were abrasions to the shoulder, torso, and abdomen that were likely related to seat belt usage. This occupant slid forward to some degree as her abdomen was compressed and engaged the glove compartment door–causing, indirectly, the right femur fracture. With her torso held in place, her head pitched forward sharply. It appears that she contacted the deployed air bag with the right side of her face–causing an abrasive injury. The pitching forward motion of her head (hyper flexion) and subsequent rearward motion of her head and torso from the air bag and rebound (hyper extension) both likely contributed to the pons medullary laceration and the C1 fracture. The hyper flexion was likely the most significant of the two. The rebound motion was significant. This occupant's head and torso were pushed rearward so that she came to rest with her back on the seat cushion and her head pivoted rearward so that her face was in contact with the seat back.

Figure 27. Webbing locked into front right passenger seat belt latch

The 4-month-old male second seat left occupant (03) was fatally injured. He was seated in an Evenflo Discovery rear facing infant safety seat. The seat was anchored to a fabric covered bench seat that was equipped with a folding back. Police photos show that the child was restrained using the 3-point harness. The investigating officer indicated that the seat was properly anchored to the case vehicle using the available lap and shoulder belt. This does not appear to be the case. The left rear seat position was equipped with an emergency locking retractor, which would have necessitated the use of a locking clip. There are no indications that

a locking clip was used. At impact, this occupant responded to the 11 o'clock direction of force by loading the infant seat back to the left and front. This likely caused the abrasions/contusions to the back of her head. She also sustained fatal brain injuries including brain lacerations and multiple skull fractures. These injuries appear to have been caused by contact with the second seat middle (04) occupant. As the impact took place, occupant 04 pitched forward and to the left. His left hand was likely outstretched and likely struck the head/face of this occupant.

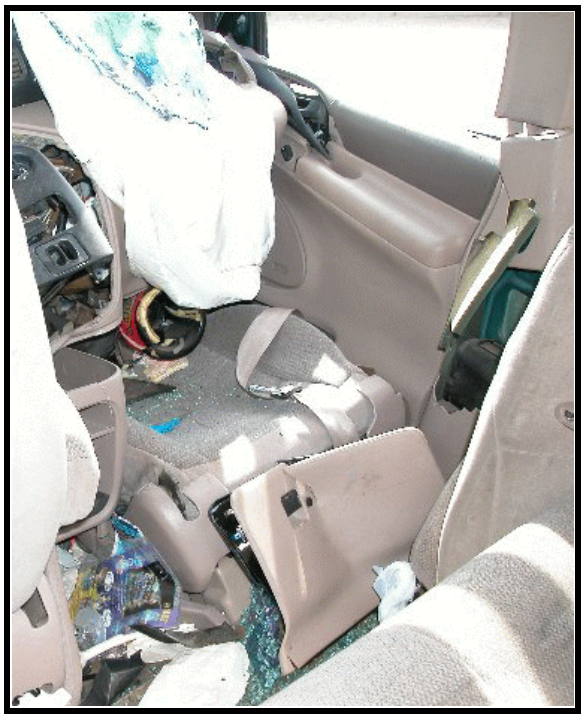

Figure 28. Front right seat position. Shows air bag and contact to glove compartment.

The 5-year-old female second seat right occupant (04) was seated in a forward facing fashion on a fabric covered bench seat that was equipped with a folding back. She was wearing the lap and shoulder belt. It was likely being worn incorrectly. This would be due to her stature and the remote offset location of the retractor. Markings on the belt indicate that there was substantial passage of the belt through the sliding latch during the impact. This would indicate that the belt was not being worn tightly. At impact, this occupant pitched forward and to the left. She likely by-passed the shoulder portion of the belt. As she continued forward, the belt spooled through the sliding latch until the belt began to be loaded by this occupant. The upper body of the child suddenly hyper-flexed around the now fixed lap belt. This likely caused the L3 Chance fracture and the thoracic cord contusions with the resultant loss of motor function. There was a compression of abdominal viscera causing a splenar laceration and a jejunal perforation. The lap belt also caused a large abrasion/contusion that began at the umbilicus and extended to the left all the way to the lumbar spine. There was a report of a possible injury to his left hand. It was x-rayed to determine if a fracture was present, but there was no evidence of fracture. As indicated earlier, it is believed that this contact was to the face/head of the left rear occupant.

Figure 29. Second row (Occupants 3 and 4)

Figure 30. Third row (Occupants 5, 6, and possibly 7)

The 2-year-old female third seat left occupant (05) was seated in a Cosco Alpha Omega forward facing child safety seat, model #02-0332, with a manufacture date of 10/2002. The child seat harness was adjusted to the top slot. The seat was anchored to a fabric covered bench seat that was equipped with a folding back. The third row left rear seat position was equipped with an emergency locking retractor, which would have necessitated the use of a locking clip. There are no indications that a locking clip was used. At impact, the child and child seat pitched forward and to the left. This occupant loaded the child seat harness, causing an abrasion to the left clavicle, an abrasion to the left side of the neck, and a contusion to the chest wall. There were indications of loading to the child seat harness, the lap and shoulder belt routing guide on the right side of the child seat, to the lap and shoulder belt itself, and to the D pillar lap and shoulder attachment. Both sides of the tray shield mounting fractured and came free during the crash. It appears likely that this was due to contact between the tray shield and the back of the second row of seats.

The 2-year-old female third seat right occupant (06) was seated in a Graco Century 1500 STE convertible forward facing child safety seat. The seat was anchored to a fabric covered bench seat that was equipped with a folding back. The third row right rear seat position was equipped with an emergency locking retractor, which would have necessitated the use of a locking clip. There are no indications that a locking clip was used. At impact, the child and child seat pitched forward and to the left. There were indications of loading to the lap and shoulder belt and to the D pillar lap and shoulder attachment. This occupant loaded the child seat harness, causing bilateral shoulder abrasions. She also sustained an abrasion below the right eye from some unknown source.

The 9-year-old male rear seat occupant was seated in an unknown location. The only open seat would have been the middle seat in the third row. There were no indications that this occupant was restrained. This occupant sustained bilateral frontal lobe brain injuries, bilateral lung contusions, a large forehead laceration, and a liver laceration. It is possible that this occupant was seated between the two third row seat occupants and impacted the rear of the second seat during the crash. There were marks to the rear of the second seat but most of these were related to extrication efforts and the stacking of other seats on top of this seat (it had been folded down at some point post-crash).

Attachment 1. Scene Diagram

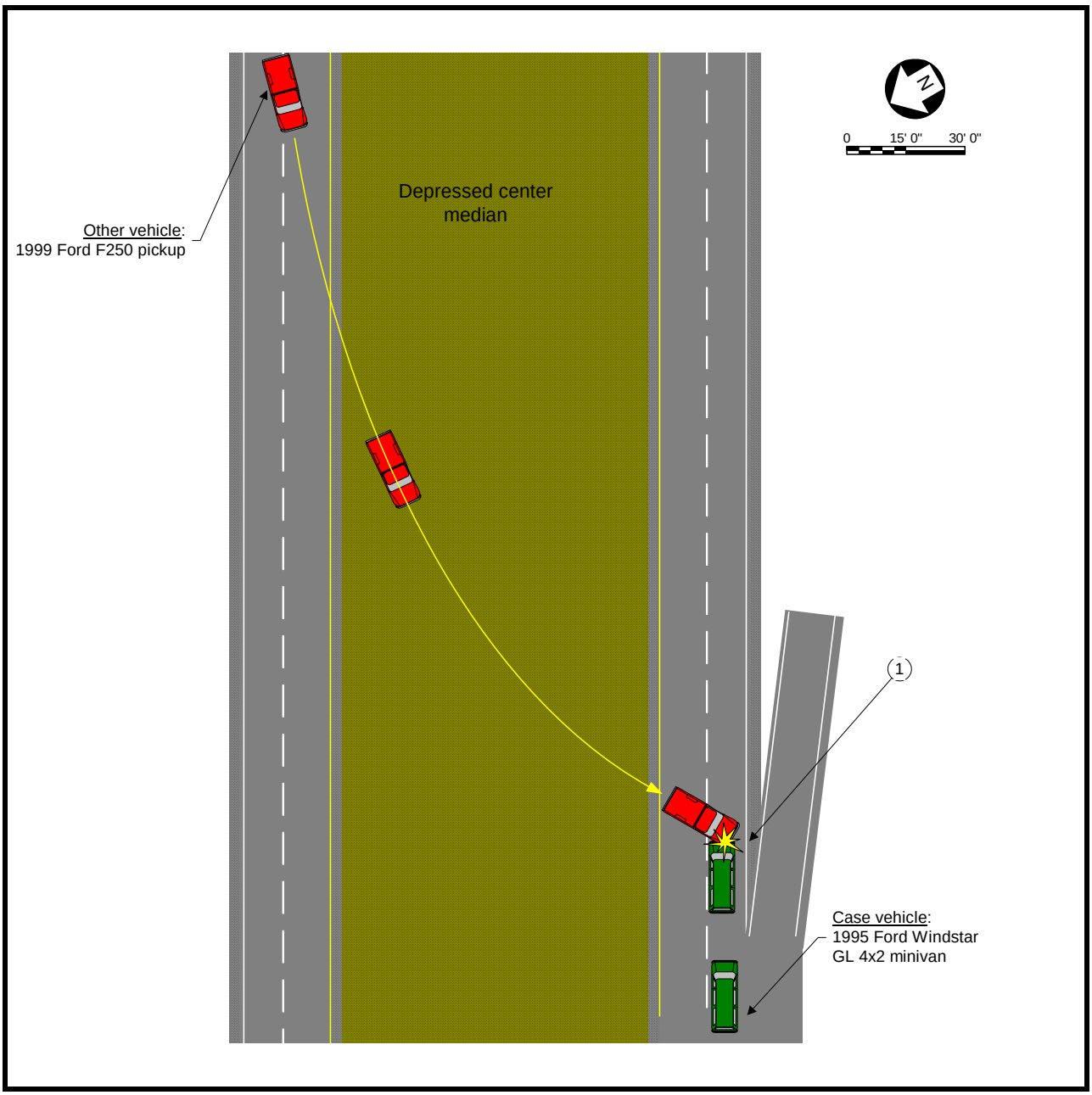

Figure 31. Scene diagram (1 of 2)

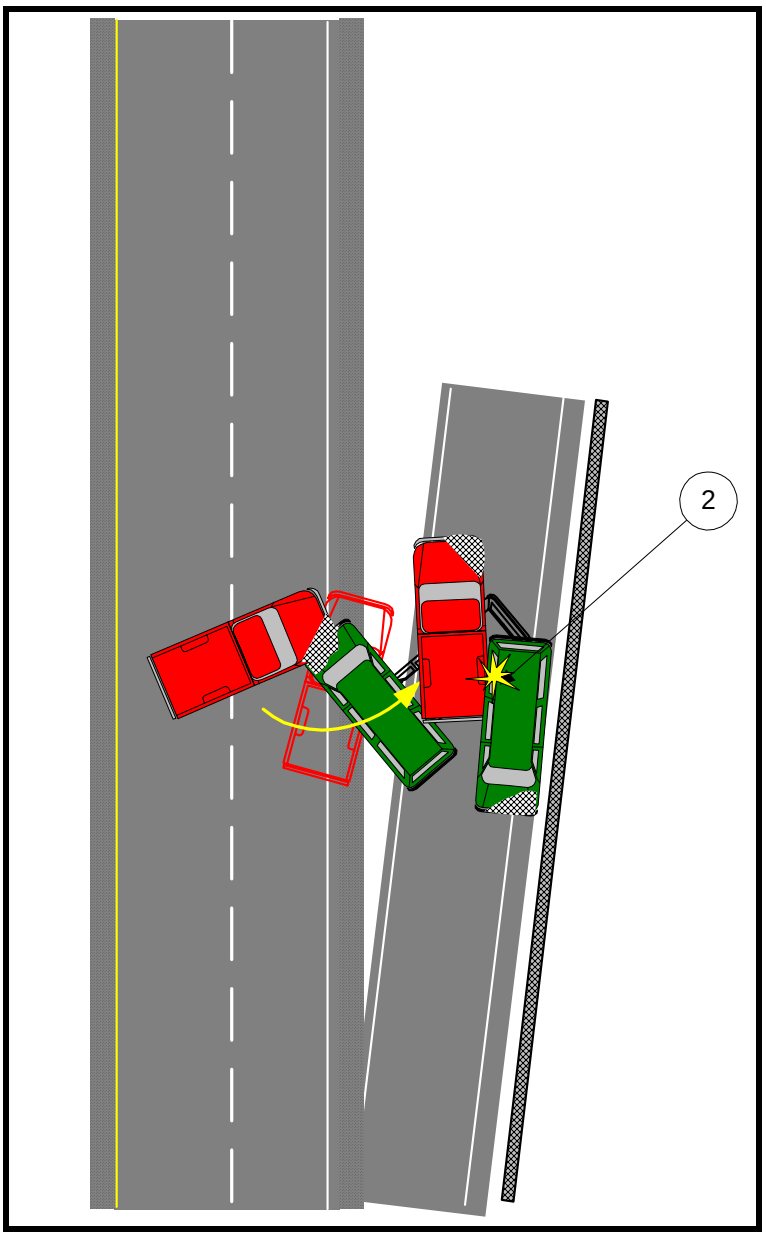

Figure 32. Scene diagram (2 of 2)