

**TRANSPORTATION SCIENCES  
CRASH DATA RESEARCH CENTER**

Veridian Engineering  
Buffalo, NY 14225

**VERIDIAN REMOTE ADAPTIVE CONTROL/DRIVER FATALITY CRASH  
INVESTIGATION  
SCI TECHNICAL SUMMARY REPORT**

**SCI CASE NO. - CA00-032**

**SUBJECT VEHICLE - 1992 FORD E-150 ECONOLINE VAN**

**LOCATION - STATE OF MICHIGAN**

**CRASH DATE - JUNE 2000**

Contract No. DTNH22-94-D-07058

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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 are 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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<p>16. <i>Abstract</i> This remote investigation focused on the fatal injury mechanisms of a 32-year-old male driver of an adaptive controlled 1992 Ford Econoline van that was involved in a head-on collision with a full-size Chevrolet pickup truck. The van was also occupied by a 45-year-old male front right passenger and a 13-year-old male passenger who was seated in the third seat center position. All of the occupants were restrained. The driver was reportedly a paraplegic with limited use of his upper extremities. The van was equipped with a tri-pin control on the steering wheel and a tri-pin control for the throttle and braking located inboard of the left front door. The driver was operating the van on a two-lane roadway that was being resurfaced. The left front tire sustained tread separation on the uneven road surface and the driver lost control of the vehicle. The van traveled across the centerline and struck the pickup truck in a head-on configuration. The occupants of the van initiated forward trajectories and loaded the manual restraints. The driver sustained multiple abrasions to the chest and legs from loading the wheelchair's lap belt, a modified 2-point shoulder belt, and the knee bolster. His close proximity to the steering wheel allowed him to load the tri-pin mechanism on the steering wheel which resulted in a sternum fracture, multiple lung contusions and lacerations with hemothorax, a large liver laceration, and spleen lacerations. The driver expired immediately after the crash. The out-of-position front right passenger sustained police-reported fractured ribs from probable contact with the center instrument panel. The third seat passenger's torso flexed over the lap belt and he sustained a fractured jaw and a fracture to the left facial area from probable contact with his knee. The front right passenger and the third seat passenger were transported by ambulance to a local hospital and admitted for treatment.</p>			
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## Table of Contents

BACKGROUND .....	1
SUMMARY .....	2
Crash Site .....	2
Pre-Crash .....	2
Crash .....	2
Post-Crash .....	3
VEHICLE DATA - 1992 Ford E-150 Econoline Van .....	3
VEHICLE DAMAGE .....	5
Exterior Damage - 1992 Ford E-150 Econoline Van .....	5
Interior Damage - 1992 Ford E-150 Econoline Van .....	6
Exterior Damage - 1992 Chevrolet K-1500 Pickup Truck .....	7
MANUAL RESTRAINT SYSTEM - 1992 Ford E-150 Econoline Van .....	7
OCCUPANT DEMOGRAPHICS - 1992 Ford E-150 Econoline Van .....	8
Driver .....	8
Driver Injuries .....	8
Driver Kinematics .....	9
Front Right Passenger .....	10
Front Right Passenger Injuries .....	10
Front Right Passenger Kinematics .....	10
Third Seat Passenger .....	11
Third Seat Passenger Injuries .....	11
Third Seat Passenger Kinematics .....	11
POLICE SCENE SCHEMATICS .....	12

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LOCATION - STATE OF MICHIGAN  
CRASH DATE - JUNE 2000**

***BACKGROUND***

This remote investigation focused on the fatal injury mechanisms of a 32-year-old male driver of an adaptive controlled 1992 Ford Econoline van (**Figure 1**) that was involved in a head-on collision with a full-size Chevrolet pickup truck. The van was also occupied by a 45-year-old male front right passenger and a 13-year-old male passenger who was seated in the third seat center position. All of the occupants were restrained. The driver was reportedly a paraplegic with limited use of his upper extremities. The van was equipped with a tri-pin control on the steering wheel and a tri-pin control for the throttle and braking located inboard of the left front door. The driver was operating the van on a two-lane roadway that was being resurfaced. The left front tire sustained tread separation on the uneven road surface and the driver lost control of the vehicle. The van traveled across the centerline and struck the pickup truck in a head-on configuration. The occupants of the van initiated forward trajectories and loaded the manual restraints. The driver sustained multiple abrasions to the chest and legs from loading the wheelchair's lap belt, a modified 2-point shoulder belt, and the knee bolster. His close proximity to the steering wheel allowed him to load the tri-pin mechanism on the steering wheel which resulted in a sternum fracture, multiple lung contusions and lacerations with hemothorax, a large liver laceration, and spleen lacerations. The driver expired immediately after the crash. The out-of-position front right passenger sustained police-reported fractured ribs from probable contact with the center instrument panel. The third seat passenger's torso flexed over the lap belt and he sustained a fractured jaw and a fracture to the left facial area from probable contact with his knee. The front right passenger and the third seat passenger were transported by ambulance to a local hospital and admitted for treatment.



**Figure 1. Damaged 1992 Econoline van**

The Crash Investigations Division of the National Highway Traffic Safety Administration (NHTSA) was informed of the crash by a third party who was involved in the adaptive equipment industry. NHTSA subsequently assigned a remote investigation of the crash to the Veridian SCI team. The crash occurred in June 2000, and a police crash report, police photographs, insurance company photographs, autopsy report, and vehicle modification specifications have been obtained and provided the basis for this summary report.

## ***SUMMARY***

### **Crash Site**

This two-vehicle crash occurred on a two-lane highway during daylight hours in June 2000. At the time of the crash, the weather was clear and the roadway surface was dry. Police reported the temperature to be 20 degrees Celsius (68 degrees Fahrenheit). The roadway surface was coarse due to the top layer of asphalt having been removed for resurfacing. The north/south roadway consisted of two travel lanes that were separated by a dashed yellow centerline and bordered by gravel shoulders. The roadside environment consisted of grassy fields and trees. There were no traffic controls present at the scene and the posted speed limit was 89 km/h (55 mph).

### **Pre-Crash**

The 32-year-old driver of the 1992 Ford van was operating the vehicle via the hand controls in a northbound direction on the two-lane roadway at a police-estimated speed of 72 km/h (45 mph). The 1992 Chevrolet pickup was traveling southbound in the opposite lane. The van's front left tire sustained a tread separation and depressurized at a rapid rate. The investigating officer documented that the tread separation occurred approximately 65 m (212') south of the point of impact. The tread separation and air-out caused the driver to lose control of the van and the vehicle pulled left across the centerline into the path of the oncoming Chevrolet pickup truck. The driver reportedly had difficulty regaining control of the van with the adaptive hand controls. The front right passenger leaned to the left and grabbed the steering wheel in an attempt to assist the driver in regaining control of the van immediately prior to impact with the Chevrolet pickup truck. The driver of the pickup truck detected the van encroaching into the southbound lane and braked and steered right in an attempt to avoid the collision. The investigating officer documented approximately 9 m (30') of pre-impact skid marks from the pickup truck. The police scene schematics are included as **Figures 15 and 16**.

### **Crash**

The vehicles impacted in a head-on configuration. Impact resulted in severe damage to both vehicles. The directions of force were in the 12 o'clock sectors for both vehicles. The damage algorithm of the WinSMASH program computed a delta-V of 51.0 km/h (31.7 mph) for the Ford van and a delta-V of 71.0 km/h (44.1 mph) for the Chevrolet pickup truck based on estimated crush profiles. The Ford van's weight made it the dominant vehicle, and the momentum of the van displaced the pickup truck rearward. Based on the police scene schematic, the Ford van traveled forward approximately 5 m (16') and rotated approximately 10 degrees in a CW direction. The Chevrolet pickup truck was displaced rearward approximately 6 m (19') and rotated approximately 60 degrees in a clockwise (CW) direction. The van came to rest in a northbound orientation on the west shoulder and the pickup truck came to rest facing southwest on the west shoulder (**Figure 2**).



**Figure 2. On-scene photograph showing final rest positions**

## Post-Crash

The occupants were removed from their respective vehicles by rescue personnel. The front right passenger in the Ford van sustained police-reported fractured ribs and was transported by ambulance to a local hospital and admitted for treatment. The third seat passenger in the van sustained a fractured mandible, a left facial fracture, and multiple lacerations and contusions. He was transported by ambulance to a local hospital and admitted for treatment. The driver of the adaptive controlled Ford van expired at the scene and was transported by ambulance to a local hospital where he was pronounced dead.

### ***VEHICLE DATA - 1992 Ford E-150 Econoline Van***

The 1992 Ford E-150 Econoline van was identified by the Vehicle Identification Number (VIN): 1FDEE14N3NH (production sequence omitted). The van was manufactured as an incomplete vehicle and was equipped with a 5.0 liter, V-8 engine, front disc and rear drum brakes, four-speed automatic transmission, and power steering. The Ford van was equipped with Goodyear Wrangler HT P235/75R15 tires for the right front, left rear, and right rear wheels. The left front wheel was equipped with a General AmeriWay XT P235/75R15 tire. The DOT number was ACHL 42 P109.

The van was modified for wheelchair access and specifically adapted for the needs of the driver by a private company that specialized in custom fitting/installation of adaptive driving equipment. The van was configured with a 15 cm (6") drop floor that extended forward from the third row bench seat with a driver cut-out. The fuel tank was repositioned aft of the rear axle due to the drop floor. The van was also configured with a Viking Executive TV top with a support cage. The driver's seat was removed to accommodate a motorized wheelchair, and an E-Z lock restraint device (**Figure 3**) was installed to secure the wheelchair in position. The base lock was mounted on the floor of the van, and acted as the receiver for the locking interfacing pin that was mounted on the wheelchair. Entry into the lock was mechanical, and the release was effected by an electrical pull solenoid. An emergency mechanical release was also present. A control module for the E-Z Lock system was located on the interior of the left B-pillar. Its functions included release of the E-Z Lock, alarm buzzer deactivation for unoccupied use, and various warning indicators.

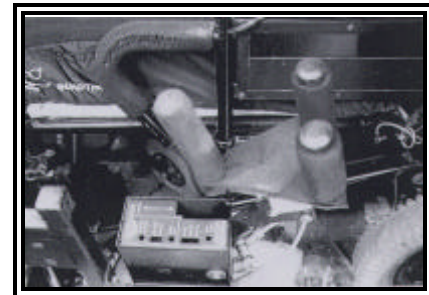


**Figure 3. E-Z Lock restraint device**

A tri-pin assembly was attached to the steering wheel rim near the 6 o'clock position (**Figure 4**). The system allowed the driver to insert his wrist between two pins, and grip the third with his hand. Since the driver had limited use of his upper extremities, the system facilitated steering by means of a zero-effort control. It was not known if modifications were made to the power steering. A VGB tri-pin assembly was also used for the throttle/brake system (**Figure 5**). A vertical bracket that measured approximately 60 cm (24") in height and 25 cm (10") front-to-back was mounted slightly inboard of the left front door. The tri-pin was mounted on the top rear aspect of the bracket. The system allowed the driver to place his wrist through the two rear pins and grip the forward pin with his left hand. The throttle was engaged by pushing the tri-pin forward, and pulling rearward would apply the brakes. The throttle/brake system was a low-effort system. Based on a conversation with the modification company, the throttle/brake engagement could be configured for either direction, based on the individual prescription. The throttle/brake system had an integrated rocker switch at the lower aspect and lateral movement would activate the respective directional signals on the vehicle. The van was also equipped with elbow pad controls for the horn and emergency wipers.



**Figure 4. View of steering wheel tri-pin device**







**Figure 5. View of tri-pin throttle/brake system**

A center console/panel with multiple large toggle switches (quad console) was added to the center instrument panel. All of the vehicle's electrical functions were rerouted to this center console and were activated by the toggle switches. The toggle switches controlled the ignition, power windows, locks, electric gear shift selector, and heater and air conditioning.

The 1992 Ford E-150 van was also equipped with a Ricon Uni-Lite automatic wheelchair lift. The lift was constructed of aluminum alloy and rated to 273 kg (600 lb). The lift was designed for use by a person in a wheelchair or by an attendant. Standard features of the lift were outboard handrails with a control switch, electric motor and direct gear drive, and a powered roll stop with a mechanical latch. The lift was also equipped with a manual backup system that included a wrench and a simple modular electrical system.



The wheelchair lift was installed inboard of the right side hinged doors and centered between the doors. The lift was configured with four functions. The descriptions of the lift functions are summarized in the following chart (**Figure 6**) from the owner’s manual:

TABLE [3-1]: LIFT FUNCTIONS	
FUNCTION	DESCRIPTION
 / DEPLOY	Platform unfolds/deploys out of the vehicle from the stowed position. (If equipped with Ricon power door operator, the door(s) automatically open before the lift deploys.)
 / DOWN	Platform is lowered from vehicle floor level position to the ground level. (The rollstop automatically lowers when platform reaches ground level.)
 / UP	Platform is raised from ground level to the vehicle floor level. (The rollstop automatically raises when the platform leaves ground level).
 / STOW	Platform folds/stows from the vehicle floor level to the stowed position. (If equipped with Ricon power door operator, the door(s) automatically close after the lift stows.)
END OF TABLE	

**Figure 6. Lift function descriptions from the owner’s manual**

The right side hinged doors were equipped with a Ricon power door operator. The power door operator electrically opened and closed the swing-type van doors. The system provided up to 90 degrees of motion for each door. The power door operator was installed internally within the door behind the door panel. Adjustable bell cranks provided smooth operation and a weatherproof closure, and the system design eliminated any potential “slap-back” when the door was open. The power door operator was designed to work in conjunction with the wheelchair lift. As the lift was activated to “Deploy”, the power door operator automatically opened the van’s hinged doors. After the ramp had been used and was activated to “Stow”, the power door operator automatically closed the van doors.

**VEHICLE DAMAGE**

**Exterior Damage - 1992 Ford E-150 Econoline Van**

Exterior damage to the 1992 Ford E-150 Econoline van was based on police photographs and insurance company photographs. The van sustained severe frontal damage as a result of the impact with the Chevrolet pickup truck (**Figure 7**). The direct damage began slightly inboard of the front left bumper corner and extended laterally across the bumper to the front right bumper corner. The combined direct and induced damage involved the entire frontal width of the vehicle. The maximum longitudinal crush was located at the front right bumper corner and was estimated to be approximately 56 cm (22"). The front bumper was displaced rearward and upward on the right aspect. The left



**Figure 7. View of frontal damage to the 1992 Ford Van**

corner of the bumper was displaced forward and downward. The bumper cover was separated from the bumper. The radiator supports and engine components were crushed rearward. The hood was displaced and buckled rearward, and fractured on the right and left aspects. The left front fender sustained minor induced buckling, and the right front fender was crushed rearward. The right A-pillar was displaced rearward and the right front door and right side swinging doors were displaced from induced damage (**Figure 8**). The impact resulted in the rearward displacement of the right front wheel which shortened the right wheelbase by 21 cm (8") based on police measurements. The Collision Deformation Classification (CDC) for the impact was 12-FDEW-4. Six crush measurements were estimated from the insurance photographs along the front bumper and were as follows: C1 = 0.0 cm, C2 = 13 cm (5"), C3 = 40 cm (16"), C4 = 38 cm (15"), C5 = 53 cm (20"), C6 = 56 cm (22").



**Figure 8. Right side view of damaged 1992 Ford van**

The left front tire sustained tread separation prior to the crash which resulted in the driver's control loss of the vehicle (**Figures 9-11**). The investigating officer noted tire fragments south of the crash scene and rubber deposits on the left front fender. The left front tire was a General AmeriWay XT All Season P235/75R15 tire.



**Figure 9. Damaged left front tire**



**Figure 10. Closeup view of tire damage**



**Figure 11. View of separated tire tread**

#### **Interior Damage - 1992 Ford E-150 Econoline Van**

Interior damage to the 1992 Ford E-150 Econoline van was based on police and insurance company photographs. The windshield was fractured from impact forces. The van sustained moderate interior damage as a result of intrusion and occupant contact (**Figure 12**). The left instrument panel was displaced from the crash forces and probable contact from the driver. The center and right aspects of the instrument panel were also displaced from crash forces. Probable longitudinal intrusions included the left, center, and right instrument panel, left toe pan, right toe pan, and right A-pillar. The wheelchair lift was displaced as a result of the



**Figure 12. Interior view of the front left area**

crash, however, it was not visible in the on-scene police photographs. Based on the remote nature of this case and available photographs, it was not known which way the lift was displaced in the crash or if the mounting hardware separated. The displaced wheelchair lift was visible in the insurance company photographs and had been placed on the floor behind the front seat area.

### **Exterior Damage - 1992 Chevrolet K-1500 Pickup Truck**

The exterior damage to the 1992 Chevrolet K-1500 pickup truck was based on police and insurance company photographs. The vehicle sustained severe frontal damage as a result of the impact with the Ford E-150 van (**Figure 13**). The direct damage began at the front left bumper corner and extended laterally to the front right bumper corner. The combined direct and induced damage also involved the entire frontal width of the pickup truck. The maximum crush was located at the front right bumper corner and was estimated to be approximately 90 cm (35"). The bumper and radiator supports were crushed rearward. The hood was buckled and folded. The left and right front fenders were crushed rearward and the right fender sustained outward buckling. The frontal crush displaced the front wheels rearward. Based on police measurements, the post-crash left wheelbase was shortened by 28 cm (11") and the right wheelbase was shortened 31 cm (12"). Both A-pillars were displaced and the roof side rails of the cab were deformed slightly upward. Both side doors were displaced from induced damage. The frame appeared to be deformed as a result of the impact. The CDC for the impact with the Ford E-150 van was 12-FDEW-4.



**Figure 13. View of frontal damage to the 1992 Chevrolet pickup truck**

### **MANUAL RESTRAINT SYSTEM - 1992 Ford E-150 Econoline Van**

The 1992 Ford E-150 Econoline van was equipped with a modified manual 2-point shoulder belt for the driver. A separate manual 2-point lap belt was installed on the wheelchair frame, that was installed by the wheelchair manufacturer. It was not known if the 2-point wheelchair restraint was designed for vehicle safety or to maintain the occupant's posture. The length, width, and structure of the wheelchair restraint was not known. The fixed-length 2-point shoulder belt was anchored to the left roof side rail approximately 13 cm (5") aft of the left B-pillar and configured with a locking latch plate (**Figure 14**). An approximate 1 m (3') section of webbing configured with a buckle was anchored to the floor on the inboard aspect of the driver's seat. This configuration allowed the latch plate to engage with the buckle across the driver's lower torso area so the slack could be adjusted at the locking latch plate. The 2-point shoulder belt reportedly remained buckled all the time, and the driver regularly "drove" the wheelchair into the E-Z Lock mechanism, which allowed the 2-point shoulder belt to be positioned across his left shoulder and chest. An aftermarket padded sleeve



**Figure 14. View of 2-point shoulder belt mounted aft of the left B-pillar**

was present on the shoulder belt at the time of the crash. A manual 3-point lap and shoulder belt was available for the front right passenger. The investigating officer reported that the belt webbing showed stretch marks from loading of the front right passenger. The webbing was cut by rescue personnel to remove the occupant from the van.

The rear seat was not visible in any of the photographs, and the manual restraints could not be identified. The police report indicated the rear occupant was restrained by a lap belt which was cut by rescue personnel.

***OCCUPANT DEMOGRAPHICS - 1992 Ford E-150 Econoline Van***

**Driver**

Age/Sex: 32-year-old male  
 Height: 185 cm (73")  
 Weight: 73 kg (160 lb)  
 Seat Track Position: N/A  
 Manual Restraint Use: Fixed-length 2-point shoulder belt, lap belt attached to wheelchair  
 Usage Source: On-scene photographs, police report  
 Eyewear: Unknown  
 Type of Medical Treatment: Fatally injured and did not receive medical treatment

**Driver Injuries**

<b>Injury</b>	<b>Injury Severity (AIS 90/Update 98)</b>	<b>Injury Mechanism</b>
Bilateral lung contusions	Severe (441410.4,3)	Tri-pin mechanism and steering wheel rim
Bilateral lung lacerations with hemothorax	Severe (441450.4,3)	Tri-pin mechanism and steering wheel rim
Large liver laceration	Severe (541826.4,1)	Tri-pin mechanism and steering wheel rim
Sternum fracture	Moderate (450804.2,4)	Tri-pin mechanism and steering wheel rim
Multiple spleen lacerations (NFS)	Moderate (544220.2,2)	Tri-pin mechanism and steering wheel rim
Right upper chest abrasion	Minor (490202.1,1)	Shoulder belt webbing
Right chest abrasion	Minor (490202.1,1)	Shoulder belt webbing

<b>Injury</b>	<b>Injury Severity (AIS 90/Update 98)</b>	<b>Injury Mechanism</b>
Diagonal abrasion across the center of chest (left-to-right)	Minor (490202.1,4)	Shoulder belt webbing
Lower left chest abrasion	Minor (490202.1,2)	Tri-pin mechanism and steering wheel rim
Left posterior forearm abrasion	Minor (790202.1,2)	Tri-pin mechanism and throttle/brake mechanism
Right posterior forearm contusion	Minor (790402.1,1)	Tri-pin mechanism and steering wheel rim
Bilateral knee abrasions	Minor (890202.1,3)	Knee bolster
Bilateral lower leg abrasions	Minor (890202.1,3)	Knee bolster

Injury source: Autopsy report

**Driver Kinematics**

The 32-year-old male driver of the Ford E-150 Econoline van was seated in an upright posture in a motorized wheelchair. The wheelchair was secured with the floor-mounted E-Z Lock device, and the driver was restrained in the wheelchair by the 2-point type restraint. It was not known of the 2-point type restraint was designed for vehicle safety or to maintain the occupant’s posture. He was restrained in the vehicle by the vehicle’s 2-point manual shoulder belt. The driver was utilizing a padded sleeve on the shoulder belt at the time of the crash, which was visible in the on-scene photographs. The driver was paralyzed from a previous incident and had limited use of his upper extremities. Based on the proximity of the wheelchair to the steering wheel, it appears that his right arm was bent approximately 90 degrees at the elbow. This position allowed him to steer the vehicle utilizing the mobility in his upper arm. He used his left arm to operate the throttle/brake controls located on the outboard side of the driver’s seat. The tri-pin grip allowed him to use the upper aspect of his left arm to move the throttle/brake control fore and aft.

As the driver was operating the van, the left front tire sustained tread separation which caused the driver to lose control of the vehicle. At impact with the Chevrolet pickup truck, the driver initiated a forward trajectory and loaded the wheelchair’s manual 2-point lap belt which resulted in an abrasion on the anterior upper right leg. He loaded the vehicle’s 2-point shoulder belt which resulted in abrasions to the right chest, diagonal abrasions on the center aspect of his chest, and a left chest abrasion. The wheelchair appeared to have remained in position within the E-Z Lock restraint. Due to the driver’s close proximity to the steering wheel, he loaded the knee bolster with his knees and loaded the steering wheel with his chest and abdomen. The contact with the tri-pin mechanism and the steering wheel rim resulted in multiple bilateral lung contusions and lacerations with hemothorax, a large liver laceration, spleen lacerations, and a sternum fracture. The position of his right forearm in the tri-pin mechanism on the steering wheel allowed the

posterior aspect of his right arm to move forward and contact the steering wheel rim which resulted in a contusion on the posterior aspect of his right arm. The driver's left forearm was positioned in the throttle/brake tri-pin mechanism outboard of the driver's seat, and the forward motion of his left forearm in the mechanism resulted in an abrasion to the left posterior forearm. The knee bolster contact resulted in bilateral anterior knee and lower leg abrasions.

The driver expired at the scene and was transported by ambulance to a local hospital where he was pronounced dead. Police photographs show the post-crash position of the driver slumped to the right with the shoulder belt positioned across the upper left arm. He came to rest with the tri-pin and steering wheel rim against the upper aspect of his abdomen.

**Front Right Passenger**

Age/Sex: 45-year-old male  
 Height: Not reported  
 Weight: Not reported  
 Seat Track Position: Appeared to be in a mid-track position in police photographs  
 Restraint Use: Manual 3-point lap and shoulder belt  
 Usage Source: Police report  
 Eyewear: Unknown  
 Type of Medical Treatment: Transported by ambulance to a regional trauma center

**Front Right Passenger Injuries**

Injury	Injury Severity (AIS 90/Update 98)	Injury Mechanism
Rib fractures (NFS)	Moderate (450210.2,9)	Center console/center instrument panel

Injury source: Police report

**Front Right Passenger Kinematics**

The 45-year-old male front right passenger was presumed to have been seated in an upright posture prior to the crash and was restrained by the manual 3-point lap and shoulder belt. After the tread separation, the driver lost control of the vehicle. As the van crossed the centerline the front right passenger leaned to the left and attempted to grab the steering wheel and assist the driver in regaining control of the van, which placed him out-of-position at the time of the crash. At impact, the front right passenger initiated a forward trajectory. Due to his position, his upper torso was inboard of the shoulder belt and loaded the added center console/panel and right instrument panel. He sustained police-reported rib fractures. He was transported by ambulance to a local hospital and admitted for treatment.

### Third Seat Passenger

Age/Sex: 13-year-old male  
Height: Unknown  
Weight: Unknown  
Seat Track Position: Fixed  
Restraint Use: Manual lap belt  
Usage Source: Police report  
Eyewear: Unknown  
Type of Medical Treatment: Transported by ambulance to a regional trauma center

### Third Seat Passenger Injuries

Injury	Injury Severity (AIS 90/Update 98)	Injury Mechanism
Fractured mandible (NFS)	Minor (250600.1,9)	Probable contact with knees due to flexion over the lap belt
Fractured left facial bone (NFS)	Minor (250400.1,2)	Probable contact with knees due to flexion over the lap belt

Injury source: Police report

### Third Seat Passenger Kinematics

The 13-year-old male passenger was presumed to have been seated in an upright posture on the center position of the third seat. He was restrained by the lap belt. At impact, he initiated a forward trajectory and loaded the lap belt. His torso most likely flexed over the lap belt which allowed his face to contact his knees. He sustained a left facial fracture and a mandible fracture from the probable contact with his knees. First responders cut the lap belt and the 13-year-old was removed from the vehicle by rescue personnel. He was transported by ambulance to a local hospital and admitted for treatment. Although the only injuries listed were facial fractures, the child was unconscious and heavily medicated after arrival at the hospital, which suggested that he sustained additional injuries that were not reported.

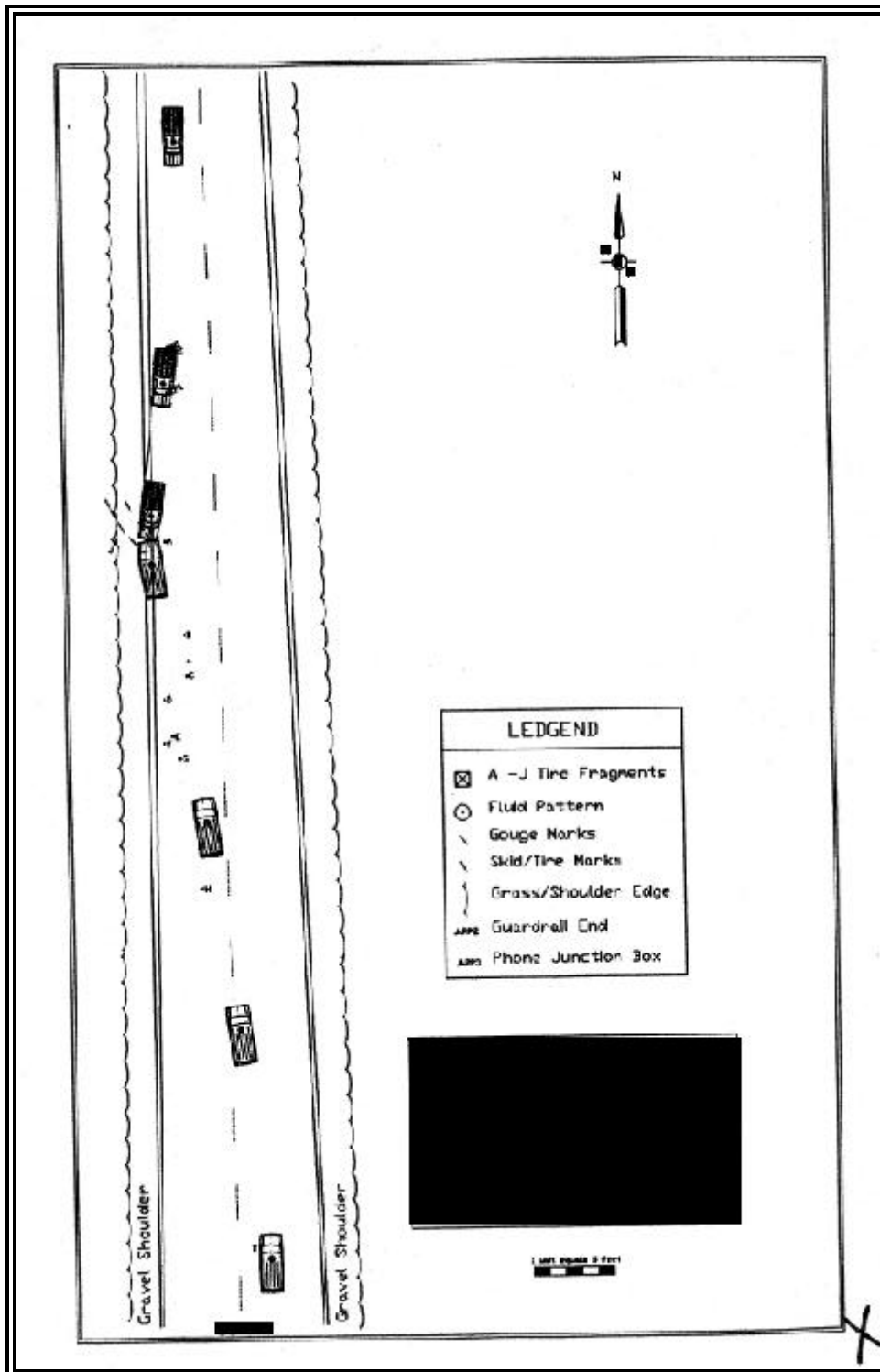


Figure 15. Police scene schematic showing pre-crash trajectories



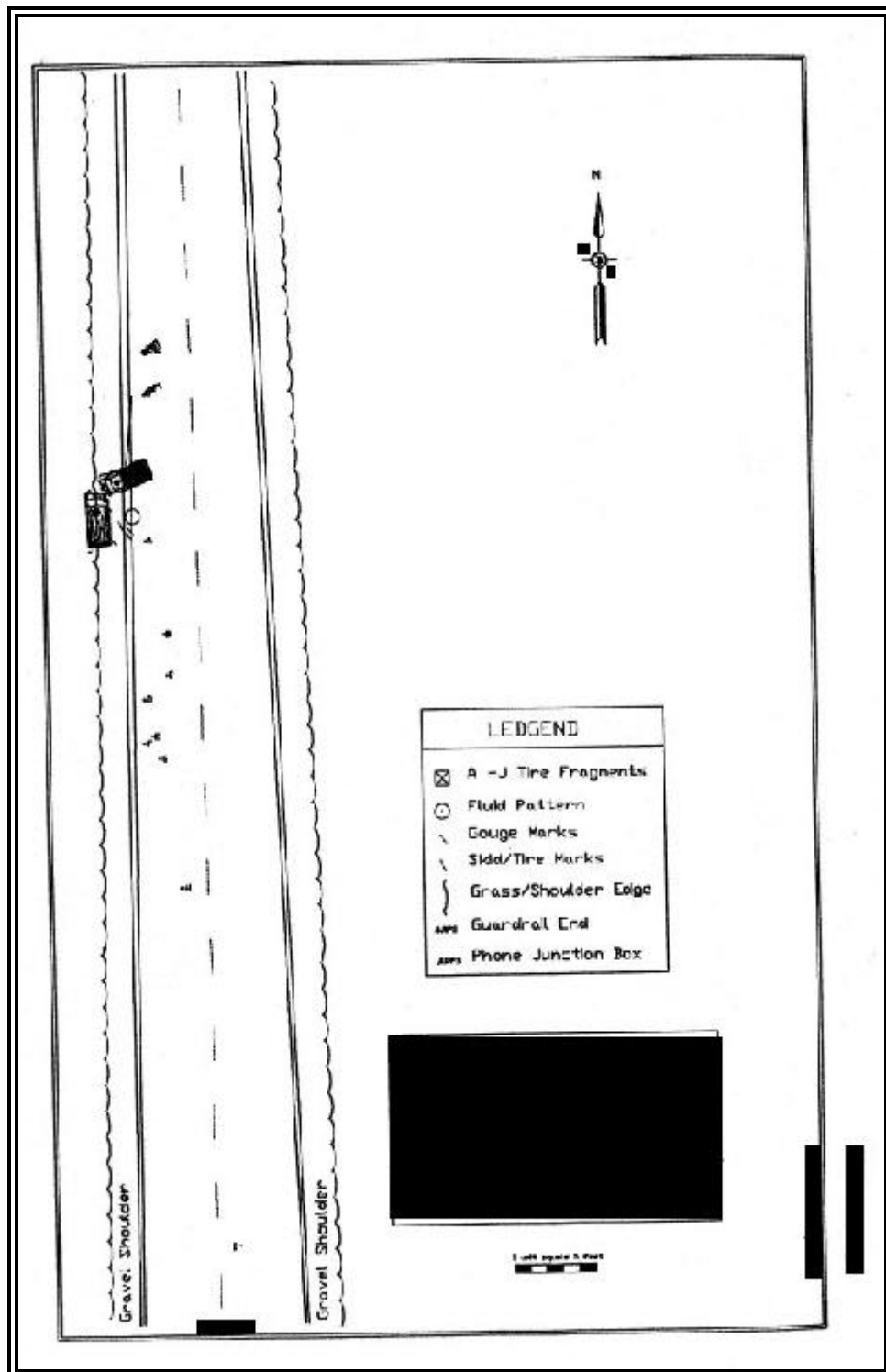


Figure 16. Police scene schematic showing final rest positions