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CRASH DATA RESEARCH CENTER

General Dynamics
Buffalo, NY 14225

GENERAL DYNAMICS ON-SITE CHILD SAFETY SEAT INVESTIGATION
SCI TECHNICAL SUMMARY REPORT

CASE NO. CA03-014

VEHICLE – 1993 PONTIAC GRAND AM

LOCATION - STATE OF NEW YORK

CRASH DATE – FEBRUARY 2003

Contract No. DTNH22-01-C-17002

Prepared for:

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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.

TECHNICAL REPORT STANDARD TITLE PAGE

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16. Abstract This on-site investigation focused on the installation and performance of a forward-facing convertible child safety seat (CSS) installed in a 1993 Pontiac Grand Am. The Grand Am was occupied by a 24-year-old male driver, and a 14-month-old male child in a forward-facing convertible CSS that was installed in the rear center position. The CSS was an older model Fisher-Price that was configured with metal tube framework, a plastic shell, and a T-shield. The Grand Am was involved in a side impact intersection collision with a 1991 Chevrolet Silverado pickup truck. The driver of the Grand Am disregarded a stop sign and entered the intersection across the path of a 1991 Chevrolet Silverado pickup truck. The impact resulted in severe left side damage to the Grand Am and moderate frontal damage to the pickup truck. The driver of the Grand Am was restrained by the automatic door-mounted 3-point lap and shoulder belt. He loaded the intruded left side components which resulted in fractures of the left 9th and 12th posterior ribs, and left 1st rib fracture with hemo/pneumothorax, an extraperitoneal bladder rupture, a left renal contusion, a Grade II laceration of the splenic lobe, bilateral superior/inferior pubic rami fractures, and a left sacral fracture, right and left frontal lobe contusions, a closed head injury, a mandible injury, a contusion of left superior eyelid, and a laceration of left superior eyelid. His rebound into the center console resulted in a Grade I hepatic subcapsular hematoma. The 14-month-old child passenger loaded the harness system of the CSS that was secured by the lap belt. He sustained facial lacerations from flying glass. The driver was transported by ambulance to a regional trauma center and admitted. The child passenger was transported by ambulance to a regional children's hospital and admitted.			
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TABLE OF CONTENTS

GENERAL DYNAMICS ON-SITE CHILD SAFETY SEAT CRASH INVESTIGATION
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SUBJECT VEHICLE – 1993 PONTIAC GRAND AM
LOCATION - STATE OF NEW YORK
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BACKGROUND

This on-site investigation focused on the installation and performance of a forward-facing convertible child safety seat (CSS) installed a 1993 Pontiac Grand Am. The Grand Am was occupied by a 24-year-old male driver, and a 14-month-old male child in a forward-facing convertible CSS that was installed in the rear center position. The CSS was an older model Fisher-Price that was configured with metal tube framework, a plastic shell, and a T-shield. The Grand Am was involved in a side impact intersection collision with a 1991 Chevrolet Silverado pickup truck. The driver of the Grand Am disregarded a stop sign and entered the intersection across the path of a 1991 Chevrolet Silverado pickup truck. The impact resulted in severe left side damage to the Grand Am **(Figure 1)** and moderate frontal damage to the pickup truck. The driver of the Grand Am was restrained by the automatic door-mounted 3-point lap and shoulder belt. He loaded the intruded left side components which resulted in fractures of the left 9th and 12th posterior ribs, and left 1st rib fracture with hemo/pneumothorax, an extraperitoneal bladder rupture, a left renal contusion, a Grade II laceration of the splenic lobe, bilateral superior/inferior pubic rami fractures, and a left sacral fracture, right and left frontal lobe contusions, a closed head injury, a mandible injury, a contusion of left superior eyelid, and a laceration of left superior eyelid. His rebound into the center console resulted in a Grade I hepatic subcapsular hematoma. The 14-month-old child passenger loaded the harness system of the CSS that was secured by the lap belt. He sustained facial lacerations from flying glass. The driver was transported by ambulance to a regional trauma center and admitted. The child passenger was transported by ambulance to a regional children's hospital and admitted.

Figure 1. Damaged 1993 Pontiac Grand Am

This crash was identified through a local police agency. The crash information was forwarded from the General Dynamics SCI team to the Crash Investigation Division of the National Highway Traffic Safety Administration (NHTSA) due to the presence of the CSS. An on-site investigation was initiated on February 26, 2003.

VEHICLE DATA – 1993 PONTIAC GRAND AM

The 1993 Pontiac Grand Am was identified by the Vehicle Identification Number (VIN): 1G2NE54N0PM (production sequence omitted). At the time of the vehicle inspection, the Grand Am's odometer read 213,503 km (132,668 miles). The vehicle was a four-door sedan that was equipped with a 3.3 liter, V6 engine, 3-speed automatic transmission, power front disc and rear

drum anti-lock brakes, OEM alloy Pontiac wheels, power steering, and a tilt steering wheel. The Grand Am was configured with Mastercraft Glacier Grip studded 195/70R14 winter tires. The specific tire data is as follows:

Tire	Measured Pressure	Tread Depth	Restricted	Damage
LF	193 kpa (28 psi)	9 mm (11/32”)	No	None
LR	193 kpa (28 psi)	7 mm (9/32”)	No	None
RF	193 kpa (28 psi)	9 mm (11/32”)	No	None
RR	152 kpa (22 psi)	7 mm (9/32”)	No	None

The seating positions in the Pontiac Grand Am were configured with front bucket seats with adjustable head restraints and a fixed rear bench seat. The driver’s seat was between the mid- and full-rear track position, and the front seat head restraints were both in the full-down positions at the time of the vehicle inspection. The vehicle was not equipped with Lower Anchorages and Tethers for Children (LATCH).

VEHICLE DATA – 1991 CHEVROLET SILVERADO PICKUP TRUCK

The 1991 Chevrolet Silverado pickup truck was identified by the VIN: 2GCEC19H5M1 (production sequence omitted). The vehicle was a 4 x 2, extended-cab pickup truck with a 2.0 m (6.5’) long box. The pickup truck was configured with a 5.0, V-8, engine, power brakes with rear ABS, and power steering. The seating in the pickup truck was configured with bench seats.

CRASH SITE

This two-vehicle crash occurred during the nighttime hours of February 2003. At the time of the crash, snow was falling and the asphalt roadway surface was snow-covered. The crash occurred at a four-leg intersection of two county roadways. The north/south roadway was configured with one travel lane in each direction separated by a double-yellow centerline. The roadway was straight with a level grade. The east/west roadway was configured with one travel lane in each direction separated by a double-yellow centerline east of the intersection and a solid/broken yellow centerline west of the intersection. The east/west roadway was straight with a slight positive eastbound grade. Both roadways were bordered by asphalt shoulders. The east/west roadway was configured with W-beam guardrails on each side of the roadway, on the west leg of the intersection. The guardrail on the south roadside continued around the contour of the southwest corner of the intersection. Sight distance looking west from the south leg of the intersection was not occluded **(Figure 2)**. Traffic flow through the intersection was controlled by standard-sized stop signs on each corner of the intersection for north/south traffic. The posted speed limit for north/south traffic was 72 km/h

Figure 2. View looking west from the north/south roadway

(45 mph) and 89 km/h (55 mph) for east/west traffic. The scene schematic is included as **Figure 14** of this report.

CRASH SEQUENCE

Pre-Crash

The 24-year-old male driver of the Pontiac Grand Am was operating the vehicle northbound on the two-lane roadway on approach to the four-leg intersection **(Figure 3)**. The 49-year-old male driver of the 1991 Chevrolet pickup truck was operating the vehicle eastbound on approach to the intersection **(Figure 4)**. For unknown reasons, the driver of the Grand Am disregarded the stop signs and proceeded into the intersection across the path of the pickup truck. There were no avoidance maneuvers attempted by either driver. Police calculated the pre-crash speed of the Grand Am to be approximately 90 km/h (56 mph) and the pre-crash speed of the pickup truck to be approximately 64 km/h (40 mph).

Figure 3. Northbound approach for the Grand Am

Figure 4. Eastbound approach for the Chevrolet pickup truck

Crash

The front aspect of the Chevrolet pickup truck impacted the left side aspect of the Pontiac Grand Am. Impact resulted in moderate damage to the pickup truck and severe damage to the Grand Am. The direction of force was in the 1 o'clock sector for the pickup truck and in the 10 o'clock sector for the Grand Am. The damage algorithm of the WinSMASH program computed a total delta-V of 50 km/h (31.1 mph) for the Grand Am and a total delta-V of 33.0 km/h (20.5 mph) for the pickup truck. The longitudinal and lateral components for the Grand Am were -25.0 km/h (-15.5 mph) and 43.3 km/h (26.9 mph), respectively. The longitudinal and lateral components for the pickup truck were -28.6 km/h (-17.8 mph) and -16.5 km/h (-10.3 mph), respectively. The impact redirected both vehicles off-road onto a snow-covered field.

Post-Crash

Rescue personnel removed the roof to facilitate the extrication of the occupants of the Grand Am. Rescue personnel cut the driver's safety belt and removed him from the vehicle. He was transported by ambulance to a regional trauma center and admitted. Rescue personnel cut the rear center lap belt and removed the CSS and 14-month-old child from the Grand Am. The child was transported by ambulance to a regional children's hospital and admitted. It was not known

how the driver of the Chevrolet pickup truck exited the vehicle. He was transported by ambulance to a regional trauma center. His admission status was not known.

VEHICLE DAMAGE

Exterior Damage – 1993 Pontiac Grand Am

The 1993 Pontiac Grand Am sustained severe left side damage as a result of the impact with the Chevrolet pickup truck **(Figure 5)**. The direct contact damage began 2.5 cm (1.0") forward of the left rear axle and extended 196.9 cm (77.5") forward along the left side aspect. Both left side doors were crushed laterally and sustained contact abrasions from the bumper of the pickup truck. The left sill was crushed laterally and displaced slightly upward at the forward aspect. The maximum crush was vertically located 34.3 cm (13.5") below the belt line on the left doors. The combined direct and induced damage began 5.1 cm (2.0") aft of the left rear axle and extended 274.3 cm (108.0") forward along the left side aspect. The left side cladding was separated from the exterior door panels. The left rear wheel was sheared from the suspension components. The vehicle also sustained damage from rescue personnel's extrication of the occupants. All of the pillars were cut and the roof was removed. The rear aspect of the left front door was deformed outward as a result of hydraulic spreaders attempting to open the door. Minor deformation was noted on the rear aspect of the left front fender and left rear quarter panel. The Collision Deformation Classification for the impact with the Chevrolet pickup truck was 10-LPAW-3. Six crush measurements were documented at the mid-door level and were as follows: C1 = 0.0 cm, C2 = 40.0 cm (15.8"), C3 = 45.7 cm (18.0"), C4 = 31.1 cm (12.3"), C5 = 12.4 cm (4.9"), C6 = 0.0 cm.

Figure 5. Left side damage to the Grand Am

Interior Damage -1993 Pontiac Grand Am

Interior damage to the 1993 Pontiac Grand Am was moderate and attributed to passenger compartment intrusion and occupant contact **(Figure 6)**. The left front and left rear doors were jammed shut. The right side doors were opened post-crash by rescue personnel and would not close at the time of the vehicle inspection. The windshield was removed by rescue personnel. The left side glazing disintegrated as a result of the impact with the pickup truck. The backlight and right side glazing was disintegrated, but it was unknown if it was crash-related or due to extrication efforts. The top half of the steering wheel rim was cut by rescue personnel. The interior aspect of the left front door and left front arm rest were deformed as a result of occupant contact. Deformation to the arm rest measured 3.8 cm (1.5") in length, and was located

Figure 6. View of front seating positions and occupant contacts

15.2 cm (6.0”) forward of the rear aspect of the arm rest and 22.9 cm (9.0”) below the belt line. The driver’s seat back was deflected rearward and laterally as a result of the impact and driver loading. The outboard aspect of the driver’s head restraint was located at the centerline of the vehicle and the top aspect of the seat back was engaged against the right aspect of the CSS. The left instrument panel was deformed as a result of the passenger compartment intrusion.

Figure 7. View from rear showing left side intrusions

Multiple intrusions **(Figure 7)** that resulted from the impact were documented as follows:

Position	**Intruded Component**	**Intrusion**	**Direction**
FL	Left front door	24.1 cm (9.5”)	Lateral
FL	Left front door arm rest	26.0 cm (10.3”)	Lateral
FL	Left sill (at B-pillar)	22.9 cm (9.0”)	Lateral
RL	Left B-pillar	34.0 cm (13.4”)	Lateral
RL	Forward aspect of left rear door	39.4 cm (15.5”)	Lateral
RL	Left rear door arm rest	35.6 cm (14.0”)	Lateral
RC	Left front seat back	22.9 cm (9.0”)	Longitudinal
FL	Kick panel	15 – 30 (6 – 11.8”)	Lateral

Exterior Damage – 1991 Chevrolet Silverado Pickup Truck

The 1991 Chevrolet Silverado pickup truck sustained moderate frontal damage as a result of the impact with the Grand Am **(Figure 8)**. The direct damage began 61.0 cm (24.0”) left of the centerline and extended 152.4 cm (60.0”) laterally across the frontal plane. The combined direct and induced damage involved the entire frontal width of the vehicle. The leading edge of the hood was abraded from direct contact and was buckled rearward. Both head lamps and grille trim were separated. The bumper trim was separated and the bumper was crushed rearward. Both front fenders were buckled rearward. The frontal crush resulted in the reduction of the right wheelbase by 7.9 cm (3.1”). The bumper and front structure sustained lateral end shifting to the left as a result of the Grand Am’s forward momentum during the crash. The left corner was displaced 19.1 cm (7.5”) to the left and the right corner was displaced 30.5 cm (12.0”) to the left. The CDC for the frontal impact with the Grand Am was 01-FDEW-2. The CDC was incremented by 80 to reflect the front end shift to the left, which resulted in a CDC of 81-FDEW-2. Six crush measurements were documented along the front bumper and were as follows: C1 = 33.0 cm (13.0”), C2 = 25.4 cm (10.0”), C3 = 27.9 cm (11.0”), C4 = 27.9 cm (11.0”), C5 = 30.5 cm (12.0”), C6 = 50.8 cm (20.0”).

Figure 8. View of frontal damage to the Chevrolet pickup truck

SAFETY BELT SYSTEMS – 1993 PONTIAC GRAND AM

The 1993 Pontiac Grand Am was configured with automatic 3-point, door-mounted, lap and shoulder belts for the front seat positions. Fixed D-rings were present on the door frames and the safety belts were configured with Emergency Locking Retractors (ELR’s) and sewn-on latch plates. The driver’s latch plate was still buckled at the time of the vehicle inspection. Both the lap and shoulder belt webbing had been cut by rescue personnel with the remainder of the webbing retracted into the left front door **(Figure 9)**. The length of the cut lap belt measured 23.5 cm (9.3”) from the latch plate and the length of the cut shoulder belt measured 58.4 cm (23.0”) from the latch plate. The right front safety belt was retracted in the right front door and the shoulder belt webbing was cut by rescue personnel during the removal of the roof.

Figure 9. View of cut driver's safety belt

The outboard rear seating positions in the Grand Am were configured with manual 3-point lap and shoulder belts with ELR's and locking latch plates. The rear center position was configured with a lap belt with a locking latch plate. The rear center safety belt was used to secure the forward-facing convertible CSS in the vehicle and was cut by rescue personnel **(Figure 10)**. The cut belt webbing measured 85.1 cm (33.5") from the cut line at the locking bar in the latch plate to the end of the webbing. The remaining webbing measured 10.8 cm (4.3") above the seat cushion to the cut point.

Figure 10. View of rear center cut lap belt

CHILD SAFETY SEAT – FISHER-PRICE MODEL 9101

A Fisher-Price Model 9101 convertible CSS was installed in the rear center position of the Grand Am. The CSS did not display a manufacture date and was not configured with a tether or LATCH clips. The CSS was an older model constructed of metal tube framework, a plastic shell and a T-shield **(Figure 11)**. The instructions and informational labels present on the rear aspect of the CSS were ripped and partially readable. The CSS label stated that the CSS was designed for children who weighed 18 kg (40 lb) or less and who measured 102 cm (40") or less in height. Six NHTSA recalls were identified for the Fisher-Price Model 9101 CSS with production dates ranging from April 1985 through January 1992.

Attempts to contact the driver and family members regarding the installation and history of the CSS were unsuccessful.

The convertible CSS was configured with a metal kickstand with three available recline positions labeled, "Infant Rear Facing", "Semi-Reclined", and "Upright." At the time of the CSS inspection, the kickstand was positioned in the "Semi-Reclined" position **(Figure 12)**.

Figure 11. Fisher-Price Convertible CSS

Figure 12. Left side view of the CSS showing kickstand position

The CSS was installed forward-facing in the Grand Am. The harness straps were routed through the lower of two sets of slots. The harness slots in use provided no reinforcement at that level. The CSS was configured with an inertia-activated retractor on the rear aspect of the seat for the harness straps. The harness straps were twisted at the time of the inspection. The left harness strap exhibited one full twist between the T-shield and harness slot. The right harness strap exhibited one half twist between the T-shield and harness slot and an additional half twist on the rear aspect of the CSS.

In the forward facing orientation, the CSS sustained fractures on the front left lower aspect of the plastic shell. The fracture measured 11.1 cm (4.4”) along the bottom edge on the left aspect, 19.1 cm (7.5”) vertically on the left aspect, and extended 7.0 cm (2.8”) along the front face.

The rear aspect of the right lower harness slot exhibited loading evidence from the harness system. The plastic around the perimeter of the harness slot was stressed and discolored on the inboard aspect.

At the time of the vehicle inspection, the CSS was placed on the rear center position of the Grand Am **(Figure 13)**. Due to the passenger compartment intrusion, the static distance between the left aspect of the installed CSS and the left rear door arm rest was 9.3 cm (3.6”), assuming the CSS was tightly installed. The static distance from the right aspect of the CSS to the right rear door arm rest was 41.6 cm (16.4”). The rear right aspect of the driver’s seat back was engaged with the front right aspect of the CSS as a result of the driver’s seat back deflection.

Figure 13. View of CSS in the rear center position of the Grand Am

OCCUPANT DEMOGRAPHICS – 1993 PONTIAC GRAND AM

Driver

Age/Sex:	24-year-old male
Height:	178 cm (70”)
Weight:	83 kg (183 lb)
Seat Track Position:	Between mid-track and full-rear
Restraint Use:	Automatic 3-point lap and shoulder belt
Usage Source:	Vehicle inspection
Eyewear:	Unknown
Type of Medical Treatment:	Transported by ambulance to a regional trauma center and admitted for nine days

Driver Injuries

Injury	Injury Severity (AIS 90/Update 98)	Injury Mechanism
Right and left frontal lobe contusions	Serious (140620.3,3)	Probable contact with the front grille area of the pickup truck
Left 9th and 12th posterior, and left 1st rib fractures with hemo/pneumothorax	Serious (450222.3,2)	Intrusion of left front door/armrest
Extraperitoneal bladder rupture	Serious (540640.3,8)	Intrusion of left front door/armrest
Left renal contusion	Moderate (541610.2,2)	Intrusion of left front door/armrest
Grade I hepatic subcapsular hematoma	Moderate (541822.2,1)	Shoulder belt
Grade II laceration of the splenic lobe	Moderate (544222.2,2)	Intrusion of left front door/armrest
Bilateral superior/inferior pubic rami fractures	Moderate (852602.2,5)	Intrusion of left front door/armrest
Left sacral fracture	Moderate (852602.2,6)	Intrusion of left front door/armrest
Closed head injury, loss of consciousness unknown, combative and confused at scene and on admission	Minor (160402.1,0)	Probable contact with the front grille area of the pickup truck
Mandible injury, NFS	Minor (250699.1,9)	Probable contact with the front grille area of the pickup truck
Contusion of left superior eyelid	Minor (297402.1,2)	Probable contact with the front grille area of the pickup truck
Laceration of left superior eyelid	Minor (297602.1,2)	Probable contact with the front grille area of the pickup truck

Injury source: Trauma center records

Driver Kinematics

The 24-year-old male driver of the 1993 Grand Am was presumed to have been seated in an upright posture. He was restrained by the automatic 3-point lap and shoulder belt. At impact, he initiated a lateral trajectory to the left. The left side glazing disintegrated from impact forces and the driver loaded the left front door, arm rest, and probably struck the front of the pickup truck as they intruded into the occupant space. The loading to the intruded door and armrest resulted in fractures of the left 9th and 12th posterior ribs, and left 1st rib fracture with hemo/pneumothorax, an extraperitoneal bladder rupture, a left renal contusion, a Grade II laceration of the splenic lobe, bilateral superior/inferior pubic rami fractures, and a left sacral fracture. His head most likely flexed over the intruding lower door, through the open door window, and contacted the front grille area of the pickup truck as it intruded into the occupant space. The driver sustained right and left frontal lobe contusions, a closed head injury, a mandible injury, a contusion of left

superior eyelid, and a laceration of left superior eyelid. He rebounded to the right and into the center console and the seat back which was displaced rearward and to the right. His rebound into the center console resulted in a Grade I hepatic subcapsular hematoma. It was not known if the driver was further displaced during the vehicle's rotation and travel to final rest. He was transported by ambulance to a regional trauma center, admitted for nine days, and released.

Rear Center Child Passenger (Forward-facing convertible CSS)

Age/Sex:	14-month-old male
Height:	Unknown
Weight:	Unknown
Seat Track Position:	Fixed
Manual Restraint Use:	Forward-facing convertible CSS
Usage Source:	Vehicle inspection, CSS inspection
Eyewear:	None
Type of Medical Treatment:	Transported by ambulance to a regional children's hospital and admitted for treatment

Rear Center Child Passenger Injuries

Injury	Injury Severity (AIS 90/Update 98)	Injury Mechanism
Facial lacerations	Minor (290602.1,9)	Flying glass

Injury source: Police

Rear Center Child Passenger Kinematics

The 14-month-old child passenger was restrained in the forward-facing convertible CSS that was installed in the rear center position of the Grand Am. It was not known how tight the CSS was installed in the vehicle, nor how tight the harness system was on the child. Attempts to contact the driver regarding the installation were unsuccessful.

At impact, the child and CSS initiated lateral trajectories to the left and slightly forward. The CSS loaded the lap belt and the child loaded the harness system and T-shield. The left side window glazing disintegrated from impact forces which resulted in facial lacerations to the child. The left aspect of the CSS loaded the intruded left rear door which resulted in a moderate fracture to the lower left corner of the plastic CSS shell. The child rebounded to the right in the CSS which mitigated additional movement as the Grand Am rotated and came to rest. The child was removed from the vehicle and transported by ambulance to a regional children's hospital and admitted. The length of the child's hospital admission was unknown.

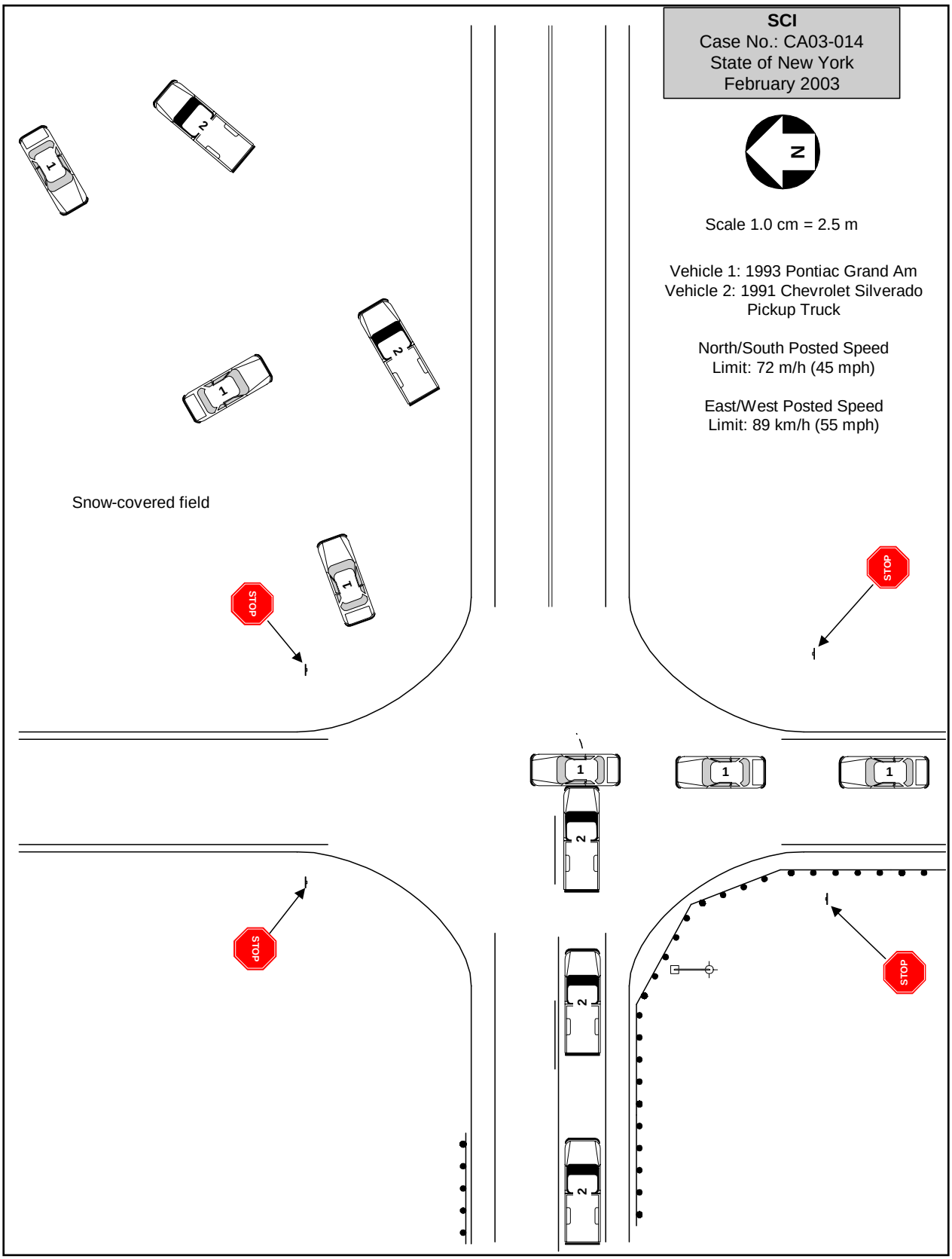

Figure 14. Scene schematic