CRASH DATA RESEARCH CENTER

Calspan Corporation
Buffalo, NY 14225

CALSPAN ON-SITE CHILD SAFETY SEAT CRASH INVESTIGATION

CASE NO: CA06-026

VEHICLE: 2000 PONTIAC GRAND PRIX

LOCATION: NEW JERSEY

CRASH DATE: OCTOBER 2006

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.

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16. Abstract This on-site investigation focused on the performance of a high back booster Child Safety Seat CSS) that was installed in a 2000 Pontiac Grand Prix four-door sedan. The vehicle was occupied by an unrestrained 25-year old driver, an unrestrained 27-year old male seated in the front right position, and a 3-year old male seated in the booster seat in the right rear position. The 3-year old male was restrained by the manual lap and shoulder belt within the CSS. The CSS was positioned on the right side of the second row seat. The Pontiac was equipped with frontal air bags for the driver and front right passenger positions, which deployed during the impact. The Pontiac was involved in moderate left side and right side impacts with two hardwood trees. The 25-year old driver of the 2000 Pontiac Grand Prix was operating the vehicle in a westbound direction on a two-lane roadway and was negotiating a right curve. She was traveling above the posted 64 km/h (40 mph) speed limit and was engaged in an argument with the front right passenger about a domestic issue. The vehicle began to drift to the left across the roadway's centerline and the driver initiated a corrective counter steer to the right. The vehicle began to rotate clockwise, traveled across the westbound lane, and then departed the right side of the roadway. The left side of the vehicle struck a hardwood tree behind the center of gravity resulting in moderate damage. The initial impact induced a rapid counterclockwise (CCW) rotation and the right rear door area impacted a second hardwood tree where it came to final rest. The vehicle contained an Event Data Recorder (EDR); however, due to less than ideal cooperation with the tow facility, the data could not be downloaded. The 27-year old front right passenger sustained soft tissue injuries and was transported and released from a local hospital. The Pontiac's driver and the 3-year old child passenger sustained serious injuries and were transported via helicopter to a regional trauma center where they were admitted for 10 days. The driver sustained internal lacerations, a fractured left clavicle, and fractured ribs. The 3-year old child sustained an open skull fracture, cerebral contusion, and subarachnoid hemorrhage from contacting the second row right C-pillar, and lacerations to his left index finger and forehead.			
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BACKGROUND

This on-site investigation focused on the performance of a high back booster Child Safety Seat (CSS) that was installed in a 2000 Pontiac Grand Prix four-door sedan **(Figure 1)**. The vehicle was occupied by an unrestrained 25-year old driver, an unrestrained 27-year old male seated in the front right position, and a 3-year old male seated in the booster seat in the right rear position. The 3-year old male was restrained by the manual lap and shoulder belt within the CSS. The CSS was positioned on the right side of the second row seat. The Pontiac was equipped with frontal air bags for the driver and front right passenger positions, which deployed during the impact. The Pontiac was involved in moderate left side and right side impacts with two hardwood trees. The 25-year old driver of the 2000 Pontiac Grand Prix was operating the vehicle in a westbound direction on a two-lane roadway and was negotiating a right curve. She was traveling above the posted 64 km/h (40 mph) speed limit and was engaged in an argument with the front right passenger about a domestic issue. The vehicle began to drift to the left across the roadway's centerline and the driver initiated a corrective counter steer to the right. The vehicle began to rotate clockwise, traveled across the westbound lane, and then departed the right side of the roadway. The left side of the vehicle struck a hardwood tree behind the center of gravity resulting in moderate damage. The initial impact induced a rapid counterclockwise (CCW) rotation and the right rear door area impacted a second hardwood tree where it came to final rest. The vehicle contained an Event Data Recorder (EDR); however, due to less than ideal cooperation with the tow facility, the data could not be downloaded. The driver sustained bilateral lung contusions, multiple left side rib fractures, internal lacerations, a closed head injury, and multiple soft-tissue injuries. The 3-year old child sustained an open skull fracture, a cerebral contusion, a subarachnoid hemorrhage, and lacerations to his left index finger and forehead. The driver and the 3-year old child passenger were transported via helicopter to a regional trauma center where they were admitted for 7 and 10 days, respectively. The 27-year old front right passenger sustained soft tissue injuries and was transported and released from a local hospital.

Figure 1 - Damaged 2000 Pontiac Grand Prix.

The crash was identified by the Crash Investigation Division of the National Highway Traffic Safety Administration (NHTSA) through an Internet news article. The article was forwarded to the Calspan SCI team who located the vehicle and established cooperation with the investigating police agency. The case was assigned on October 26, 2006 for an

on-site investigation. The Pontiac was stored at a secured impound facility with the CSS still inside the vehicle. The investigating police agency contacted the facility allowing the release of the vehicle for this SCI inspection that was conducted on October 30, 2006. A Police Accident Report (PAR) was obtained from the investigating agency and an in-person interview was conducted with the driver of the Pontiac. The driver of the Pontiac failed to authorize the release of the child's medical records relating to this crash.

SUMMARY

Crash Site

This single vehicle crash occurred on a well traveled two-lane east/west residential roadway in October 2006. At the time of the crash, the asphalt roadway was wet and it was raining. The roadway was configured with one lane in each direction that was separated by a painted double-yellow centerline. The travel lanes were 3.5 m (11.5') in width and the roadway was bordered by a 0.5 m (1.6') north side and a 1 m (2.5') south side asphalt shoulder. The roadway was curved to the right for westbound traffic. The roadway had a -2 percent negative grade in the westbound direction. The posted speed limit was 64 km/h (40 mph). The hardwood trees were 25 cm (10") and 31 cm (12") in diameter and were located 4.3 m (14.1') and 7.6 (25') outboard the north road edge, respectively.

Vehicle Data – 2000 Pontiac Grand Prix

The 2000 Pontiac Grand Prix was identified by the Vehicle Identification Number (VIN): 1G2WJ52J7YF (production number omitted). The vehicle's mileage was 226,851 km (140,963 miles). The Pontiac was designed as a four-door sedan with front wheel drive and a 6-cylinder, 3.1-liter engine. The vehicle was equipped with an automatic transmission with a console-mounted transmission lever. The vehicle was also equipped with four-wheel disc brakes with anti-lock (ABS). The vehicle was configured with 38 cm (15") steel wheels and varied P205/70R15 tires. The specific tire information at the time of the SCI inspection was as follows:

Position	Tire Model	Tire Pressure	Tread Depth	Damage
LF	Spartan SB 702	228 kPa (33 PSI)	2 mm (3/32")	None
LR	Futura 775 Radial A/S	172 kPa (25 PSI)	3 mm (4/32")	None
RF	Spartan SB 702	200 kPa (29 PSI)	3 mm (4/32")	None
RR	Futura 775 Radial A/S	0 kPa	3 mm (4/32")	Cuts in tread and sidewall

The 2000 Pontiac Grand Prix was equipped with front bucket seats and adjustable head restraints, both of which were in the full-down position. Both front seats had adjustable seat tracks that were adjusted to the mid-track position. The second row consisted of a three-position bench seat with integrated head restraints for the outboard positions.

Crash Sequence

Pre-Crash

The 25-year old female driver of the 2000 Pontiac Grand Prix was traveling in a westerly direction on a two-lane roadway and was negotiating a right curve **(Figure 2)**. The driver stated that she was engaged in an argument with the front right passenger that diverted her attention off of her driving tasks momentarily. She realized that she had drifted into the eastbound lane and initiated corrective measures in the form of steering to the right. The vehicle rotated clockwise due to a combination of the corrective action, wet roadways, and the poor conditions of the tires. The vehicle departed the roadway onto a grassy north roadside where it continued traveling toward a tree line. The vehicle rotated approximately 45 degrees as it departed the roadside, and in an attempt to regain control, the driver applied the vehicle's brakes. Physical evidence in the form of four distinct furrow marks was identified on the north roadside during the on-site investigation **(Figure 3)**. The furrows were attributed to the Pontiac's four tires as the vehicle initiated a clockwise broadside yaw to the point of impact. The furrow from the right front wheel measured 28 m (91') in length and began at the north road edge and extended outboard the same a distance of 14 m (44'). The furrow from the left front tire measured 21 m (68') in length and began 1 m (3.3') outboard the north road edge and extended outboard of the same a distance of 5 m (17'). The furrow from the left rear tire measured 14 m in length and began 1.5 m outboard of the north road edge and extended outboard of the same a distance of 2.5 m (8.2'). The furrow from the right rear tire measured 4 m (12.8') in length and began 2 m (6.2') outboard the north road edge and extended outboard of the same a distance of 2.5 m (8.2'). The physical evidence in represented in the scaled crash schematic included as **Figure 11** at the end of this narrative report.

Figure 2 - Path of travel - 2000 Pontiac Grand Prix.

Figure 3 - Furrow marks leading to point of impact.

Crash

The left side of the Pontiac impacted the first hardwood tree with its left side while at an angle of approximately 60 degrees **(Figure 4)**. The Principal Direction of Force (PDOF) for this impact was 310 degrees which resulted in a significant longitudinal delta-V component. The impact was sufficient to deploy the frontal air bags in the vehicle. The damage algorithm of the WinSMASH program computed a total delta-V of 29 km/h (18 mph) based on the crush profile. The specific longitudinal and lateral components were -19 km/h (-11.8 mph) and 22 km/h (13.7 mph), respectively.

After the initial impact, the Pontiac rotated counterclockwise 240 degrees responding to the previous narrow impact behind the vehicle's center of gravity. As the vehicle rotated, the left rear door area contacted a 28 cm (11") diameter hardwood tree **(Figure 5)**. For the second impact, the damage algorithm of the WinSMASH program computed a total delta-V of 11 km/h (6.8 mph) based on the crush profile. The specific longitudinal and lateral components were 4 km/h (2.5 mph) and -10 km/h (-6.2 mph), respectively. The vehicle came to final rest against the 28 cm (11") diameter tree.

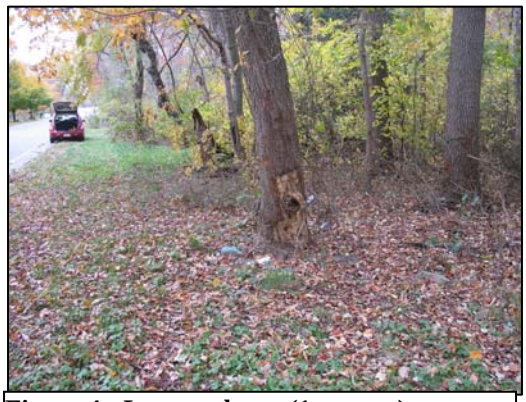

Figure 4 - Impacted tree (1st event).

Figure 5 - Impacted tree (2nd event).

Post-Crash

The driver and the front right passenger exited the vehicle through the front left and right door window openings, respectively. The child's status was observed by the front seat passengers who decided to leave the child in place until emergency personnel arrived on the scene. Upon the arrival of emergency personnel, the child was removed from the booster seat through the backlight and placed on a backboard. The driver was stabilized and she and the child were transported to a landing zone for helicopter removal to a regional trauma center. Both the driver and child were admitted to the regional trauma center due to serious injuries sustained during the crash for 7 and 10 days, respectively. The front right occupant was transported by ambulance to a local hospital where he was treated for soft tissue injuries and released. The vehicle was towed from the scene and impounded by the investigating police agency.

Vehicle Damage

Exterior Damage – 2000 Pontiac Grand Prix

The 2000 Pontiac Grand Prix sustained moderate damage as a result of the left and right side impacts with the hardwood trees **(Figures 6 and 7)**. The direct contact damage for the first impact began 36 cm (14") forward of the left rear axle and extended forward another 94 cm (37"). The Field L measurement was taken from deflection point to deflection point due to minor bowing present on the vehicle. It began 6 cm (2.5") aft of the left rear axle and extended forward 216 cm (85") to the left A-pillar. The maximum crush

Figure 6 - Damaged left side of 2000 Pontiac Grand Prix.

was located 108 cm (42.5”) forward of the left rear axle and measured 46 (18.3”) in depth. The crush profile consisted of six equidistant crush measurements taken along the level of the mid-door and was as follows: C1 = 0 cm, C2 = 34 cm (13.4”), C3 = 43 cm (17”), C4 = 30 cm (11.8”), C5 = 13 cm (5.1”) and C6 = 0 cm. The Collision Deformation Classification (CDC) for this impact was incremented to account for the shift to the left. The change in the 10 o’clock direction of force resulted in a CDC of 90-LPAW-4.

The direct contact damage for the second impact began 112 cm (44”) aft of the front right axle and extended rearward 41 cm (16”). The combined direct and induced damage began 185 cm aft of the front right axle and extended rearward 150 cm (59”). The maximum crush was located 142 cm aft of the vehicle’s side centerline and measured 21 cm (8.3”) in depth. The crush profile consisted of six equidistant crush measurements taken along the level of the mid-door and was as follows: C1 = 4 cm (1.6”), C2 = 14 cm (5.5”), C3 = 12 cm (4.7”), C4 = 4 cm (1.6”), C5 = 0 cm and C6 = 0 cm. The CDC for this impact was 04-RZAN-2.

Figure 7 - Damaged right side of 2000 Pontiac Grand Prix.

The secondary impact originated from forward of the rear axle and contacted and damaged the right rear wheel. The damaged wheel was rotated counterclockwise approximately 80 degrees post-crash.

Interior Damage – 2000 Pontiac Grand Prix

The 2000 Pontiac Grand Prix sustained severe interior damage as a result of passenger compartment intrusion and occupant contact. The lower aspect of left side armrest panel on the door was fractured from driver loading. The area of this fracture was located 8 cm (3.2”) forward of the B-pillar and 18 cm (7”) below the beltline. The steering wheel was canted approximately 20 degrees to the left and the column was compressed. The steering wheel rim exhibited prominent scuff marks measuring 23 cm (9”) confined to the upper left quadrant of the rim. The windshield exhibited distinct occupant loading patterns at two locations accompanied by hair transfers. The first was on the left aspect of the windshield and its radiant was located 36 cm (14”) inboard of the left A-pillar and 20 cm (8”) below the windshield header. The radiant from the second windshield contact area was located on the right aspect and was 22 cm (8.5”) inboard of the right A-pillar and 15 cm (6”) below the windshield header. Body fluid transfers were visible on the left front door panel and along the entire instrument panel. The rearview mirror was separated from the windshield and fractured due to impact forces. The center console was also deformed as a result of occupant contact. It was shifted slightly to the right and its rigid plastic housing components were fractured or displaced at multiple locations.

Intrusion reduced the occupant space at the front left position and all three second row seating positions. The area of greatest intrusion was located in the second row left

position that reduced the occupant space laterally by 43 cm (17”). The front left door panel and B-pillar intruded laterally contributing to the injuries sustained by the driver. The right side C-pillar intruded laterally into the second row right seating position. The 3-year old male child seated within a CSS in that position sustained injuries from the intruding pillar. The specific passenger compartment intrusions are identified by seating position in the following table:

Position	Intruded Component	Magnitude	Direction
Front left	Door panel	20 cm (8”)	Lateral
Front left	B-pillar	23 cm (9”)	Lateral
Front left	Roof	8 cm (3”)	Vertical
Second row left	Door panel	43 cm (17”)	Lateral
Second row left	C-pillar	25 cm (10”)	Lateral
Second row left	Roof side rail	20 cm (8”)	Lateral
Second row left	Kick panel	33 cm (13”)	Lateral
Second row left	Roof	20 cm (8”)	Vertical
Second row middle	Roof	13 cm (5”)	Vertical
Second row right	C-pillar	8 cm (3”)	Lateral

Manual Restraints – 2000 Pontiac Grand Prix

The 2000 Pontiac Grand Prix was equipped with 3-point lap and shoulder belts for the four outboard positions and a fixed length lap belt for the second row middle position. The driver’s belt was configured with a sliding latch plate, and Emergency Locking Retractor (ELR), and an adjustable D-ring, which was in the full-down position. The driver’s belt revealed no loading marks consistent with belt usage during a crash of this severity. Additionally, the left side intrusion trapped the lap and shoulder between the seat cushion and the B-pillar indicating that the restraint was not used during the crash. The front right restraint was configured with a sliding latch plate, a switchable ELR/Automatic Locking Retractor (ALR), and an adjustable D-ring, which was in the full down position at the time of the crash. The restraint’s webbing exhibited no loading evidence consistent with belt usage in a crash of this severity. It should be noted that post-crash, the front right restraint was used to fasten the front right door to a closed position. Furthermore, occupant contact patterns to the windshield of the vehicle clearly indicate that the restraint was not used.

The second row outboard lap and shoulder belts contained sliding latch plates, switchable ELR/ALR retractors, and fixed D-rings. The retractors were in the ELR mode at the time of the SCI inspection. The second row right restraint was utilized in unison with a forward-facing booster CSS. A reddish brown fabric transfer was present on the shoulder webbing of the second row right belt. The transfer was 11 cm in length, was accompanied by minor material fraying, and began 117 cm (46”) below the fixed D-ring on the belt webbing at full excursion.

Frontal Air Bag System - 2000 Pontiac Grand Prix

The 2000 Pontiac Grand Prix was equipped with frontal air bags for the driver and front right passenger positions. The driver’s air bag **(Figure 8)** was housed in the center of the

steering wheel hub and deployed from symmetrical I-configuration cover flaps. The cover flaps measured 11 cm (4.5”) horizontally and 8 cm (3”) vertically. The driver’s air bag measured 67 cm (26.5”) in its deflated state and had a 50 cm (20”) excursion. The air bag was vented by two circular ports located in the 10 and 2 o’clock sectors on the back of the bag. The air bag was not tethered. There was no discernable contact evidence to the air bag; however, horizontal vinyl striations were present in a linear pattern 11 cm (4.5”) above and below the air bag’s centerline. These striations resulted from the out of position driver loading the steering assembly and impeding the initial deployment of the air bag. A splattering of body fluids was also present on the back left aspect of the air bag. These fluids likely resulted from the soft tissue injuries incurred by the front right passenger. The following nomenclature was stamped on the back of the air bag:

16760859 – 02
Pontiac W/AL
TRAP 90571903

The front right passenger’s air bag **(Figure 9)** deployed from a top-mount module configured with a single rectangular vinyl cover flap hinged at the top aspect. The cover flap measured 32 cm (12.5”) in width and 15 cm (5.75”) in height. The air bag measured 47 cm (18.5”) in width and 56 cm (22”) in height in its deflated state and had an excursion of 64 cm (25”). The air bag was vented by two circular ports located in the 10 and 2 o’clock sectors. The air bag was not tethered. There were significant amounts of body fluid on the air bag mostly concentrated on the left edge. The front right occupant sustained multiple facial lacerations and is the probable source of this fluid transfer. The following nomenclature was stamped on the back of the air bag:

16825735 – 00
Pont 2W PAB
TRCK 90165605

Figure 8 - Deployed driver's air bag.

Figure 9 - Deployed front right air bag.

Child Safety Seat

Century Breverra Transit

A forward facing Century Breverra Transit CSS **(Figure 10)** was installed in the second row right position of the 2000 Pontiac Grand Prix. The CSS was in its original position inside the vehicle at the time of the SCI inspection. The model number was 44845DRB and the date of manufacture was 03/28/2003. The CSS was configured with a 5-point internal harness and a two-piece retainer clip. The internal harness was not used to secure the child. The dual-purpose CSS was rated separately for use with the internal harness and without using the system. For usage with the harness the CSS was designed for children weighing between 14 – 18 kg (30 – 40 lb) and between 89 – 110 cm (35 – 43") in height. For usage as a belt positioning booster seat, the CSS was designed for children weighing between 14 – 36 kg (30 – 80 lb) and between 89 – 127 cm (35 – 50") in height. The CSS was used as a belt positioning booster seat by the driver who routed the shoulder belt through the belt positioning clip over the child's right shoulder. According to the driver, the lap belt was positioned under the arm rests and snug against the child's abdominal region. There were no discernable stress marks on the seat or shell of the CSS.

Figure 10 - Century Breverra CSS.

The CSS was equipped with the Lower Anchors and Tethers for Children (LATCH) system; however, the vehicle was not equipped with lower anchors or a top tether hook. The CSS was placed on the seat and the child was secured with the manual lap and shoulder belt; it was removed and reinstalled frequently by the owner.

Occupant Demographics

Driver

Age/Sex:	25-year old/Female
Height:	165 cm (65")
Weight:	65 kg (143 lb)
Seat Track Position:	Mid-track
Manual Restraint Use:	None
Usage Source:	Vehicle inspection
Eyewear:	None
Type of Medical Treatment:	Transported via helicopter to regional trauma center and admitted for 7 days

Driver Injuries

Injury	Injury Severity (AIS90/Update 98)	Injury Source
Bilateral pulmonary contusions with pneumothorax	Severe (441410.4.3)	Left door panel
Grade III liver laceration, 7 cm (2.75") in diameter	Serious (541824.3,1)	Steering wheel rim
Right lung laceration to medial lower lobe	Serious (441414.3,1)	Console
Grade II spleen laceration, 2 cm (0.5") in depth	Moderate (544222.2,2)	Left door panel armrest
Multiple left side rib fractures (posterior ribs 1 and 11)	Moderate (450220.2,2)	Rib 1 (indirect from left from door panel) Rib 11 (direct to left door panel armrest)
Left clavicle fracture*	Moderate (752200.2,2)	Left A-pillar
Right liver contusion	Moderate (541810.2,1)	Steering wheel rim
Concussion, NFS	Minor (160499,1.0)	Windshield
Right adrenal hemorrhage	Minor (540222.1,1)	Center console
Abdominal contusion (left flank)	Minor (590402.1,2)	Left door panel armrest
Left buttock contusion	Minor (890402.1,2)	Left door panel armrest
Left lower back abrasion	Minor (690202.1,8)	Left door panel armrest
Left foot abrasion	Minor (890202.1,2)	Foot controls (possible)

Source: Hospital records

** Denotes interview as source*

Driver Kinematics

The unrestrained 25-year old female driver of the Pontiac was seated in an upright posture in the front left seat, which was adjusted to a mid-track position. At impact with the first tree, she initiated a lateral left and forward trajectory toward the left A-pillar and door panel in response to the 10 o'clock direction of force. As the air bag deployed, the driver loaded the steering wheel rim through the expanding air bag and deformed the column to the left. As a result of loading the steering wheel rim, the driver sustained a Grade III liver laceration. Her trajectory further directed her to the left of the expanding air bag which she partially overrode and contacted the intruded left side door panel and the windshield, the latter of which was evidenced by the cracked glazing and associative hair transfers embedded into the laminate. From the intruded left door contact, the driver sustained bilateral lung contusions, a Grade II spleen laceration, an indirect fracture to

her left side posterior rib 1 due to the left arm and shoulder being compressed laterally into the posterior rib, a fracture to the left side posterior rib 11, and soft tissue injuries to her left abdomen, lower back, and left buttock. The windshield contact resulted in a concussion.

After the initial impact, the vehicle rotated counterclockwise approximately 240 degrees and contacted a second tree on its right side. The driver was redirected rearward and laterally in response to the 4 o'clock direction of force. She loaded the center console and displaced the same to the right. From contact with the center console, the driver sustained a right adrenal hemorrhage. After the vehicle came to rest, the driver exited the vehicle under her own power through the left front window opening and remained on scene until the arrival of emergency personnel. She was subsequently flown to a regional trauma center and admitted for 7 days.

Front Right Passenger

Age/Sex:	26-year old/Male
Height:	178 cm (70")
Weight:	77 kg (170 lb)
Seat Track Position:	Mid-track
Manual Restraint Use:	None
Usage Source:	Vehicle inspection
Eyewear:	None
Type of Medical Treatment:	Transported by ambulance to local hospital – treated and released.

Front Right Passenger Injuries

Injury	Injury Severity (AIS90/Update 98)	Injury Source
Laceration to face extending from above the left eye to the left temple	Minor (290600.1,2)	Windshield
Scalp laceration to the top of head	Minor (190600.1,2)	Windshield
Laceration of right elbow	Minor (790600.1,1)	Windshield

Source: Interview

Front Right Passenger Kinematics

The unrestrained 26-year old male passenger seated in the front right position of the Pontiac was seated in an upright posture. At impact with the first tree, he initiated a trajectory to the left and slightly forward and overrode the expanding front right air bag. He contacted the windshield with his face and head and sustained lacerations to the left side of his face. The laceration began above his left eye and extended upward to his left temple. He also sustained a scalp laceration to the top left aspect of his head. These injuries were correlative to the windshield damage and associative soft-tissue and hair evidence. The right front passenger was repositioned back into his seat as a result of the

second impact to the right side of the vehicle and he contacted and lacerated his elbow on the shattered right front door glazing. Following the crash events, this passenger exited the vehicle through the right front window and tended to the child in the second row prior to arrival of emergency personnel to the scene. He was later transported by ambulance to a local hospital where he was treated and released.

Second Row Right Passenger

Age/Sex:	3-year old/Male
Height:	104 cm (41")
Weight:	17 kg (38 lb)
Seat Track Position:	Not adjustable
Manual Restraint Use:	Lap and shoulder restraint used with high back booster CSS
Usage Source:	Vehicle inspection
Eyewear:	None
Type of Medical Treatment:	Transported via helicopter to regional trauma center and admitted for 10 days

Second Row Right Passenger Injuries

Injury	Injury Severity	Injury Source
Open fracture to the left frontal skull with accompanying 13 cm (5") semicircular scalp laceration	Serious (150404.3,2)	Second row left door panel
Right cerebral contusion, NFS	Serious (140602.3,1)	Right C-pillar
Right subarachnoid hemorrhage	Serious (140684.3,1)	Right C-pillar
3 cm forehead laceration, NFS	Minor (290602.1,7)	Second row left door panel
2 cm (0.8") laceration to left index finger	Minor (790602.1,2)	Second row left door panel

Source: Hospital Records

Second Row Right Passenger Kinematics

The 3-year old male second row right passenger was seated within a high-back booster CSS and was restrained by the manual lap and shoulder restraint. At impact with the first tree, the child and the CSS responded to the 10 o'clock direction of force by initiating a lateral and slightly forward trajectory to the left. Simultaneously, the second row left door panel intruded into the passenger compartment laterally 43 cm (17"). As the CSS rotated to the left, the child's head contacted the intruded door panel, which resulted in an open skull fracture to the left frontal skull, accompanied by a 13 cm (5") semicircular laceration to his scalp, and a 3 cm (1") laceration to his left index finger. At impact with the second tree, the child and CSS were redirected rearward laterally to the right responding to the 4 o'clock direction of force. The right side C-pillar intruded laterally 8 cm (3") and the child's head contacted the component as evidenced by scuffing on the C-

pillar housing panel. The child sustained a subarachnoid hemorrhage to the right side of his brain, a right side cerebral contusion, and a forehead laceration.

The child was removed from the vehicle by emergency personnel and flown to a regional trauma center where he was admitted for 10 days. As a result of his head injuries, the child experienced persistent tremors in his left hand, changes in vision, severe headaches, and frequent vomiting. He was subsequently transferred to a pediatric care center for an unknown length of time prior to being discharged to his family.

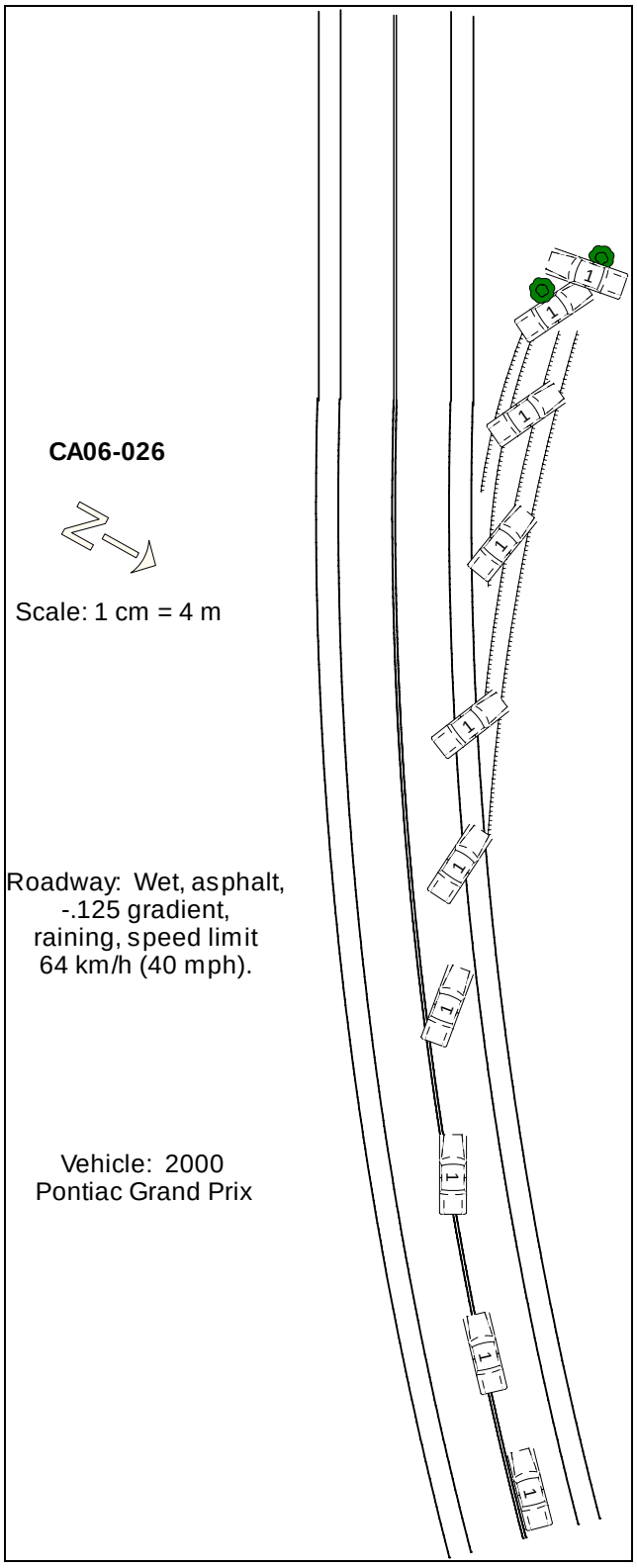

Figure 11 – Crash Schematic