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**CALSPAN REMOTE AIR BAG NON-DEPLOYMENT CRASH INVESTIGATION**

**NASS/SCI CASE NO: 2007-04-114C**

**VEHICLE: 2004 HONDA CIVIC**

**LOCATION: NEW JERSEY**

**CRASH DATE: OCTOBER 2007**

Contract No. DTNH22-07-C-00043

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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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**CALSPAN REMOTE AIR BAG NON-DEPLOYMENT CRASH INVESTIGATION**  
**NASS/SCI COMBO CASE NO: 2007-04-114C**  
**VEHICLE: 2004 HONDA CIVIC**  
**LOCATION: NEW JERSEY**  
**CRASH DATE: OCTOBER 18, 2007**

**BACKGROUND**

This remote investigation focused on the crash dynamics and the non-deployment of the frontal air bags in a 2004 Honda Civic (**Figure 1**). The Honda was equipped with a redesigned frontal air bag system and retractor mounted safety belt pretensioners. The vehicle was occupied by a 17-year-old female driver and a 17-year-old female front right passenger. Both occupants were restrained at the time of the crash by the vehicle's three-point lap and shoulder belt systems. The crash occurred when the Honda departed the left side of the road and the front and right side of the Honda's impacted six small diameter trees and a large diameter tree. This impact sequence did not deploy the frontal air bag system; however, it did result in the actuation of the safety belt pretensioners. The driver sustained police reported incapacitating injuries and was transported to a hospital where she was admitted for treatment. The front right passenger suffered police reported minor injuries. She was transported to a trauma center where treatment was administered. However, it's unknown if she was treated and released or hospitalized. Both the driver and passenger were transported to medical facilities that are non-cooperating with the National Automotive Sampling System (NASS) program. Therefore, the medical records were not obtained for this investigation.



**Figure 1: Front oblique view of the Honda.**

This crash was initially selected for research within the NASS. The case was reviewed by the Crash Investigation Division (CID) and the Office of Defects Investigation (ODI) within the National Highway Traffic Safety Administration. ODI subsequently requested that the CID assign a combined NASS/Special Crash Investigations (SCI) investigation of the crash to the SCI team at Calspan. A remote investigation was assigned on January 2008. Calspan SCI reviewed the NASS data and a technical report documenting the crash was linked to the completed Electronic Data System (EDS).

**SUMMARY**

***Crash Site***

The crash occurred during the daylight hours of October 2007 on the north roadside (left) in a rural environment. At the time of the crash, the weather was clear and the asphalt road surface was dry. At the crash site, the east/west asphalt road was straight and level. The road was comprised of a 3.8 m (12.5 ft) wide eastbound lane and a 3.5 m (11.5) wide westbound lane. These lanes were separated by a broken yellow lane line and bordered by white fog lines. Beyond the north fog line, the roadside consisted of a 0.7 m (2.3 ft) wide asphalt shoulder while the south roadside consisted of a 1 m (3.3 ft) wide asphalt shoulder. A 4.2 m (13.8 ft) wide private driveway intersected the roadway at the area of the crash site. The terrain along the north

side of the road was level immediately outboard the road edge and consisted of grass and trees. The struck trees were located from 5.5 meters (18 feet) to 12 meters (39 feet) north of the road edge and varied in diameter from approximately 15-61 cm (6-24”). The crash schematic is included in this report as **Figure 9**.

**Vehicle Data**

**2004 Honda Civic**

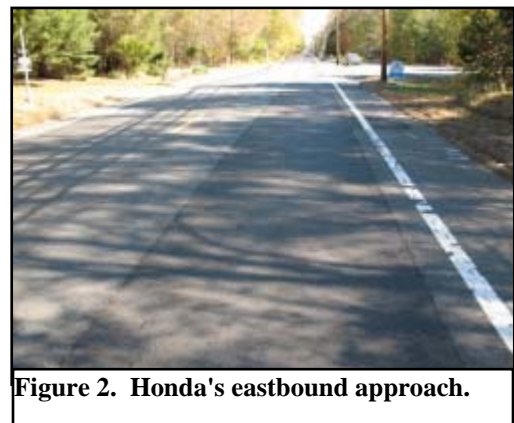
The 2004 Honda Civic identified by the Vehicle Identification Number (VIN): 1HGEM229X4L (production sequence deleted). The Honda’s date of manufacture was 07/04. The electronic odometer was inoperable at the time of the inspection due to the expended vehicle battery; therefore the mileage at the time of the crash was unknown. The two-door coupe was constructed on a unibody design with a 262 cm (103.1 in) wheelbase. The power train consisted of a 1.7 liter/I4 engine linked to a four-speed automatic transmission. The service brakes were a front disc and rear drum system with four-wheel ABS. The vehicle had the seating capacity for five passengers. The Honda was equipped with Hankook Optimo H418 tires on the front and Bridgestone Potenza RE92 tires on the rear, size P195/60R15 tires on OEM five-spoke alloy wheels. The vehicle manufacturer recommended cold tire pressure was 207 kPa (30 PSI). The specific measured tire data at the time of the NASS inspection was as follows:

<b>Tire</b>	<b>Measured Pressure</b>	<b>Tread Depth</b>	<b>Restricted</b>	<b>Damage</b>
LF	186 kPa (27 PSI)	5 mm (6/32 in)	Yes	None
LR	90 kPa (13 PSI)	5 mm (6/32 in)	No	None
RF	207 kPa (30 PSI)	5 mm (6/32 in)	No	None
RR	186 kPa (27 PSI)	4 mm (5/32 in)	No	None

**Crash Sequence**

**Pre-Crash**

The Honda was driven by a 17-year-old restrained female that was operating the vehicle eastbound (**Figure 2**). Although the driver was interviewed by both the NASS researcher and the investigating police officer, she would not discuss the details of the crash. However, the front right passenger stated to the police investigator that as the driver operated the vehicle, she threw a lit cigarette out of the open left front window. As a result of the vehicle in motion, the wind blew back some of the lit ashes into the vehicle and down the back of the driver’s shirt. The driver struggled to get the lit ashes out of her shirt and in the process allowed the vehicle to depart the right road side. Once off-road, the driver applied a left steering input returning the vehicle to the roadway. The Honda traversed the travel lanes and departed the left roadside. Two witnesses that were riding bicycles on the westbound lane observed the vehicle’s pre-crash trajectory. They stated to the investigating officer that the Honda approached at what

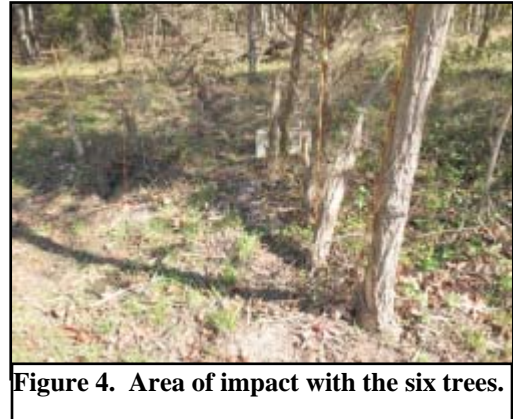


**Figure 2. Honda's eastbound approach.**

appeared to be a high rate of speed. The witnesses further stated that the Honda swerved right and left and then crossed the westbound lane and passed between the two bicyclists and departed the north roadside while sliding sideways. However, there was no physical evidence at the crash site to support the pre-impact trajectory of the Honda.

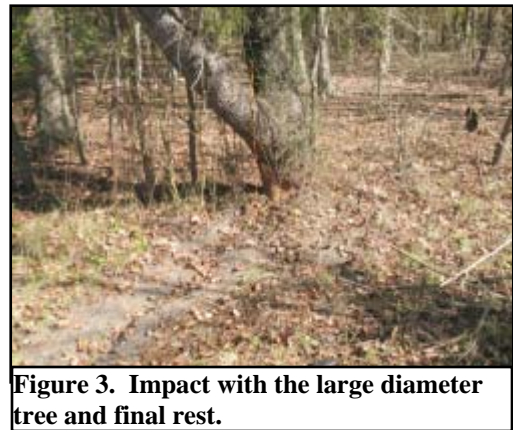
### ***Crash***

The Honda travelled off-road in a northeast trajectory approximately 23 m (75 ft) where the front and right side planes impacted and overrode a cluster of six small diameter trees (**Figure 3**). The second and third trees in the crash resulted in swiping contact down the right side of the vehicle. The sixth tree in this cluster was slightly larger and resulted in damage to the front right corner of the Honda. This impact resulted in damage to the front right satellite sensor of the air bag system. In addition to the damage, this impact triggered the actuation of the front retractor mounted safety belt pretensioners. The Honda continued the northwest trajectory approximately 8 m (26 ft) and impacted a larger diameter tree with the center front aspect (**Figure 4**).



**Figure 4. Area of impact with the six trees.**

Although the vehicle sustained multiple overlapping impacts, a delta-V was calculated using the frontal crush and the Barrier Equivalent Algorithm of the WINSMASH model. The resultant delta-V was 48 km/h (30 mph). The dynamics of this crash were beyond the limits of the WINSMASH model due to the narrow objects coupled with the multiple closely spaced overlapping impacts. The frontal air bags in the vehicle did not deploy as a result of the impact.



**Figure 3. Impact with the large diameter tree and final rest.**

### ***Post-Crash***

Police and emergency medical personnel responded to the crash scene. The driver sustained police reported incapacitating injuries and was transported to a hospital where she was admitted for treatment. The front right passenger suffered police reported minor injuries and was transported to a trauma center. Care was administered at the trauma center; however, its unknown if she was treated and released or hospitalized.

### ***Exterior Damage***

The exterior damage to the Honda consisted of moderate impact damage to the front and right side planes as a result of the multiple tree impacts. The first impact was to a small diameter tree and the resultant damage was overlapped from the other tree impact and could not be located on the vehicle. Therefore, a crush profile was not documented for this impact. **Figures 5 and 6** are overall views of the residual damage and frontal crush profile.

The damage from the second and third tree impacts began on the right front corner and swiped down the right side of the vehicle onto the rear bumper cover just beyond the right rear wheel.



This damage consisted of longitudinal abrasions and minor lateral deformation. The NASS researcher measured the direct contact damage lengths as 173 cm (68") and 129 cm (51"), respectively. Based on the exterior images of the damage, the lengths appeared to be underestimated. Additionally, crush profiles were documented for each impact; however, they were not representative of the sideswipe impact configuration and were not used in this report.



**Figure 5. Residual frontal damage.**



**Figure 6. Frontal crush profile.**

The Honda impacted three additional trees with the frontal plane as it continued its off-road trajectory. These trees were knocked down and overridden by the vehicle. Part of the resultant damage from these impacts was masked from the final impact with the large tree. However, the front right aspect of the Honda exhibited crush damage from the sixth tree impact. The damage appeared to begin on the front right frame rail and continued onto the right edge of the bumper beam. Longitudinal crush was also present on the hood and upper radiator support. Located within this area of the vehicle was the right air bag sensor. The sensor was damaged during the crash. Tree bark was present on the air bag sensor which was consistent with direct contact with a tree. In addition to the sensor damage, the wiring harness was cut and the connector was fractured. Due to the overlapping impacts, crush data was generated for these events.

The final impact in this crash sequence consisted of the front center and front left aspects of the Honda impacting a large diameter tree. This tree did not grow straight up from the ground; rather it grew angled to the left in relation to the front of the Honda. As a result of the angled tree, the resulting damage pattern extended from the center of the Honda to the left front area measuring 92 cm (36") in width. A crush profile was documented along the 92 cm wide (36") bumper beam which yielded residual crush of: C1 = 16 cm (6"), C2 = 30 cm (12"), C3 = 53 cm (21"), C4 = 57 cm (22"), C5 = 31 cm (12"), C6 = 5 cm (2"). The Collision Deformation Classifications (CDC) for this multiple event crash are identified in the following **Table 1**. Note 9 = unknown.



**Table 1. Collision Deformation Classifications**

Event No.	CDC	Object Struck
1	12-FRE9-9	Small diameter tree
2	12-RDAS-2	Small diameter tree
3	12-RDAS-2	Small diameter tree
4	12-F999-9	Small diameter tree
5	12-F999-9	Small diameter tree
6	12-FREE-2	Small diameter tree
7	12-FYEW-3	Large diameter tree

***Interior Damage***

Due to the magnitude of the crash, the extent of the interior damage was distributed across the front width of the occupant compartment. The interior damage was a result of occupant contact points and passenger compartment intrusion.

The NASS researcher identified occupant contact points from the driver that consisted of deformation and a fracture of the upper left door panel from the driver’s left elbow. An abrasion was noted on the lower door panel from contact with the driver’s left hip. Deformation was present on the knee bolster from contact by both of the driver’s knees. The brake pedal was displaced to the left from contact by the driver’s foot. It’s unknown which of the driver’s feet displaced the brake pedal. The top aspect of the steering wheel rim was bent and the steering wheel flange was compressed forward. This was attributed to contact from the driver’s torso. Additionally, clothing fibers were noted the safety belt from driver loading. Although the driver was belted, she was probably out of position as a result of trying to get the lit ashes out of her shirt.

Occupant contact points from the front right passenger were present and consisted of deformation of the glove compartment door from contact with her left knee. This contact also resulted in deformation of the steel backer panel of the glove box door. A clothing transfer was noted on the safety belt from loading by the passenger. The profiles of intruded components identified during the NASS vehicle inspection are listed by their magnitude in the following

**Table 2:**

Position	Component	Magnitude	Direction
Front left	Toe pan	3 - 8 cm (1 -3”)	Longitudinal
Front center	Center console	3 - 8 cm (1 -3”)	Longitudinal
Front right	Instrument panel	3 - 8 cm (1 -3”)	Longitudinal
Front right	Toe pan	3 - 8 cm (1 -3”)	Longitudinal
Front right	Side panel forward of A-pillar	3 - 8 cm (1 -3”)	Lateral

***Manual Restraint System***

The Honda Civic was equipped with a 3-point manual lap and shoulder belt system for all five-seating positions. The driver’s restraint consisted of continuous loop webbing, sliding latch plate, Emergency Locking Retractor (ELR), and a retractor mounted pretensioner. The NASS researcher documented an abrasion on the shoulder portion of the webbing near the D-ring which

occurred from the actuated pretensioner. Also noted was creasing on the lap belt portion of the safety belt and a clothing transfer. The creasing was attributed to loading from the driver. Frictional abrasions from the shoulder belt were documented on the top left aspect of the seatback that occurred from the combination of occupant loading and the actuation of the pretensioner.

The front right safety belt was equipped with the same features as the front left with the addition of a switchable ELR/Automatic Locking Retractor (ALR). During the crash phase, the retractor pretensioner actuated resulting in an abrasion on the shoulder belt aspect of the webbing near the D-ring. Also noted was a portion of the lap belt webbing that was gathered and restricted in the latch plate. This occurred as the pretensioner actuated while the passenger loaded the safety belt system. During the actuation of the pretensioner and loading from the passenger, contact occurred from the shoulder belt webbing on the top right aspect of the seatback. The movement of the webbing against the seatback resulted in frictional abrasions on the seatback. These abrasions were severe enough to wear off the outer fabric of the seatback. In addition to the loading a clothing transfer was noted on the safety belt.

The rear safety belts were equipped with continuous loop webbing, sliding latch plates, and switchable ELR/ALR's. The rear seat was not occupied during the crash; therefore these restraints were not in use.

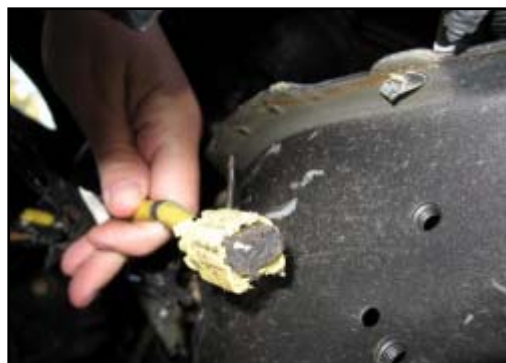
### ***Frontal Air Bag System***

The Honda Civic was equipped with a dual-stage frontal air bag system that did not deploy during this crash. The root cause of the non-deployed air bags in this crash was not directly identified. It was unknown if the vehicle had been involved in a previous(s) crash; therefore the history of the Honda's air bag system was unknown. The air bag system utilized two accelerometer based satellite sensors that were located at the front of the vehicle below the upper radiator support. These sensors were mounted to the sub-frame behind the bumper beam. The manufacturer of the sensors was Denso.



**Figure 7. Damaged front right satellite air bag sensor.**

The following scenario is a possible cause for the non-deployment of the air bag system. The pre-impact steering maneuvers and the off-road travel prior to the impact phase of the crash probably woke-up the air bag control module. During the initial impacts with the small diameter trees, the air bag control module commanded the actuation of the pretensioners. However, the frontal plane of the Honda was penetrated and the front right satellite sensor was contact by the sixth tree which was the largest in this cluster. The penetration resulted in



**Figure 8. Front right satellite air bag sensor fractured connector.**

damage to the front right sensor, cutting of the wiring harness, and a fracture of the connector. **Figures 7 and 8** are images of the damaged right sensor.

The Honda traveled approximately 8 m (26 ft) over the comparatively rough terrain to the final impact. During this off-road trajectory, the sensing algorithm probably continued to analyze the long duration event. During this period, the system either did not reset or timed-out, thereby suppressing the deployment of the air bag system. Additionally, the Honda was not equipped side impact air bags.

***Driver Demographics***

Age/Sex: 17-year-old/Female  
 Height: 175 cm (69")  
 Weight: 64 kg (141 lbs)  
 Seat Track Position: Between middle and rear track position  
 Manual Restraint Use: Manual 3-point lap and shoulder belt  
 Usage Source: Vehicle inspection  
 Eyewear: Unknown  
 Type of Medical Treatment: Hospitalized, police reported incapacitating injuries

***Driver Injuries***

<b>Injury</b>	<b>Injury Severity AIS90/Update 98</b>	<b>Injury Source</b>
Incapacitating injuries, NFS	Unknown	Unknown

*\*Non-cooperating hospital*

***Driver Kinematics***

Prior to the crash, the 17-year-old female driver was restrained by the manual 3-point lap and shoulder belt and the seat track was adjusted between the middle and rear track positions. As the driver operated the vehicle, she threw a lit cigarette out of the left front window. Due to the moving status of the vehicle, part of the lit ashes blew back into the vehicle and down the rear of the driver’s shirt. The driver attempted to remove the ashes and in the process allowed the vehicle to depart the right road side where she applied a left steering input.

This action by the driver probably displaced her forward and out of position as she attempted to remove the ashes. As the vehicle continued forward, the front of the Honda impacted a cluster of six trees. The first five of the six trees were small diameter and probably did not displace the driver. The sixth tree was larger and resulted in the actuation of the pretensioner. The driver was mostly likely minimally displaced from this impact.

The Honda continued its forward travel and the front of the vehicle impacted a large diameter tree prior to final rest. This impact stopped the forward motion of the vehicle. The driver responded to the 12 o’clock crash forces by initiating a forward trajectory and loading the steering wheel rim. This loading resulted in the steering wheel rim deformation and compression of the steering column. During this forward trajectory, her knees contacted and deformed the knee bolster. At some point during the crash phase, one of the drivers’s feet contacted and deformed the brake pedal to the left. As the vehicle rotated counterclockwise to final rest, her

left arm and hip areas contacted the door panel resulting in the deformation identified during at the vehicle inspection.

Although the NASS researcher spoke to the driver, she did not detail her injuries; however, she did state that she was hospitalized. Medical information could not be obtained from the hospital as this facility does not cooperate with the NASS program. Therefore the driver’s injured status is based upon the police reported information. The police report indicated that the driver sustained incapacitating injuries and was transported to a local hospital for treatment.

***Front Right Passenger Demographics***

Age/Sex: 17-year-old/Female  
 Height: 175 cm (69”)  
 Weight: 61 kg (134 lbs)  
 Seat Track Position: Rear track position  
 Manual Restraint Use: Manual 3-point lap and shoulder belt  
 Usage Source: Vehicle inspection  
 Eyewear: Contact lenses  
 Type of Medical Treatment: Transported to a trauma center, unknown admission status

***Front Right Passenger Injuries***

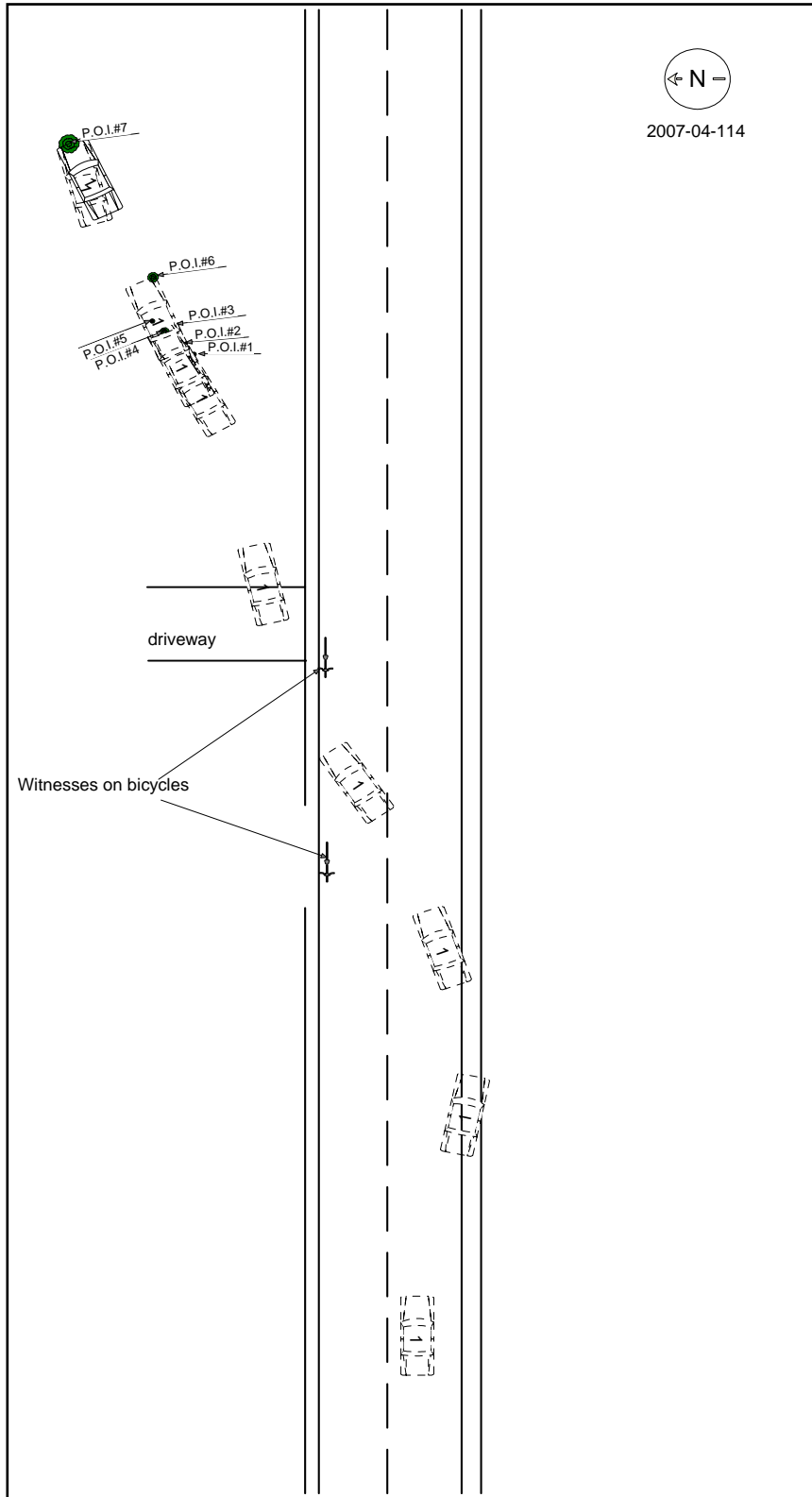
<b>Injury</b>	<b>Injury Severity AIS90/Update 98</b>	<b>Injury Source</b>
Unknown possible injuries	Unknown	Unknown

*\*Non-cooperating trauma center*

***Front Right Passenger Kinematics***

The 17-year-old female front right passenger was seated in a rear track position and was restrained by the manual 3-point lap and shoulder belt. The pre-crash trajectory of the vehicle probably displaced the passenger right and left within the front right seating position. The impact to the initial cluster of trees was minor and probably resulted in minimal forward movement of the passenger. At impact with the larger tree (sixth tree), the pretensioner actuated which retained the passenger’s position within the seat.

The final impact in this crash sequence was the most significant and resulted in the forward displacement of the passenger. During her forward motion, her left knee contacted and deformed the glove box door and steel backer panel. The NASS researcher conducted an interview with the driver and passenger; however, only partial information was given to the researcher. Due to the partial interview, the injury information was not obtained. The police reported data indicated that passenger sustained possible injuries and was transported to a trauma center. It’s unknown if the passenger was hospitalized.



**Figure 9: Scene Schematic**