CRASH DATA RESEARCH CENTER
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CALSPAN ON-SITE POTENTIAL UNINTENDED ACCELERATION CRASH INVESTIGATION
SCI CASE NO.: CA10011
OFFICE OF DEFECTS INVESTIGATION

VEHICLE: 2008 TOYOTA AVALON

LOCATION: PENNSLYVANIA

CRASH DATE: MARCH, 2010

Contract No. DTNH22-07-C-00043

Prepared for:

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National Highway Traffic Safety Administration
Washington, D.C. 20590

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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 alleged Unintended Acceleration (UA) crash that resulted in the death of a 67-year-old male driver of a 2008 Toyota Avalon. The Toyota Avalon was included in the recall population for both the Floor Mat Entrapment NHTSA Campaign No. 09V388000 and the Sticky Pedal Recall Campaign No. 10V017000. The Toyota entered a controlled 4-leg intersection and was struck on the left side by a 2005 Honda Pilot sport utility vehicle. The Toyota was equipped with Certified Advanced 208-Compliant frontal air bags, driver knee bolster air bag, front seat-mounted side impact air bags and side impact Inflatable Curtain (IC) air bags. The front safety belts were equipped with retractor pretensioners. The force of the side impact crash deployed the left side impact air bag and the left IC air bag. The impact deflected the Toyota to its right where it impacted and fractured a concrete curb with the left front suspension. The force of this frontal crash resulted in the deployment of the CAC frontal air bags and the driver knee bolster air bag. The 68-year-old female front right passenger of the Toyota sustained serious injuries and was hospitalized for treatment. The 40-year-old female driver and second row right child passenger in the Honda were treated and released from a local hospital with minor injuries. The vehicles were impounded by the investigating officer at a police storage facility where they were inspected for this SCI investigation.			
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BACKGROUND

This on-site investigation focused on the alleged Unintended Acceleration (UA) crash that resulted in the death of a 67-year-old male driver of a 2008 Toyota Avalon, **Figure 1**. The Toyota Avalon was included in the recall population for both the Floor Mat Entrapment NHTSA Campaign No. 09V388000 and the Sticky Pedal Recall Campaign No. 10V017000. The Toyota entered a controlled 4-leg intersection and was struck on the left side by a 2005 Honda Pilot sport utility vehicle. The Toyota was equipped with Certified Advanced 208-Compliant frontal air bags, driver knee bolster air bag, front seat-mounted side impact air bags and side impact Inflatable Curtain (IC) air bags. The front safety belts were equipped with retractor pretensioners. The force of the side impact crash deployed the left side impact air bag and the left IC air bag. The impact deflected the Toyota to its right where it impacted and fractured a concrete curb with the left front suspension. The force of this frontal crash resulted in the deployment of the CAC frontal air bags and the driver knee bolster air bag. The 68-year-old female front right passenger of the Toyota sustained serious injuries and was hospitalized for treatment. The 40-year-old female driver and second row right child passenger in the Honda were treated and released from a local hospital with minor injuries. The vehicles were impounded by the investigating officer at a police storage facility where they were inspected for this SCI investigation.

Figure 1: Left front oblique view of the Toyota Avalon.

The investigating police officer provided notification of the crash to the National Highway Traffic Safety Administration's (NHTSA) Office of Defects Investigation (ODI) as a potential UA-related crash. The front right passenger did not complain of UA or any mechanical issues with the Toyota. ODI established cooperation with the investigating officer and scheduled an on-site investigation of the crash for March 29 and 30, 2010. Details of the crash were then forwarded to the Calspan Special Crash Investigations (SCI) team on March 23, 2010 by NHTSA's Crash Investigations Division with the directive to assist the ODI on this on-site

investigation. The SCI investigation involved a detailed inspection and documentation of the vehicles, imaging of the Toyota's Event Data Recorder (EDR), and documentation of the crash site. An investigator from ODI inspected and removed the accelerator pedal assembly from the Toyota on March 28, 2010, the day prior to the SCI inspection. The accelerator pedal assembly was not inspected by the SCI investigator.

SUMMARY

VEHICLE DATA

2008 Toyota Avalon

The 2008 Toyota Avalon was identified by the Vehicle Identification Number (VIN): 4T1BK36BX8U (production sequence deleted). The date of manufacture was unknown as the manufacturer's label could not be accessed due to the jammed left front door. The impact fractured the vehicle's battery and rendered the electrical system inoperative; therefore the digital odometer reading was unknown. The four-door sedan was equipped with the XLS trim package, and a 3.5-liter, V6 engine linked to a five-speed automatic transmission. The four-wheel disc brake system was equipped with anti-lock (ABS). The interior of the vehicle was configured for five passenger seating. Each seat position was equipped with a 3-point lap and shoulder restraint. The front safety belts were equipped with retractor pretensioners. The Toyota was equipped with Certified Advanced 208-Compliant (CAC) air bags for the driver and front right passenger, driver knee bolster air bag, front seat-mounted side impact air bags, and side impact Inflatable Curtain (IC) air bags. The vehicle's recommended tire size was P215/55R17 with a cold tire pressure of 220 kPa (32 PSI), front and rear. The vehicle was equipped with Bridgestone Turanza P215/55R17 tires mounted on OEM alloy wheels. The specific tire data at the time of the SCI inspection was as follows:

Tire	Measured Pressure	Tread Depth	Restricted	Damage
LF	Tire flat	6 mm (8/32)	Yes	Suspension fractured, Tire debeaded
LR	214 kPa (31 PSI)	6 mm (7/32)	No	None
RR	214 kPa (31 PSI)	6 mm (8/32)	No	None
RF	207 kPa (30 PSI)	6 mm (8/32)	No	None

The Toyota's records indicated that the vehicle had received recent dealer service pertaining to both the Floor Mat Entrapment and Sticky Pedal Recalls. An October 2009 service record indicated the floor mats were checked and found to be anchored down during service for an annual inspection and periodic maintenance. The vehicle's mileage at the time of the October dealer service was 11,539 km (7,170 miles). At the time of the SCI inspection, there were no floor mats located in the driver's foot well (**Figure 2**). Toyota Avalon (OEM) all-weather floor mats were located in the front right foot well and in both second row positions.

A February 2010 record documented the dealer service for the Sticky Pedal recall (Campaign No. 10V017000). At the time of the service, the vehicle's mileage was 15,229 km (9,463 miles). The service consisted of the addition of a shim to the accelerator pedal assembly. The ODI investigator removed the pedal assembly from the vehicle on the day prior to the SCI inspection. The police investigator was present during ODI's removal of the assembly and reported that he observed that the shim was present in the assembly.

Figure 2: View of the Toyota's driver foot well. No floor mats were located within the foot well.

2005 Honda Pilot

The 2005 Honda Pilot was identified by the VIN 5FNYF18505B (production number omitted) and was manufactured in 08/05. The sport utility vehicle was equipped with a 3.5-liter V6 engine linked to an automatic transmission with all-wheel drive. The Honda was also equipped with the EX level trim package, ABS, traction control, and electronic stability control. The manual restraint system consisted of 3-point lap and shoulder belts for the five seat positions. The front safety belts were equipped with retractor pretensioners. The Honda was equipped with Certified Advanced 208-Compliant (CAC) frontal air bags, front seat-mounted side impact air bags and Inflatable Curtain air bags. The driver pretensioner actuated and the CAC driver air bag deployed as a result of the crash. The tires on the vehicle were Goodyear Integrity, size P235/70R16 mounted on five-spoke OEM alloy wheels. The tires were the manufacturer's recommended size. The vehicle manufacturer's recommended cold tire pressure was 221 kPa (32 PSI) for the front and rear. The specific tire data at the time of the SCI inspection was as follows:

Tire	Measured Pressure	Tread Depth	Restricted	Damage
LF	186 kPa (27 PSI)	4 mm (5/32)	No	None
LR	200 kPa (29 PSI)	5 mm (6/32)	No	None
RR	Tire flat	5 mm (6/32)	No	Rim abrasion, Tire debeaded
RF	200 kPa (29 PSI)	5 mm (6/32)	No	None

CRASH SITE

The crash occurred during the daylight hours of March 2010. At the time of the crash, the environmental conditions were reported as heavy rain. The asphalt road surface was wet. The crash occurred at the 4-leg intersection of a 3-lane north/south road and a 3-lane east/west road. **Figure 3** is a northbound trajectory of Toyota. The intersection was controlled by overhead

traffic signals. The signals were functioning properly at the time of the crash. Each leg of the intersection was configured with 2 lanes to accommodate the opposite direction traffic and a left turn only lane. The width of the northbound through lane measured 4.4 m (14.4 ft).

There was a positive grade in the northbound direction leading into the intersection that measured +6.9 percent. The northbound grade within the intersection measured +1 percent. The width of the eastbound through lane measured 4.5 m (14.9 ft). The outboard edges of all the travel lanes were bordered by 20 cm (8 in) tall concrete curbs. The northeast curb was fractured and displaced over a 3 m (10 ft) length, (**Figure 4**), as a result of a secondary impact from the left front suspension of the Toyota. The posted speed limit was 56 km/h (35 mph). **Figure 12**, attached to the end of this report, is a schematic of the crash.

Figure 3: Northbound trajectory view of the Toyota.

Figure 4: View of the fractured and displaced northeast curb.

CRASH SEQUENCE

Pre-Crash

The Toyota Avalon was northbound driven by a 67-year-old restrained male. A 68-year-old restrained female was the front right passenger in the Toyota. The occupants were returning home from Maryland at the time of the crash and were approximately 2.4 km (1.5 miles) from their destination. The Honda was eastbound driven by a 40-year-old restrained female and occupied by a child passenger restrained in the second row right position. Both vehicles entered the intersection precipitating the crash. There were no witnesses to the events. At the time of the on-scene police investigation, there was no reported pre-crash indication of UA.

Crash

The front plane of the Honda struck the forward aspect of the Toyota's left side (Event 1). The point of impact was identified by a gouge mark in the northbound lane. The gouge was attributed to contact with the Toyota's left front wheel rim during the impact. The force of the

impact resulted in the deployment of the Toyota's driver seat-mounted air bag and the left IC air bag. The driver air bag in the Honda also deployed. The severity of the crash was calculated by the Damage Algorithm of the WINSMASH model. The total delta-V of the Toyota was 38.0 km/h (23.6 mph). The longitudinal and lateral components were -13.0 km/h (-8.1 mph) and 35.7 km/h (22.2 mph). The total delta-V of the Honda was 33.0 km/h (20.5 mph) with a longitudinal and lateral component of -31.0 km/h (-19.3 mph) and -11.3 km/h (-7.0 mph), respectively.

The lateral impact redirected the Toyota to the northeast. The Toyota separated from the Honda and traveled 12.5 m (41 ft) where the left front suspension impacted the concrete curb bordering the northeast quadrant of the intersection (Event 2). The force of this impact fractured and displaced the curb, and resulted in the deployment of the vehicle's CAC frontal air bag system and the driver knee bolster air bag. The Toyota overrode the curb and came to rest facing east on the east leg of the intersection, 15.2 m (50 ft) from the initial impact. The Honda separated from the impact with a counterclockwise rotation. The Honda rotated 270 degrees CCW and came to rest facing south within the intersection, 9.4 m (31 ft) east of the impact. Analysis of this event was beyond the scope of WinSMASH.

Post-Crash

The police and ambulance personnel responded to the crash site. The driver of the Toyota was pronounced deceased at the scene. The Toyota's front right passenger was transported by ground ambulance to a trauma center and hospitalized with incapacitating injuries. The Honda's driver and second row right passenger sustained minor injuries and were treated and released from a local hospital. Both vehicles sustained disabling damage and were towed to the police impound pending the conclusion of the police investigation.

2008 TOYOTA AVALON

Exterior Damage

Figure 5 is a left side view depicting the impact damage to the Toyota. The left plane and left front suspension of the Toyota sustained impact damage consistent with the multiple event crash sequence. The direct contact damage to the left plane (Event 1) began at the left front corner and extended rearward onto the left front door panel. Post-crash extrication damage was noted on the left front door panel and window frame. The exterior door panel had separated from the inner door structure at the B-pillar and the panel and window frame had been pulled outboard. This post-crash damage hampered a precise determination of the crush profile and location of the end of the direct and induced impact damage. The end of the direct and induced damage was located on the aft third of the door panel and was estimated to be located at 165 cm (65 in) forward of the left rear axle. The total length of the left side damage measured 196 cm (77.0 in). The residual crush profile measured at the mid-door elevation was as follows: C1 = 0, C2 = 38 cm (14.6 in), C3 = 34 cm (13.4 in), C4 = 17 cm (6.7 in), C5 = 15 cm (5.9 in), C6 = 7 cm (2.8 in). The maximum crush was located on the forward third of the door panel at the C2 crush

measurement, 198 cm (78.0 in) forward of the left rear axle. The height of the maximum crush location measured 46 cm (18.0 in) above the ground. The Door Sill Differential (DSD) at that location measured 11 cm (4.5 in). Refer to **Figure 6**. The Collision Deformation Classification (CDC) was 10LYEW3.

Figure 5: Left view of the Toyota Avalon.

Figure 6: Close-up view of the maximum crush location and the DSD.

The front left suspension impacted and fractured the concrete curb (Event 2). The impact resulted in the fracture of the front left suspension and caused the left drive shaft to separate from the transmission. The left wheelbase was reduced 10 cm (3.9 in). The front bumper was located above the elevation of curb and was not directly involved in the impact. There was induced vertical deformation to the left frame rail. The CDC of the impact was 12UFLN3.

Interior Damage

The interior damage to the Toyota consisted of intrusion into the driver's space and deployment of the safety systems. Post-crash body fluid evidence was observed throughout the front interior seats and instrument panel. A 76 cm (30 in) long spatter pattern of body fluid was observed on the head liner. The pattern began at the overhead accessory on the windshield header extending rearward along the centerline of the vehicle. **Figure 7** is a view of the driver's interior. The left A-pillar, left door, and instrument panel intruded into the driver's position. The occupant compartment intrusions are listed in the following table:

Figure 7: View of the left front interior and the intrusion of the Toyota.

Position	Component	Intrusion	Direction
1st Row Left (Driver)	Left Lower Instrument Panel	8 cm (3.0 in)	Longitudinal
	Door – Forward Lower Quadrant	20 cm (8.0 in)	Lateral
	Left kick Panel	13 cm (5.0 in)	Lateral
	Left A-pillar	3 cm (1.0 in)	Lateral
	Left B-pillar	10 cm (4.0 in)	Lateral
	Sill	10 cm (4.0 in)	Lateral

The driver seat was adjusted to a mid-track position that measured 11 cm (4.5 in) forward of full-rear. Its position was measured by reference to the front right seat. The seat back angle measured 10 degrees aft of vertical. The horizontal distance between the seat back and the driver air bag module measured 50 cm (19.5 in). This distance was measured 38 cm (15.0 in) above the seat bight. There was no deformation of the individual spokes steering wheel rim. However, the steering wheel mounting flange was deformed. The gap between the mounting flange and the column was compressed at the 12 o'clock sector and the width of the corresponding gap at the 6 o'clock sector had increased. There was no evidence of steering column shear capsule separation.

The front right passenger seat was adjusted to the full-rear position. The seat back angle measured 20 degrees aft of vertical. The horizontal distance from the seat back to the vertical face of the instrument panel measured 76 cm (30.0 in). The horizontal distance from the seat back to the passenger air bag module measured 98 cm (38.5 in). These horizontal distances were measured 38 cm (15.0 in) above the seat bight.

The center console was disassembled prior to the SCI inspection hampering the identification of occupant contact points. The console had been disassembled by the police investigator in order to remove the Air bag Control Module (ACM).

Manual Restraint Systems

The Toyota Avalon was equipped with 3-point lap and shoulder belts in the five seat positions. The driver's restraint consisted of continuous loop webbing, a sliding latch plate, an adjustable D-ring and an Emergency Locking Retractor (ELR). The driver's D-ring was adjusted to the full-up position. The retractor was equipped with a pretensioner that actuated as a result of the crash. The webbing was extended and the retractor was locked. The length of the exposed webbing measured 160 cm (63 in). **Figure 8** is a view of the driver seat and safety belt. The lap section of the webbing was creased and loaded over a 20 cm (8 in) length. Examination of

Figure 8: View of the Toyota's driver seat and safety belt webbing.

the latch plate revealed a full-width abrasion to the hardware surface. All the evidence observed at the time of the SCI inspection indicated the driver was restrained at the time of the crash.

The front right passenger belt consisted of continuous loop webbing, a sliding latch plate, an adjustable D-ring and a switchable Automatic Locking/ELR. The right front D-ring was adjusted to the full-up position. The retractor was equipped with a pretensioner that actuated as a result of the crash. During the passage of time between the crash date and the SCI inspection, the webbing had slowly retracted to a nearly stowed position. The belt webbing could not be extended. Examination of the latch plate revealed historical use evidence and crash-related evidence. A full-width abrasion was noted on the latch plate hardware from occupant loading. Based on the evidence observed at the time of the SCI inspection, the front right passenger was restrained at the time of the crash.

Air Bag Systems

The Toyota's driver seat-mounted side impact air bag and the left IC air bag deployed as a result of the lateral crash event (Event 1). **Figure 9** is a left lateral view across the front row interior. The seat-mounted air bag was elliptical in shape and configured as an inflatable ring with a reinforced fabric center. The air bag measured 43 cm (17 in) in height and extended 18 cm (7.0 in) forward of the seat bolster. The estimated lateral depth of the inflated air bag was 8 cm (3.0 in). There was no residual evidence of direct occupant contact on the air bag.

The left IC deployed from the roof side rail and provided coverage from the upper aspect of the A-pillar to the C-pillar. The curtain was rectangular. The overall dimensions of the curtain measured 173 cm x 43 cm (68.0 in x 17.0 in), length by height. A 25 cm x 33 cm (10.0 in x 13.0 in) sail panel was sewn to the forward edge of the curtain and covered the open triangular area formed by the A-pillar and belt line. A large contact area consisting of body fluid was identified on the forward upper aspect of the curtain. The contact was attributed to the driver's head. The section of the IC with the contact area had been cut away from the rest of the curtain prior to SCI involvement. (Note - the section was repositioned during the imaging of Figure 10.) The contact area measured 20 cm x 23 cm (8 in x 9 in), width by height. **Figure 10** is a close-up view of the forward aspect of the IC and the driver head contact.

Figure 9: Left lateral view of the Toyota driver's position and the deployed air bags.

Figure 10: View of the Toyota's left IC and the driver's head contact.

The CAC frontal air bags and the driver knee air bag deployed as a result of the curb impact (Event 2). The driver air bag deployed from an H-configuration module located in the center of the steering rim. The symmetrical cover flaps was measured 8 cm x 7 cm (3.2 in x 2.8 in), width by height. There was no occupant contact to the flaps. The deployed air bag measured 61 cm (24.0 in) in diameter. The air bag was vented by two 6 cm (2.5 in) long slit-type vents located on the back side of the bag in the 1/11 o'clock sectors. Large areas of post-crash body fluid evidence were present on the face of the air bag.

The knee air bag deployed through an H-configuration module that was located in the knee bolster. The air bag measured 51 cm x 10 cm (20 in x 8 in), width by height. There was no residual evidence of driver contact to the knee air bag.

The front right passenger air bag deployed from a top-mount module located in the right aspect of the instrument panel. The symmetrical cover flaps were designed into the top surface of the panel. Each flap was trapezoidal in shape and measured 7 cm (2.8 in) in height. The width of the center seam measured 9 cm (3.5 in). The width of the hinged edge measured 20 cm (8.0 in). The passenger air bag measured 66 cm x 61 cm (26.0 in x 24.0 in), width by height. The air bag was not tethered and was vented by two 5 cm (2.0 in) diameter ports located on the side panels. Post-crash body fluid spatter was observed on the face of the bag.

Event Data Recorder

The Toyota's air bag systems were controlled by the ACM located under the center instrument stack (forward of the transmission selector). The ACM had been removed from the Toyota by the police investigator and was stored as evidence. The ACM had limited Event Data Recording (EDR) capabilities and was not capable of recording pre-crash data per Toyota. The data was

imaged at the time of the SCI investigation through the use of the Toyota ROT tool and software version 1.10. The data was imaged through a direct cable connection to the ACM by supplying external 12-volt electrical power. The data below has been analyzed and reported utilizing software version 1.4.1.1.

The EDR was configured with two memory buffers to record data. The data buffers were labeled the "Latest" and "Next Most Recent". Fields within the "Latest" data set indicated that a recording had taken place and that the writing of the data was finished. The "Latest" data recorded that the driver and front right passenger were belted and the driver and front right passenger air bag deployment was a Hi-stage deployment at 4 milliseconds. The maximum recorded post-crash velocity change (delta-V) was 24.8 km/h (15.4 mph) at 123 milliseconds. This velocity change was measured in the vehicle's longitudinal direction and in the opinion of the SCI investigator appeared consistent with the curb impact (Event 2). The velocity change in the lateral direction was not measured by the ACM. The ACM in this vehicle did not measure or record pre-crash data according to proprietary data released by Toyota. All the pre-crash data fields were zero.

The EDR data within the "Next Most Recent" buffer was incomplete and in the opinion of the SCI investigator unrelated to the crash sequence. The belt switch status for the driver and front right passenger were recorded as invalid. The writing flag in the buffer indicated the data was not recorded and an additional field indicated the data was in an initial state.

2005 HONDA PILOT

Exterior Damage

The front plane of the Honda sustained direct contact damage that extended across the entire 163 cm (64.0 in) end width. **Figure 11** is a front left oblique view of the vehicle. The damaged components included the bumper fascia, bumper reinforcement bar, grill, radiator, head lamp assemblies, hood and fenders. The bumper reinforcement deformed into a V-shape and had separated from the frame on the right. The front aspect of the vehicle was deformed to the left approximately 15 cm (6 in) consistent with the 1 o'clock direction of the impact force. The residual crush profile measured along the reinforcement bar was as follows: C1 = 9 cm (3.5 in), C2 = 19 cm (7.5 in), C3 = 35 cm (13.8 in), C4 = 34 cm (13.4 in), C5 = 21 cm (8.3 in), C6 = 10 cm (3.9 in). The maximum crush measured 45 cm (17.7 in) and was located 8 cm (3.1 in) right of C3. The left wheelbase was reduced 8 cm (3.1 in). The right wheelbase dimension was

Figure 11: Front left oblique view of the Honda.

unchanged. The windshield was fractured from the exterior force of the crash. All the doors remained closed during the impact and were operational post-crash. All the side glazing was intact. The CDC was 01FDEW2.

TOYOTA DRIVER DEMOGRAPHICS

	Driver
Age/Sex:	67-year-old/Male
Height:	Unknown
Weight:	Unknown
Seat Track Position:	Mid-track
Restraint Use:	3-point lap and shoulder belt
Restraint Usage Source:	SCI interior inspection, EDR, PAR
Mode of Transport From Scene:	Deceased at the scene
Type of Medical Treatment	None, Fatal injuries

Driver Injury

Injury	**Injury Severity (AIS-2008 Update)**	**Injury Source**
Fatal blunt force head trauma, NFS	Unknown (100999.9, 0)	Frontal structure of the Honda
Blunt force neck trauma, NFS	Unknown (300999.9, 0)	Frontal structure of the Honda

Source: Police Report. Coroner's report not available at the time of this submission.

Driver Kinematics

The driver was seated in a mid-track position and was restrained by the vehicle's safety belt. Upon impact, the safety belt retractor locked the webbing and the left seat-mounted air bag and left IC air bag deployed. The left front window glazing disintegrated. The driver initiated a left and forward trajectory in response to the 10 o'clock direction of the force. The driver's left flank contacted and loaded the deployed seat-mounted air bag and intruding door panel. The driver's head loaded through the deployed IC air bag and contacted the deformed frontal structure of the Honda that was located behind air bag. The driver sustained fatal injuries.

The vehicle separated from the Honda and impacted the curb with the front left suspension. The force of the impact resulted in the deployment of the vehicle's frontal air bags and actuated the pretensioner. The driver responded to the frontal impact with a forward trajectory. He loaded the locked safety belt system and driver air bag with his chest and head. He rebounded from the loading, back into the driver seat and then slumped forward again. He was pronounced deceased at the scene of the crash.

TOYOTA FRONT RIGHT PASSENGER DEMOGRAPHICS

	Driver
Age/Sex:	68-year-old/Female
Height:	Unknown
Weight:	Unknown
Seat Track Position:	Rear-track
Restraint Use:	3-point lap and shoulder belt
Restraint Usage Source:	SCI interior inspection, EDR, PAR
Mode of Transport From Scene:	Ground ambulance
Type of Medical Treatment	Hospitalized with incapacitating injuries

Front Right Passenger Injury

Injury	**Injury Severity (AIS-2008 Update)**	**Injury Source**
Tiny right pneumothorax	Serious (441402.3,1)	Safety belt loading
Left diaphragmatic rupture	Moderate (440604.2,2)	Safety belt loading
Left superior/inferior pubic rami fracture NFS w/ left iliac wing fracture, left sacral iliac joint widening, psoao hematoma	Moderate (856100.2,4)	Center console
Displaced sternum fracture	Moderate (450804.2,4)	Safety belt loading
Left 4th and 5th rib fractures	Moderate (450202.2,2)	Safety belt loading
Grade II liver laceration	Moderate (541822.2,1)	Safety belt loading
Left adrenal hemorrhage	Minor (540210.1,2)	Safety belt loading

Source: Discharge Summary

Front Right Passenger Kinematics

The 68-year-old female front right passenger was seated in a full-rear track position and was restrained by the vehicle's safety belt. Upon impact with the Honda, the safety belt retractor locked and the passenger initiated a left and forward trajectory loading the belt system. The passenger's left hip loaded the center console resulting in the left pelvic fracture. As the passenger rode down the initial impact, the Toyota separated from the Honda and impacted the curb with the left front suspension. This impact resulted in the deployment of the frontal air bags and actuated the pretensioner. The passenger responded to this 12 o'clock direction of force with

a forward trajectory by loading the safety belt and the deployed front right air bag with her chest. The loading of the safety belt was the probable source of her rib, pulmonary and abdominal injuries. The passenger then rebounded back into the front right seat. She was assisted from the vehicle by the first responders and transported to a trauma center for treatment.

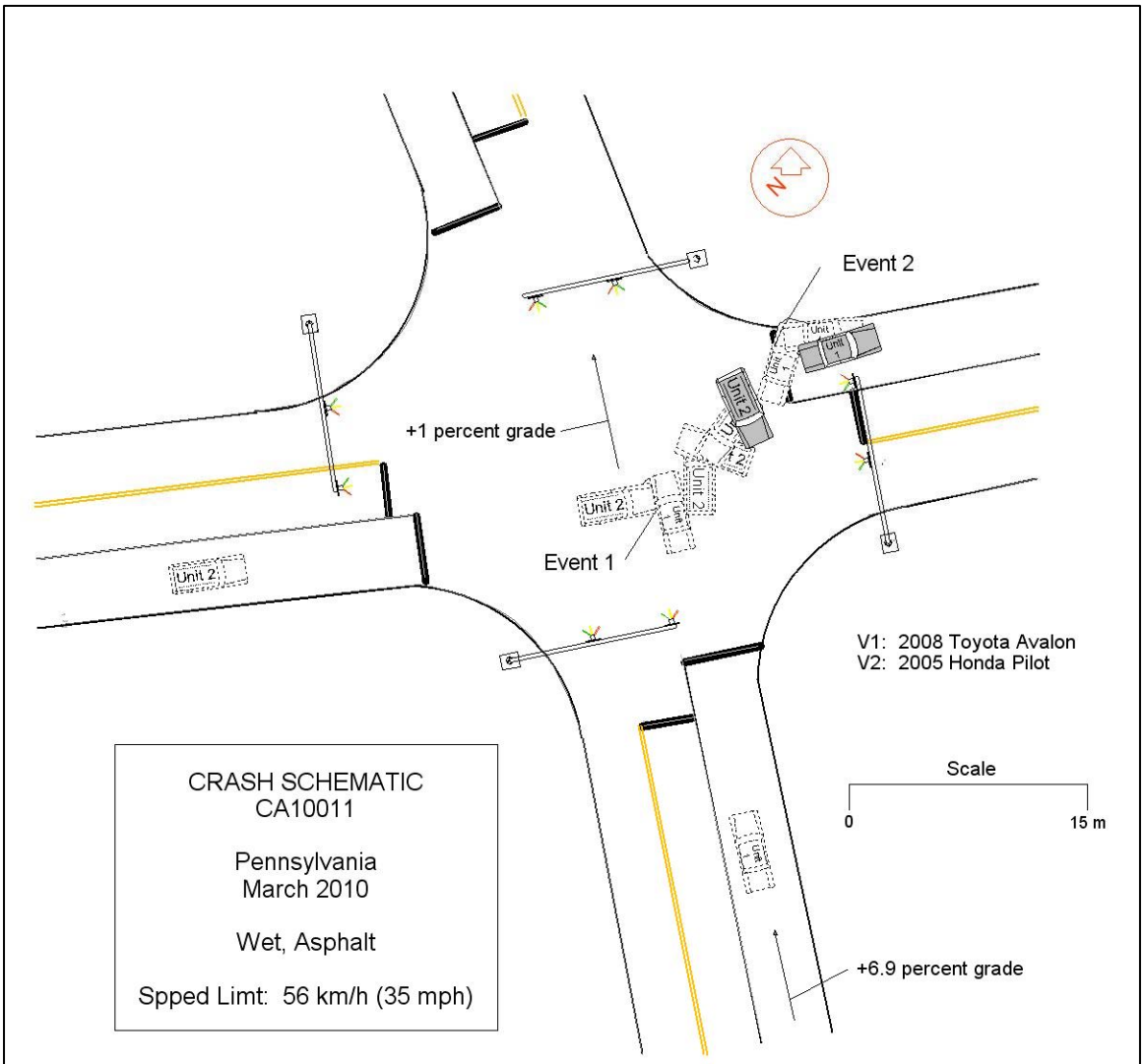

Figure 12: Crash Schematic.