CRASH DATA RESEARCH CENTER

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CALSPAN ON-SITE CHILD RESTRAINT SYSTEM CRASH INVESTIGATION

SCI CASE NO.: CA09058

VEHICLE: 2007 NISSAN VERSA

LOCATION: NORTH CAROLINA

CRASH DATE: MAY 2009

Contract No. DTNH22-07-C-00043

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 system.

TECHNICAL REPORT STANDARD TITLE PAGE

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16. Abstract This on-site investigation focused on two Child Restraint Systems (CRS) that were installed in a 2007 Nissan Versa sedan that was involved in an off-road rollover crash. The Nissan was equipped with a Certified Advanced 208-Compliant (CAC) frontal air bag system, side impact air bags and inflatable curtain (IC) air bags. The manufacturer of the Nissan has certified that the vehicle is compliant to the advanced air bag portion of Federal Motor Vehicle Safety Standard (FMVSS) No. 208. The CAC system consisted of dual-stage frontal air bags for the driver and right front passenger positions, seat track positioning sensors, buckle switch sensors, retractor pretensioners, and a front right occupant presence sensor. The Nissan departed the roadway to the right and traversed an embankment with a negative grade. The Nissan initiated a counterclockwise (CCW) yaw and tripped into a right side leading rollover. The driver's frontal air bag, right seatback-mounted side impact air bag, and both IC air bags deployed. The restrained 24-year-old female driver sustained minor severity injuries. There were two children restrained in Child Restraint Systems (CRS) in the second row of the vehicle. A 3-year-old female was restrained in a forward-facing CRS in the second row left position. The CRS and the child passenger were fully ejected through the backlight of the vehicle. The child sustained upper and lower extremity fractures and multiple soft tissue injuries. A 2-year-old male was restrained in a forward-facing CRS in the second row right position. He sustained minor severity soft tissue injuries. The driver and right second row passenger were transported by ground ambulance to a local hospital where they were treated and released. The second row left passenger was transported by ground ambulance to a local hospital and transferred to a pediatric trauma center where she was admitted for treatment.			
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BACKGROUND


Figure 1: 2007 Nissan Versa case vehicle.

This on-site investigation focused on two Child Restraint Systems (CRS) that were installed in a 2007 Nissan Versa sedan **(Figure 1)** that was involved in an off-road rollover crash. The Nissan was equipped with a Certified Advanced 208-Compliant (CAC) frontal air bag system, side impact air bags and inflatable curtain (IC) air bags. The manufacturer of the Nissan has certified that the vehicle is compliant to the advanced air bag portion of Federal Motor Vehicle Safety Standard (FMVSS) No. 208. The CAC system consisted of dual-stage frontal air bags for the driver and right front passenger positions, seat track positioning sensors, buckle switch sensors, retractor pretensioners, and a front right occupant presence sensor. The Nissan departed the roadway to the right and traversed an embankment with a negative grade. The Nissan initiated a counterclockwise (CCW) yaw and tripped into a right side leading rollover. The driver's frontal air bag, right seatback-mounted side impact air bag, and both IC air bags deployed. The restrained 24-year-old female driver sustained minor severity injuries. There were two children restrained in CRS in the second row seat of the vehicle. A 3-year-old female was restrained in a forward-facing Cosco CRS in the second row left position. The CRS and the child passenger were fully ejected through the backlight of the vehicle. The child sustained upper and lower extremity fractures and multiple soft tissue injuries. A 2-year-old male was restrained in a forward-facing CRS in the second row right position. He sustained minor severity soft tissue injuries. The driver and second row right passenger were transported by ground ambulance to a local hospital where they were treated and released. The second row left passenger was transported by ground ambulance to a local hospital and transferred to a pediatric trauma center where she was admitted for treatment.

The vehicle was identified through a visit to a regional vehicle salvage facility. Based on the rollover of the vehicle, the deployment of the IC air bags, and the ejection of the child occupant, this case was assigned for an on-site investigation on September 10, 2009. The field activities for this investigation were initiated on September 15, 2009, and involved the inspection and documentation of the Nissan and the CRS's, a detailed interview with the driver of the vehicle, an interview with the owner of the property on which the crash occurred, and the documentation of the crash site. Additionally, the Event Data Recorder (EDR) in the Nissan was imaged during this investigation.

SUMMARY

Crash Site

The crash occurred during the daylight hours in May 2009 on a two-lane north/south roadway. The weather conditions were clear and dry at the time of the crash. The travel lanes were 2.8 m (9.2 ft) in width. The roadway was surfaced with asphalt and was straight and level. Located outboard of the fog line on the east roadside was a grass roadside. The roadside was level for 1 m (3.2 ft), then transitioned to a negative embankment with a grade of -16 percent for a distance of 3.1 m (10.2 ft). An agricultural field was located outboard of the roadside. The owner of the property identified the location of the vehicle at final rest and stated that at the time of the crash the field had been recently planted and was level, surfaced with a layer of loose soil. At the time of the SCI inspection, the field had matured, obscuring the evidence related to the crash. The posted speed limit was 89 km/h (55 mph). The crash schematic is included as **Figure 14** of this report.

Vehicle Data

2007 Nissan Versa

The case vehicle was a 2007 Nissan Versa, four-door sedan. The Nissan was manufactured in March 2007 and was identified by Vehicle Identification Number (VIN): 3N1BC11E57L (production sequence deleted). The odometer reading at the time of the crash was 144,180 km (89,589 mi).

The front-wheel drive Nissan was powered by a 1.8-liter, transverse-mounted, inline four-cylinder engine linked to a 4-speed automatic transmission. The braking system consisted of power-assisted front disc and rear drum brakes with four-wheel antilock. The Nissan was also equipped with an indirect Tire Pressure Monitoring System (TPMS). The driver stated that the TPMS warning light on the instrument panel was not illuminated prior to the crash. The Nissan was equipped with four Goodride Radial SP06 tires, sized at P185/65R15. The manufacturer recommended tire size was P185/65R15. The tires were mounted on OEM steel wheels with plastic wheel covers. The manufacturer recommended cold tire pressure was 228 kPa (33 PSI) for the front and rear. The specific tire data at the time of the SCI inspection was as follows:

Position	Measured Tire Pressure	Measured Tread Depth	Damage
Left Front	Tire flat	6 mm (7/32 in)	None
Left Rear	Tire flat	6 mm (8/32 in)	None
Right Front	Tire flat	6 mm (7/32 in)	None
Right Rear	193 kPa (28 PSI)	6 mm (8/32 in)	None

The interior of the Nissan was configured with cloth-surfaced five-passenger seating. The front bucket seats were separated by a center console and equipped with adjustable head restraints. Both front head restraints were in the full-down position. The front left seat track was adjusted to a mid-track position, 7 cm (2.8 in) forward of full-rear. The front right seat track was also in a mid-track position, located 10 cm (3.9 in) forward of full-rear. The front left seat back angle was measured at 24 degrees aft of vertical. The

front right seat back was impacted by the second row left child passenger and was displaced to an angle of 5 degrees forward of vertical. The second row consisted of a bench seat with a folding back. The second row outboard seats were equipped with adjustable head restraints, all in the full-down position.

The interior occupant safety systems consisted of 3-point lap and shoulder belt systems for the five designated seating positions, front seat safety belt pretensioners, dual-stage CAC frontal air bags, front seatback-mounted side impact air bags and the IC air bags that provide protection for the four outboard seating positions.

Crash Sequence

Pre-Crash

The restrained 24-year-old female driver of the Nissan was operating the vehicle in a northbound direction on the two-lane roadway **(Figure 2)**. Her travel lane was straight and level. The Nissan was traveling at a driver estimated speed of 105-113 km/h (65-70 mph). The driver of the Nissan stated that she turned around and directed her attention to one of the children in the second row seat. As a result of her inattention, the Nissan drifted to the right and departed the roadway. The driver of the Nissan initiated an avoidance maneuver by applying the brakes and steering left in an attempt to return to the roadway. The Nissan yawed in a CCW direction down the embankment and entered the soft soil of the agricultural field. The front wheels and front undercarriage of the Nissan furrowed into the soft soil of the field.

Figure 2: Northbound direction of travel.

Crash

The right side tires of the Nissan furrowed into the soft soil and tripped the vehicle into a right side leading rollover. The vehicle rolled over a distance of approximately 34 m (112 ft) based on the description of the property owner. The Nissan completed a minimum number of seven-quarter turns based on the vehicle damage and the distance traveled. The rollover event was not interrupted. During the rollover sequence, the second row left passenger was fully ejected through the disintegrated backlight while secured in her CRS. The Nissan came to rest on its left side facing in a northerly direction in the field below the east roadside.

Post-Crash

The driver stated during the SCI interview that she exited the vehicle unassisted through the backlight opening and removed the second row right passenger through the disintegrated backlight. The second row right occupant was conscious and crying post-crash. The driver then proceeded to search for the ejected second row left passenger. A passing motorist stopped at the crash site to assist the driver. The driver located the second row left passenger; however, she could not recall the final rest position of the

child and the CRS. The passerby told her not to remove the child from the CRS in case of injury. The driver unbuckled the child passenger who was conscious and crying.

Police, emergency medical, and tow personnel responded to the crash site. The driver and the second row right passenger of the Nissan were transported to a local hospital where they were treated for soft tissue injuries and released. The fully ejected second row left passenger was transported to a local hospital where she was evaluated and transferred to a pediatric trauma center the same day. She was admitted to the pediatric trauma center for three days for treatment of fractures to her right forearm arm and right femur. The Nissan was towed to a local tow yard where it remained until it was transferred to a regional vehicle salvage facility where it was inspected.

Vehicle Damage

Exterior

The exterior of the Nissan sustained moderate severity damage to the left, top and right planes as a result of the rollover event. The scratches on the roof were oriented in multiple directions as the vehicle had rolled onto the roof at least twice during the event. The direct contact damage to the roof extended 108 cm (42.5 in) laterally from roof side rail to roof side rail and 332 cm (130.7 in) longitudinally from the leading edge of the hood to the backlight header. The maximum vertical and lateral crush was at the same location, on the left roof side rail 59 cm (23.2 in) aft of the B-pillar. The maximum vertical crush measured 10 cm (3.9 in), and the maximum lateral crush measured 13 cm (5.1 in). The windshield glazing was completely fractured with a laminate tear that extended from the left A-pillar to the right A-pillar approximately one-third of the distance from the top of the windshield. The left rear door window and quarter glazing, the backlight and the right front door windows all disintegrated during the rollover. The left front, right rear and right rear quarter glass was not damaged during the crash. All four doors remained closed during the crash and were operational post-crash. **Figures 3 and 4** depict the rollover damage sustained by the Nissan. The CDC assigned for the rollover was 00TDDO3.

Figure 3: Rollover damage to the Nissan from the left rear.

Figure 4: Overhead view of the rollover damage.

Interior

The Nissan sustained moderate severity interior damage that was attributed to passenger compartment intrusion, occupant/CRS contact, and air bag deployment. The front right seatback and head restraint were deformed forward by contact with the unrestrained second row left CRS. This contact also resulted in three horizontal scuff marks to the cloth fabric on the rear aspect of the head restraint. All three marks were 6 cm (2.4 in) in width and were located 7, 10 and 14 cm (2.8, 3.9 and 5.5 in) below the top of the right head restraint. The front right seatback was displaced forward and there was a Z-shaped scuff mark in the cloth on the rear aspect of the seatback. This scuff mark was located 26-45 cm (10.2-17.7 in) below the top of the seatback and 10-28 cm (3.9-11 in) right of the left edge of the seat. The roof was abraded with a plastic and cloth transfer that was 113 cm (44.5 in) in length and 22 cm (8.7 in) in width, attributed to contact with the second row left CRS (**Figure 5)**. This contact began at the backlight header and extended 113 cm (44.5 in) forward. It extended 55 cm (21.7 in) left of the right roof side rail and ended at the backlight header, 62 cm (24.4 in) left of the right roof side rail. The headliner was also torn at the front edge of this contact. There was a scuff mark on the second row center seat back attributed to the movement of the second row right CRS as it reached the end of the slack in the belt system. This scuff mark was located 58-80 cm (22.8-31.5 in) left of the right edge of the seatback and 36-56 cm (14.2-22 in) above the bight of the seat.

Figure 5: Roof contact to the Nissan.

The intrusion to the Nissan is listed on the following table:

Position	Component	Direction	Magnitude
Row 2 Left	C-pillar	Lateral	4 cm (1.6 in)
Row 2 Left	Roof side rail	Lateral	5 cm (2 in)
Row 2 Left	Roof side rail	Vertical	4 cm (1.6 in)

Manual Restraint Systems

The Nissan was equipped with manual 3-point lap and shoulder belts for the five designated seating positions. All belt systems utilized continuous loop webbing and sliding latch plates. The front left belt system included a retractor mounted pretensioner which actuated during the crash. The front left upper D-ring was height adjustable and was located in the full-down position. The driver's belt retracted onto an Emergency Locking Retractor (ELR). The driver used the belt at the time of the crash, which was supported by loading evidence on the belt webbing. This evidence consisted of a frictional abrasion on the belt webbing near the upper D-ring. The D-ring abrasion was located 173-179 cm (68.1-70.5 in) above the floor anchor. Additionally, the actuated pretensioner locked the safety belt in the used position. The total length of the locked webbing measured 185 cm (72.8 in).

The front right and second row safety belt systems utilized switchable ELR/Automatic Locking Retractors (ALR). In addition, the unoccupied front right seat utilized a retractor pretensioner which actuated during the crash which pulled the webbing taut against the right B-pillar. The second row outboard safety belts were used to secure the CRS's. There was loading evidence on the second row right belt consisting of abrasions and indentations from engagement against the shell of the CRS. On the second row right belt webbing, this evidence was located 24-120 cm (9.4-47.2 in) above the lower anchor of the belt. There was no damage or loading evidence to the second row center belt system. The second row left belt system contained a single indentation attributed to use with a CRS and an abrasion. This indentation was located 22 cm (8.7 in) above the lower floor anchor of the belt, and the abrasion was located 68-80 cm (26.8 -31.5 in) above the lower anchor. All three second row belt retractors were in the ELR mode at the time of the SCI inspection, including the second row right belt which still secured the installed CRS.

Frontal Air Bag System

The Nissan was equipped with a CAC frontal air bag system. The CAC system included dual-stage frontal air bags for the driver and front right passenger positions, seat track positioning sensors, safety belt buckle switches, retractor pretensioners, and a front right occupant presence sensor. The driver's frontal air bag deployed during the crash. The frontal air bag was concealed within the center hub of the three-spoke steering wheel by five cover flaps. The top flaps were 7 cm (2.8 in) in height and width. There was a circular Nissan logo attached to the upper right flap. The two lower outboard flaps were 9 cm (3.5 in) in height, 4 cm (1.6 in) in width at the upper seam and 6 cm (2.4 in) in width at the lower seam. The lower center flap was 7 cm (2.8 in) in width at the lower edge, 3 cm (1.2 in) in width at the upper tear seam, and 4 cm (1.6 in) in height. The air bag was 50 cm (19.7 in) in diameter in its deflated state **(Figure 6)**. The air bag was vented by two vent ports at the 11 and 1 o'clock positions at the upper rear aspect of the air bag. The air bag was tethered by two tethers attached to the face of the air bag at the 12 and 6 o'clock positions. The tether reinforcement sewn to the face of the air bag measured 15 cm (5.9 in) in diameter. The driver's air bag was labeled with the nomenclature:

Figure 6: Driver's frontal air bag.

2418253A1
0103071ll50
02 03 07 M
S

There were no occupant contact on the air bag; however, the left side of the face of the air bag included a plastic deployment transfer. The front right air bag was mounted within the top aspect of the right instrument panel. The front right seat was not occupied during the crash; therefore the CAC system suppressed the deployment of the air bag.

Side Impact Air Bag System

The Nissan was equipped with front seatback-mounted side impact air bags and IC air bags. Both IC air bags and the right side impact air bag deployed during the rollover. The left side impact air bag did not deploy.

The IC air bags deployed from their respective roof side rails. The IC air bags measured 172 cm (67.7 in) in length. At the front and second row seating positions, the IC's were 42 cm (16.5 in) in height. The air bag was tethered to the A-pillar by a 35 cm (13.8 in) long strap. The IC's provided complete longitudinal coverage across the rear side glazing, and coverage across the front side glazing with the exception of a void at the front of the curtain at the A-pillar area. This void measured 39 cm (15.4 in) in width, 36 cm (14.2 in) in height at the rear and 16 cm (6.3 in) in height at the A-pillar. Vertically, the IC's extended 5 cm (2 in) below the beltline at each outboard seating position. The inboard side of the left IC contained a makeup transfer attributed to the left side of the driver's face. This transfer was located 7-17 cm (2.8-6.7 in) above the bottom of the IC and 61-69 cm (24-27.2 in) aft of the front edge of the IC. **Figures 7 and 8** depict the side air bags. Both IC's were labeled with the nomenclature:

6086046D
SI/PA 6.6

Figure 7: Left inflatable curtain air bag.

Figure 8: Right inflatable curtain air bag.

The right side impact air bag deployed from a 28 cm (11 in) panel in the upper outboard aspect of the right seatback. The air bag measured 11 cm (4.3 in) in width and 29 cm (11.4 in) in height. The air bag was not vented or tethered. There was no damage to the air bag and no occupant contact evidence on the air bag. **Figure 9** depicts the front right side air bag.

Figure 9: Right side impact air bag.

Event Data Recorder

The air bag control module of the Nissan had Event Data Recorder (EDR) capabilities. The imaging of the EDR was attempted using a Consult II diagnostic scan tool supplied by Nissan North America. The Nissan imaging process was conducted by applying

power to the vehicle and imaging the data through the Diagnostic Link Connector (DLC) located under the left instrument panel. At impact, the number of ignition cycles was 6,135. The imaged data indicated the system had detected side impact and frontal events and actuated the pretensioners, the driver's frontal air bag, and side curtain air bags. There was no pre-crash, delta-V, or vehicle condition data stored in the module. The Nissan's battery fractured and separated from the vehicle during the rollover sequence prior; therefore the data was not written to the memory within the EDR.

Second Row Left Child Restraint System

The CRS installed in the second row left seating position was a Cosco/Dorel High Back booster seat that could be used as a forward-facing CRS or as a booster CRS **(Figure 10)**. The 5-point harness was installed in the CRS and the CRS was installed and used as a forward-facing restraint. The seat was manufactured on January 12, 2009, and was labeled with the Model N0. 22-233-PDP. A stamp on the rear aspect showed that this seat should not be used after December 2015. The seat was equipped with Lower Anchors and Tethers for Children (LATCH). The LATCH system was not in use at the time of the crash. The vehicle's safety belt had been routed through the forward-facing belt path at the rear shell of the CRS. The child passenger was restrained within the CRS by the 5-point harness system. The chest positioning clip was used. The driver stated in the interview that the retainer clip was positioned in the middle of the child passenger's chest. The harness straps were in the top slots at the time of the SCI inspection. The CRS was not regularly removed from the Nissan.

Figure 10: Second row left CRS.

The second row left CRS was fully ejected from the Nissan during the rollover sequence. The safety belt securing the CRS to the vehicle was not buckled at the on-set of the crash. The driver believes that the child passenger unbuckled the vehicle's safety belt prior to the crash. The driver stated in the interview that she had turned around after hearing her daughter playing with the safety belt prior to departing the roadway to the right. The driver further stated that the child passenger often buckled herself into the CRS. The driver could not recall during the interview if she had buckled the child into the CRS that day, or if the child had secured herself.

The right side of the shell of the CRS sustained moderate damage, and the left side and back of the seat sustained minor damage in this rollover crash sequence. The right side displayed evidence of color loss due to stress loading that was 30 cm (11.8 in) in height along the right side support. There was a 22 cm (8.7 in) crack in the shell on the lower section that originated at the right side and extended to the attachment point for the crotch strap of the 5-point harness and continued towards the left side of the lower section. The lower attachment of the 5-point harness had detached from the CRS. There was a 10 cm (3.9 in) abrasion on the back aspect of the right side, and further color loss due to stress loading at the right side belt path. There was an 8 cm (3.1 in) abrasion adjacent to the

right side belt positioning clip for the shoulder belt when used as a booster seat. On the rear aspect of the CRS, there was abrasion on the shell at both rail sections and on the right rail, a 4 cm (1.6 in) wide by 14 cm (5.5 in) high section where a thin strip of plastic had separated from the shell. At the right side of the shell, there were two areas of color loss due to stress loading near the opening for the belt path and a 5 cm (2 in) area of stress loading on the upper right aspect neat the shoulder strap positioning clip. **Figures 11 and 12** depict the damage to the CRS used in the second row left seating position.

Figure11: Damage to the right side of CRS.

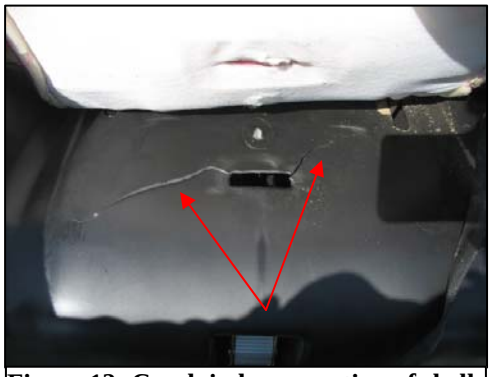

Figure 12: Crack in lower section of shell of the CRS.

Second Row Right Child Restraint System

The CRS installed in the second row right seat of the Nissan was a Cosco/Dorel Ventura DX High Back booster, Model No. 22-248-WAL. The CRS was manufactured on March 2, 2005 and could be used as a forward-facing CRS or a belt positioning booster. The CRS was installed in the Nissan as a forward-facing CRS. The child was secured within the CRS with the 5-point integral harness. The Nissan's safety belt was routed through the forward-facing belt path on the rear of the CRS. The seat was still installed in the Nissan at the time of the SCI inspection. There was slack in the safety belt system sufficient to allow 12 cm (4.7 in) of CRS movement in either the vertical or horizontal directions. The safety belt retractor was in the ELR mode. There was 159 cm (62.6 in) of the vehicle's safety belt spooled out of the retractor and routed through the CRS.

Figure 13: Second row right CRS.

The CRS in the second row right position was equipped with LATCH but this system was not used during the crash. The 5-point harness straps were in the top slots. There was a harness retainer clip present on the harness system that would have been located at approximately the middle of a child's chest. There was no damage to the harness or

hardware of the CRS. There was no damage to the shell of the CRS in the second row right seating position. The second row right CRS remained in the vehicle during the rollover sequence and the child remained harnessed in the CRS. **Figure 13** depicts the CRS used in the second row right seat.

Driver Demographics/Data

Driver Age/Sex:	24-year-old/Female
Height:	163 cm (64 in)
Weight:	67 kg (148 lb)
Eyewear:	None
Seat Track Position:	Mid-track, 7 cm (2.8 in) forward of full-rear
Manual Safety Belt Use:	3-point lap and shoulder belt
Usage Source:	Vehicle inspection
Egress from Vehicle:	Exited under her own power through the backlight
Mode of Transport from Scene:	Ground ambulance
Type of Medical Treatment:	Transported to a local hospital where she was treated in the emergency department and released

Driver Injuries

Injury	Injury Severity (AIS 90/Update 98)	Injury Source
Left shoulder contusion	Minor (790402.1,2)	Safety belt
Chest contusion	Minor (490402.1,4)	Safety belt
Right hip contusion	Minor (890402.1,1)	Safety belt
Head injury (no LOC, only headache)	Minor (160402.1,0)	Non-contact impact force

Source - Medical records and driver interview

Driver Kinematics

The 24-year-old female driver was seated in a mid-track position and was restrained by the manual 3-point lap and shoulder belt system. Prior to departing the roadway, the driver had turned around to attend to a child in the second row seat. The vehicle departed the roadway to the right and the driver applied the brakes and attempted to steer left to return to the roadway. The vehicle rotated CCW and tripped into a right side leading rollover.

During the rollover event, the driver's safety belt pretensioner actuated, the driver's frontal air bag, the right side impact air bag and both IC air bags deployed. The driver initiated a left trajectory within the front left seating position. The driver loaded the left IC with her face resulting in the make-up transfer, but no injury. The driver loaded the safety belt system, resulting in contusions of the left shoulder, chest and right hip. The driver initiated an upward and right trajectory but was restrained by the belt system. She also sustained a minor severity head injury that was attributed to the impact force.

After the vehicle came to rest on its left side, the driver unbuckled the safety belt and exited the vehicle under her own power through the backlight. The driver was

transported by ground ambulance to a local hospital where she was treated in the emergency department and released.

Second Row Left Passenger

Age/Sex:	3-year-old (40-months)/Female
Height:	91 cm (36 in)
Weight:	16 kg (36 lb)
Eyewear:	None
Seat Track Position:	Not adjustable.
Restraint Use:	Restrained in a forward-facing CRS. The 3-point vehicle lap and shoulder belt was unbuckled.
Usage Source:	Vehicle Inspection
Egress from Vehicle:	Fully ejected while still restrained in the CRS
Mode of Transport from Scene:	Ground ambulance
Type of Medical Treatment:	Transported to a local hospital and transferred to a regional pediatric trauma center and admitted for three days.

Second Row Left Occupant Injuries

Injury	Injury Severity (AIS 90/Update 98)	Injury Source
Right femur fracture, (an oblique, displaced fracture of the mid right femoral diaphysis)	Serious (851814.3,1)	Front right seat back
Right distal radius fracture, (transverse, with displacement of the distal fracture fragment)	Serious (752804.3,1)	Front right seat back
Right distal ulna fracture (transverse, volarly and medially angulated)	Moderate (753202.2,1)	Front right seat back
Left scalp hematoma (tempo-parietal area)	Minor (190402.1,2)	Front right seat back
Left eyelid contusion	Minor (297402.1,2)	Front right seat back
Bilateral leg contusions, (including right thigh and bilateral below knee)	Minor (890402.1,3)	Front right seat back
Bilateral shoulder contusions (on top of shoulder)	Minor (790402.1,3)	CRS harness
Contusion on dorsal side of right arm, upper and lower	Minor (790402.1,1)	Front right seat back

Source =Medical records and driver interview

Second Row Left Passenger Kinematics

The 3-year-old female second row left passenger was restrained by the 5-point harness in the forward-facing CRS. The Nissan's safety belt securing the CRS to the second row left seat was unbuckled prior to the crash event. As the vehicle departed the roadway and entered the soft ground of the agricultural field, it began to rotate CCW. The child and the CRS initiated a forward trajectory as a unit from the second row left seating position. The vehicle's safety belt snagged the CRS and induced a CCW rotation on its vertical axis. The child and the CRS impacted the back of the front right seat during the rollover event.

The right side of the CRS impacted the upper aspect of the front right seatback and the head restraint, displacing the seatback and head restraint forward and resulting in the right femur fracture, the right distal radius and ulna fractures, and multiple soft tissue injuries of the extremities, face and scalp. During the rollover, the CRS impacted the headliner of the vehicle, producing a transfer and fracturing the headliner. The CRS then initiated a rearward trajectory towards the backlight, contacting the headliner as it traveled rearward. The CRS, with the second row left passenger secured in the restraint by the integral harness, was fully ejected through the disintegrated backlight and into the agricultural field. There were no injuries or damage to the CRS attributed to the ground contact.

The child was removed from the CRS by the driver of the Nissan. She was transported by ground ambulance to a regional hospital. Due to a need for services not available at that facility, she was transferred several hours post-crash to a regional pediatric trauma center where she was admitted for three days for treatment of her injuries.

Second Row Right Passenger Demographics/Data

Driver Age/Sex:	2-year-old (27-months)/Male
Height:	71 cm (28 in)
Weight:	10 kg (23 lb)
Eyewear:	None
Seat Track Position:	Not adjustable.
Restraint Use:	Restrained in a CRS that was secured to the vehicle by the 3-point lap and shoulder belt
Usage Source:	Vehicle Inspection
Egress from Vehicle:	Removed post-crash by driver through the disintegrated backlight
Mode of Transport from Scene:	Ground ambulance
Type of Medical Treatment:	Transported to a local hospital where he was treated in the emergency department and released

Second Row Right Passenger Injuries

Injury	Injury Severity (AIS 90/Update 98)	Injury Source
Mid-chest wall contusion	Minor (490402.1,4)	Harness retainer clip
Contusion to the right side of face, cheek to ear	Minor 290402.1,1)	Right side of CRS shell
5 cm (2 in) contusion top of left shoulder	Minor (790402.1,2)	CRS harness
Left shoulder abrasion	Minor (790202.1,2)	CRS harness

Source – Hospital emergency room records

Second Row Right Passenger Kinematics

The 2-year-old male second row right passenger of the Nissan was restrained in a forward-facing CRS. The vehicle's safety belt was routed through the forward-facing belt path on the rear of the CRS and buckled into the second row right buckle with the retractor in ELR mode prior to the crash. The child was secured within the CRS by the 5-point harness system.

During the rollover event, the ELR locked the safety belt and the forward motion of the CRS was arrested approximately 12 cm (4.7 in) above and forward of the bight of the second row right seat. The child passenger and the CRS initiated a forward, lateral, and vertical trajectory within the limits of the slack in the safety belt. The second row right passenger loaded the 5-point harness resulting in the contusions to his left shoulder and the center of his chest, and an abrasion of the left shoulder. The CRS impacted and deposited a 28 cm (11 in) scuff mark on the second row center seat back. The occupant's face contacted the inner right side of the CRS shell, resulting in the contusion to the right side of the face.

When the vehicle came to final rest on its left side, the CRS came to final rest belted to the second row seat. The passenger was restrained in an inverted position post-crash. The driver exited the vehicle under her own power and unharnessed the second row right passenger from the CRS and removed him through the disintegrated backlight.

The second row right passenger was transported by ground ambulance to a local hospital where he was treated in the emergency department and released.

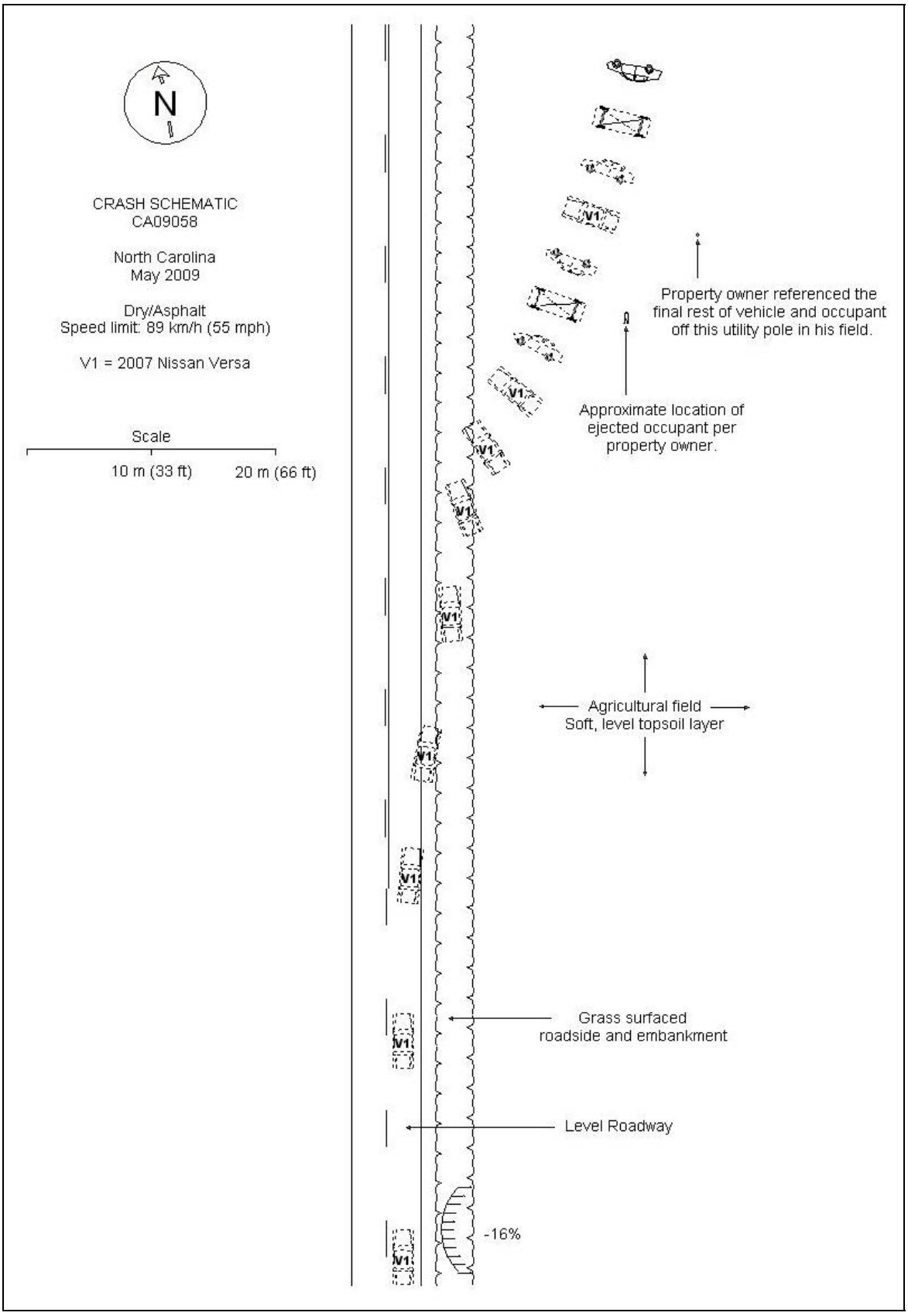

Figure 14: Scene Schematic