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Transportation Safety Training Center

Virginia Multi-disciplinary Crash Investigation Team

Report Number 200 – May, 2007

ABSTRACT

The crash described in this report occurred when a Sport Utility Vehicle (SUV) ran off the right side of the roadway, traveled some distance along the edge of the road and the driver swerved left to avoid stationary roadside objects. This overcorrection caused the vehicle to rotate counter-clockwise as it regained the pavement. The vehicle crossed the center lines and entered the opposing lanes. The driver then swerved right, again overcorrecting, and the vehicle rolled onto its left side and slid into a pickup truck traveling in the opposite direction. The initial impact was between the hood, windshield and roof of the SUV and the front bumper of the pickup. The SUV rolled up onto the hood of the pickup, where it came to rest. Five fatalities resulted. The unrestrained toddler in the pickup died, as did the driver and three of the four passengers in the SUV. The driver of the pickup and the remaining passenger in the SUV were hospitalized with serious injuries.

The crash described in this report illustrates the potentially tragic consequences of driving while under the influence of alcohol and/or drugs. The importance of properly restraining children in safety seats, over-correction as a common driver error, and roads with narrow and/or sloped shoulders are also discussed. An addendum describes a second overcorrection type crash that resulted in four fatalities, including a child.

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SYNOPSIS

Day, Time, Season: Friday, 10:20 p.m., Winter

Road/Weather: Rural primary road; clear and dry

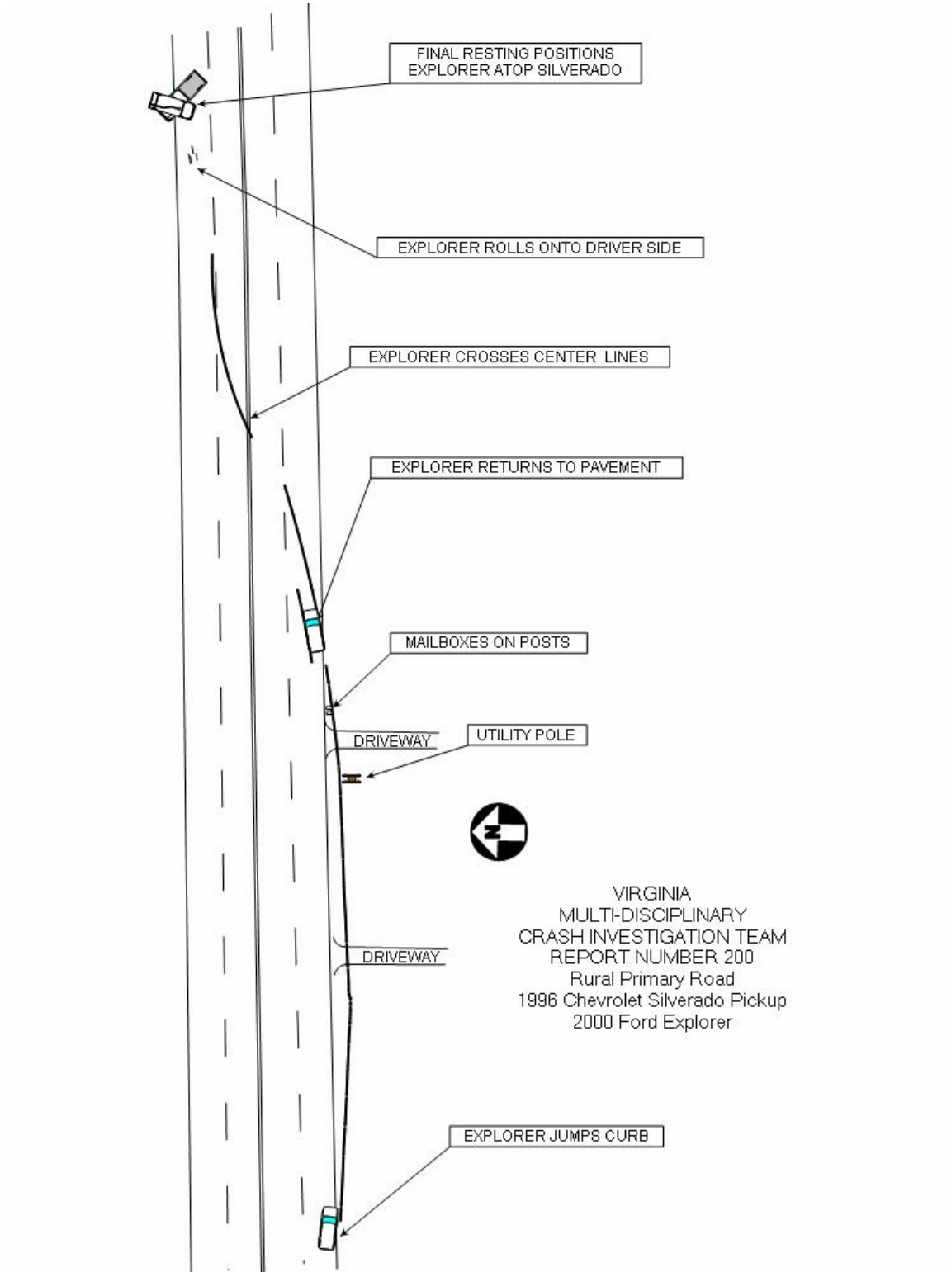
Vehicles Involved: 2000 Ford Explorer Sport Utility Vehicle
1996 Chevrolet Silverado Pickup

Summary: After running off the road to the right, the driver of the SUV steered evasively to miss several objects off the road. This brought the SUV back onto the roadway where it then entered the opposing lanes of traffic. The driver swerved back to the right in a failed attempt to avoid the oncoming pickup. This overcorrection caused the SUV to rotate and overturn; it then struck the oncoming pickup.

Severity: 5 fatalities, 2 persons seriously injured, extensive property damage

Probable Cause: Speeding, alcohol and/or substance abuse.

Significant Points: Alcohol and/or substance abuse, lifestyle choices, speeding, child safety seat use, crash scene management.


FINAL RESTING POSITIONS
EXPLORER ATOP SILVERADO
EXPLORER ROLLS ONTO DRIVER SIDE
EXPLORER CROSSES CENTER LINES
EXPLORER RETURNS TO PAVEMENT
MAILBOXES ON POSTS
DRIVEWAY
UTILITY POLE
DRIVEWAY
EXPLORER JUMPS CURB
VIRGINIA
MULTI-DISCIPLINARY
CRASH INVESTIGATION TEAM
REPORT NUMBER 200
Rural Primary Road
1996 Chevrolet Silverado Pickup
2000 Ford Explorer

CRASH DESCRIPTION

At 10:20 p.m. on a clear Friday evening, five young men were traveling in a black 2000 Ford Explorer Sport Utility Vehicle (SUV). They were headed east on a four lane rural primary route that passed through a residential section not far from an intersection with a major primary road. The road has four lanes (two lanes in each direction) with asphalt pavement and concrete curb and gutter. Each lane is approximately 11 feet wide; adjacent to each outside lane is a 2 foot wide gutter and 6 inch high curb. The lanes are controlled by pavement markings which are in good condition. In addition, raised, snow plowable reflective pavement markers are installed in the pavement to help delineate the roadway at night and during inclement weather. The posted speed limit is 45 mph. The markers and signs are in good condition.

The SUV driver was a 21 year old male, who was accompanied in the front passenger seat by a 21 year old male friend. Three other male friends, ages 20, 21, and 24 years old, sat in the second row seat. None of the occupants wore safety restraints. The group had just left a local restaurant, about a mile and a half away, where they had dined with the driver's brother. Their destination was unknown.

A black Silverado extended cab pickup was headed west in the right lane. The 29 year old female driver was accompanied by her 29 month old son, who sat in the left rear position, just behind her. The driver wore her lap/shoulder belt. Although her child was sitting on a child safety seat, he was not restrained by either the seat's internal harness or the lap/shoulder belt available for that seating position. The two had just been to a local grocery store, where the driver had made several purchases. She had traveled about a third of a mile and had only a mile and a half to continue to reach her home. The pickup had just rounded a gentle tree lined curve to the right before coming to the straight segment of roadway where the crash occurred.

The SUV was near the end of a gentle curve to the left when its right wheels jumped the curb bordering the roadway. The roadway then runs straight for approximately ¾ mile. The SUV left tracks on the grass shoulder to the right of the curb for approximately 200 feet. The farthest point from the edge of the road to the tracks measured less than seven feet. The departure angle of these marks was calculated at approximately 4 degrees. These marks ran in an arc generally parallel to the road's edge. The marks traversed the grassy shoulder for a distance of approximately 70 feet before evidence of any change in direction, then continued for another 57 feet, gradually getting closer to the curb. The driver swerved back to the left in order

to avoid a utility pole that was located within six feet of the curb. It traveled an additional 35 feet and struck two mailboxes, narrowly missing the posts which they had been mounted upon, before regaining the roadway.

Photo #1: View facing west, looking into area that the eastbound SUV had just traveled. Yaw marks can be seen in the foreground crossing the eastbound lanes.

The vehicle began to rotate counter-clockwise crossing both eastbound travel lanes diagonally, covering another 85 feet. It then crossed the double solid center lines and encroached upon the oncoming (westbound) travel lanes. The SUV driver then swerved back to his right and the vehicle began to rotate clockwise, violently transferring the weight of this top heavy vehicle onto its left wheels. It continued east for another 66 feet before it rolled onto its left side and slid into the path of the oncoming pickup. The SUV struck the front of the pickup with the top of the hood and front half of the roof, collapsing it downward and rearward upon the

occupants. The SUV continued to roll up onto the hood and passenger area of the pickup, collapsing the windshield and left "A" pillar back into the occupant compartment. The pickup came to rest with its right front tire on grass, the inside of the left front tire in the gutter, against the curb, and the rear wheels in the right travel lane. It was angled off the roadway at approximately 45˚ with the SUV inverted atop its hood and windshield. The front of the SUV was facing south nearly perpendicular to the road.

Photo # 2: View of approaching westbound lanes. Pickup had completed the curve and was traveling in the outside lane. The area of the collision can be identified in the foreground.

Photo #3: Vehicles at final rest

The front seat occupants in the SUV died on impact as the front end of the pickup crushed their vehicle and intruded into their occupant space. Both suffered fatal skull fractures. The rear occupants were tossed about during the rollover. One remained in the second row seat and died from head injuries. The remaining two were thrown into the cargo area, one landing on top of the other. The passenger who landed on top was killed as a result of severe head trauma while the 24 year old under him suffered life threatening injuries.

The pickup driver was pinned in her seat and had serious injuries. Her toddler son had been thrown from his seat and lay on the floor behind the front passenger seat. He suffered fatal head injuries.

Witnesses to the crash called for emergency help. Fire and rescue personnel were first on the scene, followed within minutes by state troopers and local officers. Once it was determined that there were multiple fatalities as well as seriously injured survivors, the State Police dispatcher contacted State Police Divisional Reconstruction Team members, the Sergeant on

duty, and the Area First Sergeant. They also notified the Field Lieutenant, the Division Commander, as well as the Public Information Officer (PIO), all of whom are assigned to the division headquarters some 80 miles away. The PIO then alerted the media who responded to the scene from their offices, the same distance away. The PIO did not respond to deal with the media blitz that descended upon the scene, but the Sergeant on duty was present. By the time the first Reconstruction Team member arrived, about 50 minutes after the crash, family members and reporters had already arrived.

The survivors were extricated from the vehicles. A medical evacuation helicopter flew the pickup driver to a major trauma center located about 80 miles away. Since the trauma center was out of state, a specific description of her injuries was not available. Emergency personnel started cardio-pulmonary resuscitation efforts on the toddler but his head injuries were extensive. An ambulance transported the child, as well as the sole survivor from the SUV, to a local hospital a short distance away. The little boy was declared dead upon arrival. The SUV passenger suffered head and internal injuries, as well as crushing to both arms. He was later airlifted to the same trauma center as the pickup driver. He remained alive at the time this report went to press, but was awaiting a liver transplant and facing further surgeries.

The local Medical Examiner's office was notified and medicolegal investigators responded to the scene. Relatives for all the victims were also present. Once the identities of the deceased were confirmed, family members were notified at the scene. After the bodies were extricated and removed to local funeral homes for viewing by the Medical Examiner, the vehicles were moved to storage facilities. The scene was cleared about five hours after the crash.

REMARKS

The Virginia Multi-disciplinary Crash Investigation Team (VMCIT) responds to all crashes with five or more fatalities. As soon as this crash was reported, members contacted the investigating trooper and began making plans to visit the site. In addition, the VMCIT previously had made inquiries into a crash that had occurred three weeks prior, in which four people had been killed in a collision in the same county. Both crashes involved the deaths of young children. When members discussed the incidents with State Police Divisional Reconstruction Team members and area office leaders, they were informed that this county had a high death rate for the number of licensed drivers. With all these factors in mind, the VMCIT decided to conduct a full investigation.

On the evening of the crash, the five occupants of the SUV met with the driver's brother at a local restaurant for dinner and drinks. The five friends left together and got into the Explorer with the owner at the wheel. They had three 12 packs of beer in the vehicle, plus more loose cans, and their destination was unknown. The passengers had all been drinking alcohol prior to the crash, although some had consumed more than others. One of the back seat passengers had joined the group approximately 45 minutes before the crash. He had a blood alcohol concentration (BAC) of .03%, and is presumed not to be under the influence (see §18.269(1) of the Code of Virginia). The other deceased back seat passenger, who was 20 years old, had a BAC of .14%. The front seat passenger's toxicology report revealed that his BAC was .31%, which is very high, especially for a 21 year old. The passenger who survived was carrying a small plastic bag containing a substance that appeared to be marijuana. No tests were performed on any of the passengers to determine if they were under the influence of drugs.

The SUV driver kept pace with his partying friends that evening. Toxicological analyses of his blood revealed a BAC of .31%, the same as that of his front seat passenger. Typically, this level of intoxication is associated with stupor, where the individual is in a state of semi-consciousness and cannot stand or walk. The fact that he was able to get behind the wheel of his vehicle and drive any distance reveals that he had developed a tolerance to alcohol and could compensate for the effects of the drug to some extent, although he was significantly impaired. In addition to the alcohol, his blood test was also positive for Tetrahydrocannabinol (THC), the active component of marijuana. THC also impairs performance and judgment and has a

synergistic effect when combined with alcohol. It is not surprising, then, that eyewitnesses claimed the SUV was weaving prior to hitting the curb.

The behaviors of the SUV occupants are consistent with a lifestyle in which partying and high levels of risk taking are the norm. While not a factor in this crash, two of the deceased passengers had been arrested during the previous summer for a variety of infractions, including reckless driving by speed (115 mph), driving under the influence of alcohol and possession of crack cocaine. The high alcohol levels found in the two front seat occupants reveal that they were experienced and habitual alcohol abusers, despite their youth. Even though one of the five had consumed relatively little alcohol that evening, he did not take responsibility as a designated driver, instead allowing his inebriated friend to get behind the wheel of the SUV. The addition of passengers, especially ones who are known to enjoy pushing the limits of the law and responsible action, only increased the likelihood that the driver would take dangerous risks while behind the wheel. Research has shown that the mere presence of passengers is enough to increase the level of risk taking in teens and young adults (Gardner & Steinberg, 2005). When those passengers are also likely to encourage and reward such behaviors, the results can lead to disastrous consequences (see *Technical Alert: Number 15*).

The SUV driver was familiar with his vehicle and the area. He had been involved in a crash in 2004 and was convicted of following too closely. The court referred him to a driver improvement clinic, which he completed. In April of 2006, he voluntarily requested and completed a second driver improvement clinic. His license showed plus four points at the time of the fatal crash.

The SUV displayed a valid Virginia registration and a safety inspection approval sticker that was due to expire in about four months. There were no apparent defects of the components not damaged in the crash. The tires, while all the same size, were from different manufacturers. The front axle tires were both Goodyear of the same model; the rear tires were a Cooper Life Line and a Mastercraft. The tread depth measurements ranged from 3/32 to 6/32 of an inch with air pressure between 31 and 37 psi. A history on the vehicle showed it had one previous owner and did not reflect any prior crashes.

Prior to the collision, this vehicle was destabilized upon mounting the 6 inch high curb. It continued forward with one set of wheels on the road and one set off. There was no evidence that the driver ever applied his brakes. The vehicle further destabilized when the driver first jerked the wheel to the left to avoid the utility pole. He then went through a second driveway

Photo #4: Front view of SUV.

and struck adjacent mail boxes before dropping off the same curb. He regained the roadway and began rotating counter-clockwise as he crossed both eastbound lanes and the center lines. His next violent steering action, to the right, caused the vehicle's weight to transfer from one side of the vehicle to the other and the SUV began to rotate clockwise, which ultimately caused it to roll onto its left side. The SUV's roll was stopped when it struck the pickup and mounted its hood. A speed calculation from the scuff marks left by SUV just after it entered the westbound lanes was approximately 65 mph.

Fatality rates (per million registered vehicle years) in Ford Explorer SUVs (model years 2000-2003) are higher than the average and the rate in single vehicle rollover crashes is significantly above the national average. This is in part due to the lower stability of the vehicle, which can be measured by its Static Stability Factor (SSF) and dynamic maneuvering tests. A vehicle's SSF is determined by measuring the track width (t) and dividing by 2 times the height

of the center of gravity above the road (2h). The higher the ratio, the more stable the vehicle. Generally, passenger cars have SSFs between 1.3 and 1.5 while SUV's and pickups, with higher centers of gravity and shorter track widths, often range between 1.0 and 1.3. Published reports of the SSFs for 4 door Ford Explorers released between 1995 and 2002 ranged from 1.07 to 1.14 (Walz, 2005). The National Highway Traffic Safety Administration (NHTSA) combines the SSF with a dynamic maneuvering test for tipping to arrive at a star safety rating for rollover chances in different vehicles. These ratings are reported in addition to the frontal and side impact safety ratings. Although the 2000 Ford Explorer SUV was not rated in this category, the 2001 model received a low two-star rating. Vehicles receiving this rating had a 30 to 40 percent chance of rollover during a single vehicle crash. Many manufacturers, including Ford, have redesigned their vehicles to improve their stability and their safety ratings, as well as adding electronic stability control systems for improving outcomes in dynamic maneuvering situations.

Photo #5: Side view of SUV.

In addition to the vehicle's inherent design factors, studies have shown that the addition of passengers increases the risk of rollovers (Robertson & Maloney, 1997, for example). So, while SUVs are designed to carry multiple passengers and additional cargo, adding weight adds to the problem. Having four adult male passengers in the SUV involved in this crash not only increased the likelihood of high risk behaviors on the part of the driver, it also increased the probability of a rollover type crash if the vehicle was not properly controlled.

A few minutes before the crash, the pickup driver had purchased diapers and soft drinks at a grocery store and settled into her vehicle with her son. Previously licensed in a distant state, she had only been licensed in Virginia since 2005. However, she lived near the crash site and often drove that section of road. Her driving record showed a balance of minus four points, the result of a conviction of speeding 10 to 14 miles above the limit in a business or residential district. She did not have any physical impairment and was not under the influence of alcohol or drugs at the time of the crash.

The pickup was an older model with approximately 130,000 miles on the odometer, and it displayed a valid Virginia registration and a safety inspection approval sticker. The inspection sticker was due to expire in twelve days. There were no visible defects, and the components not damaged in the crash were in sound mechanical condition. The tires were a matched set on all four wheels with tread depths exceeding 5/32 of an inch and air pressure of about 30 psi. A history on the vehicle revealed it was a single owner vehicle with no prior crashes reported.

While the pickup driver was negotiating the curve, she had over 600 feet of sight distance to what would become the point of impact. She could also see further down the road. However, the crash occurred well after dark and no street lights illuminated the area, so the edges of the roadway and the environment beyond the area illuminated by headlamps were not clearly visible. Additionally, the headlights of approaching vehicles would have created glare, which also decreases the conspicuity of objects in the visual field (like mailboxes and curbing). Consequently, many of the visual cues that would have normally enabled the pickup driver to determine that the oncoming vehicle was moving erratically and outside its lane may not have been available to the pickup driver. Since the Explorer was off the road to the right, the pickup driver was less likely to perceive it as a threat to her path of travel. Only when the SUV crossed the centerlines would the pickup driver have had her first decisive evidence that the Explorer was on a direct collision course. This occurred just 110 feet from the area of impact for the two vehicles. With the SUV traveling at about 65 mph, or 95 feet per second, the pickup driver

would have had just over a second to perceive and react to the danger. This amount of time was insufficient for her to perceive, process and respond defensively to the imminent collision.

Photo #6: Front view of pickup.

Her toddler son was legally required to be restrained in a child safety seat, and a restraint device was placed on the back seat of the extended cab, just behind his mother. The Cosco High Back Booster Car Seat was a combination type, which faced forward and could be used differently depending on the size of the child. It had been manufactured in 2005 and was not on the NHTSA recall list. For children between 20 and 40 pounds who were between 29 and 40 inches in height, it could be installed in the vehicle with either a latch system or the vehicle's safety belts. For these smaller children, the seat's internal harness provides a five point

protection system that, in the event of a crash, prevents movement within the vehicle interior and spreads collision forces across a greater area of their fragile bodies. As a child grows, the seat can be used as a belt positioning booster. For children weighing between 30 and 80 pounds and between 29 to 52 inches in height, the seat is designed to be used with the lap/shoulder belts in the vehicle. The booster adds sufficient height to raise the child so that the lap portion of the seat belt does not ride up above the hips. It also ensures that the shoulder portion of the belt fits correctly across the shoulder and chest, rather than lying across the neck. Such boosters are effective for youngsters as long as the top of the seat is at least even with the middle of their ears, because they provide additional protection to the head and neck from rearward forces.

The child killed in this crash was small for his age. Although he was 29 months old, he was only 33 inches in height and weighed approximately 24 pounds, according to the Medical Examiner. At this size, he should have been buckled into the seat's five point internal harness. The mother stated that the child had unbuckled his belt while they were driving and she was telling him to buckle it back up when the crash occurred. Based on the VMCIT inspection of the seat and testing of the internal harness buckles, it is probable that the internal harness was not in use. The buckles were very difficult to open and it is doubtful that the child would have had enough hand strength to release the catches. It is more likely that the seat was used in the belt positioning booster mode, with the lap/shoulder belt being the restraining aspect. These belts are much easier to buckle and unbuckle, and often within the ability of a small child. Due to the placement of his seat behind the driver, if he had been buckled in properly, even if using the child seat inappropriately as a belt-positioning booster, it is very likely he would have survived this horrific crash. This was one area in the pickup where the occupant space was relatively uncompromised. Unfortunately, the toddler was unrestrained and propelled forward in the direction of the collision forces toward the intruding SUV. He was found lying on the floorboard of the back seat, facing the passenger side of the vehicle, with fatal head injuries. Attempts to resuscitate him were unsuccessful and he was declared dead at the hospital shortly after the crash.

Photo #7: Side view of pickup.

According to the Department of Motor Vehicles' *2005 Traffic Crash Facts*, the death rate for this county was 0.67 per 1,000 Virginia licensed drivers. This places it in the upper 10% of counties and well above the statewide average of 0.22 deaths per 1,000 licensed drivers. (The counties' death rates include the counts for incorporated towns within those counties, but not independent cities.) It is difficult to determine the exact causes for higher death rates in particular locations within the state. However, during interviews with those involved in investigating and reconstructing this crash, officers expressed frustration because they spent most of their time "working crashes" rather than focusing on the enforcement that could reduce the number of crashes. State police troopers assigned to this locality cover a broad geographic area with many miles of road to patrol. This often results in less time for proactive types of enforcement, such as DUI checks and speed enforcement programs.

In addition to being concerned about the fatality rates and their inability to take more pre-emptive law enforcement measures to help reduce speeds and driving violations, troopers in this area expressed concern about their ability to manage the scene and effectively deal with members of the media. The trooper assigned to this crash was already trying to coordinate with the emergency personnel present, as well as gather witness statements, obtain driver and passenger identification and deal with the delicate task of death notifications. His ability to attend to these tasks was further complicated by the pressure of media personnel wanting answers to questions that the investigation had not yet uncovered. In high profile crashes with significant numbers of individuals, all with different reasons for being present, trying to manage the scene can be a monumental task. In this case, the Sergeant on duty handled media, in addition to other support activities. Members of the VMCIT have noted in past investigations that an effective PIO, especially one familiar to and trusted by the media personnel, can also be a valuable asset to the primary investigating trooper, as well as those assigned to reconstruct the crash. Having a clear understanding of the different roles and procedures to be followed in such high interest and chaotic situations can improve the quality of the investigation and the findings, as well as law enforcement agencies' relationship with the press and surrounding community.

RECOMMENDATIONS

1. Driving while under the influence of alcohol and/or drugs continues to be a significant contributing factor in motor vehicle crashes. Ultimately, the choice to drive while impaired is made by a driver, and ways to influence better decision making should be explored by educators, psychologists, legislators and the courts. While punitive measures may work for some segments of the population, measures that would decrease the perceived benefits of substance abuse and risky behaviors should be considered and researched.

2. Potential passengers in motor vehicles must actively assess the condition of a driver and make responsible choices with regard to (a) getting into a vehicle with an impaired driver and (b) allowing an impaired driver to get behind the wheel of any vehicle. The Virginia Department of Motor Vehicles, public information officials and educators should consider ways to promote passengers taking a more active role in ensuring their own safety and that of other passengers, as well as their drivers.

3. Education and enforcement of the law related to child safety seat use should continue to be a focus of the Virginia Department of Health, the Department of Motor Vehicles, the Department of State Police, other state and local agencies. On July 1, 2007, changes to Virginia's law will require that all children under the age of 8 years be restrained in an appropriate child restraint device, two years longer than the previous requirement. The changes also incorporate restrictions to the placement of children in rear facing devices, so that they are not positioned in front of active airbags, as well as removing the exception that allowed unrestrained children to ride in cargo area of vehicles such as SUVs and mini-vans. Education and enforcement will play important roles in implementing this law and improving the survivability of child passengers in motor vehicle crashes.

4. In addition to understanding proper seat selection, installation and use, those who transport children could also benefit from education about specific techniques to employ when a child removes their restraints while a vehicle is in motion. Such

actions not only place the child at risk, they often distract the driver as well. Pediatricians, child development specialists, case workers and child advocacy groups should address these behavioral issues in their educational programs and materials.

5. The Virginia Department of State Police, the Department of Motor Vehicles and the Department of Transportation, in conjunction with local agencies and community groups, should continue their efforts to develop ways to better understand and address highway safety issues in the localities. When the Commonwealth implements the upcoming Traffic Records Electronic Data System (TREDS), a multi-agency cooperative effort, more information should become available more quickly. This information can then be used to design, implement and evaluate safety initiatives, potentially including education, enforcement and/or roadway improvement projects, with decreasing crashes and their severity as a goal.

6. Vehicle owner/operators should exercise diligence in keeping the proper tires on their vehicles and maintaining proper air pressure and monitoring tread depths, all of which contribute to the handling of the vehicles, especially the top heavy SUV.

7. The Department of Transportation should continue to seek ways, whenever possible, to improve existing roadways in the Commonwealth. Many rural roads in the Commonwealth have narrow and/or steep shoulders, leaving little room for error on the part of drivers. Although funding, property ownership and design issues are factors in roadway construction and improvement, having "recovery" room could significantly improve the consequences of single vehicle run off the road situations (see page 24 in the addendum).

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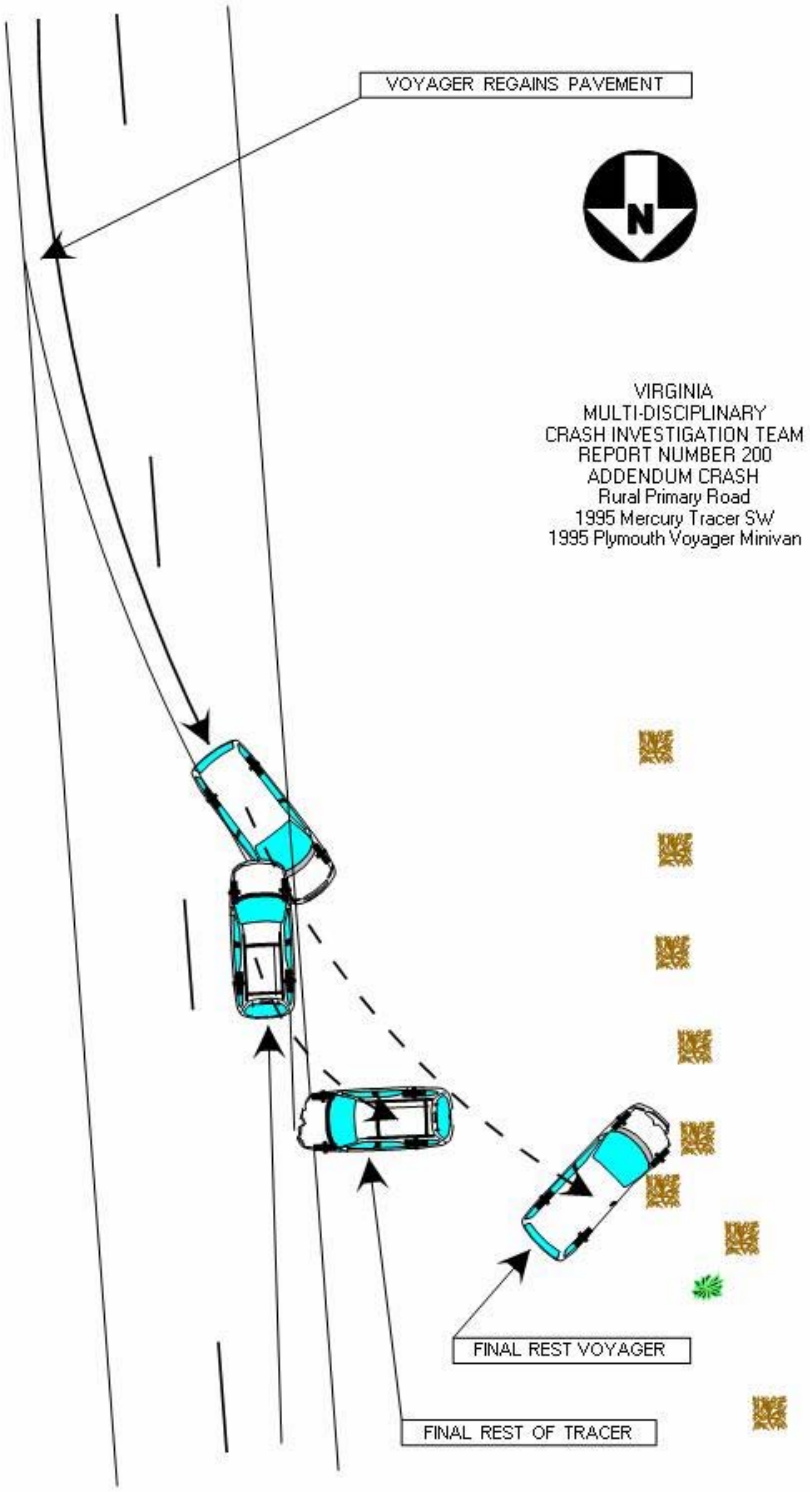
VOYAGER REGAINS PAVEMENT
N
VIRGINIA
MULTI-DISCIPLINARY
CRASH INVESTIGATION TEAM
REPORT NUMBER 200
ADDENDUM CRASH
Rural Primary Road
1995 Mercury Tracer SW
1995 Plymouth Voyager Minivan
FINAL REST VOYAGER
FINAL REST OF TRACER

ADDENDUM

Three weeks prior to this five fatality crash, another collision occurred in the same county, resulting in the deaths of four people, including one child. The crashes were similar in that one vehicle ran off the road to the right, then overcorrected and crossed the center line, striking the oncoming vehicle.

This multiple fatality crash occurred at 3:15 p.m. on a clear, dry Sunday. A 67 year old man was driving a 1995 Mercury Tracer station wagon south on a two lane primary road. His wife sat in the right front seat and, while he wore his lap/shoulder restraint, she did not. The couple had attended church earlier in the day and was headed to a local bank to deposit the Sunday collection. This straight and level asphalt paved road is in good condition and is comprised of two lanes which are separated by pavement markings that permit passing in both directions. This segment of roadway is governed by a statutory speed limit of 55 mph. Each lane is approximately 10 feet wide and the shoulders are grass. The narrow shoulders have steep slopes, approximately 20 degree declines that bottom out in ditches on both sides of the roadway. Woods are located some 20 feet from the ditch on the west side. On the far side of the ditch on the east side, a second slope rises slightly higher than the road. A railroad bed built along the top of this crest runs parallel to the roadway.

A 1995 Plymouth Voyager minivan was headed north, driven by the owner, a 29 year old female. A 42 year old male sat in the right front passenger seat and the woman's daughters sat in the rear seat. The oldest, a five year old, sat behind her mother and was restrained in a child safety seat. Her four year old sister sat behind the front passenger. She may have been sitting in a child safety seat, but she was not restrained and the seat was only fastened to the minivan with the top tether.

The vehicles were approaching one another in a straight segment of roadway when the right wheels of the minivan ran off the pavement and dropped 3 inches onto the grass shoulder. The driver overreacted and turned the vehicle sharply to the left. This caused the minivan to begin rotating counter-clockwise as the right wheels regained the pavement. It traversed the northbound lane diagonally, crossed the center lines and entered the southbound lane, where it encroached upon the path of the Tracer. The driver of the Tracer, seeing the minivan coming toward him, applied the brakes and left skids from tires on both sides. The marks measured approximately 7.5 feet on the left and 19.6 feet on the right and angled toward the right shoulder.

The minivan struck the front of the Tracer with its right front corner and continued to rotate, bringing the passenger compartment's right side in contact with the front of the Tracer. Damage on the minivan extended back to the "C" pillar. The minivan pushed the Tracer backward and off the west edge of the road. The minivan, still rotating, struck the Tracer a second time with its right side rear at the passenger door of the Tracer. The two vehicles disengaged and the station wagon came to rest perpendicular to the pavement with the front wheels on the grassy shoulder and the rear wheels in the drainage ditch. The minivan came to rest behind the Tracer and beyond the ditch at the tree line. It was facing approximately 130 degrees from its original path. A driver following the Tracer witnessed the crash, stopped and called for help.

During the collision, both front airbags in the Tracer deployed. The unbelted passenger was thrown into the bag as it expanded; she then continued forward and to her right, in the direction of the impact. She died at the scene from severe head, neck and chest trauma. Her husband, who was belted, suffered severe injuries to his chest and abdominal areas and was unconscious. He was transported to a nearby hospital, where he died in the emergency room. No toxicology samples were drawn before his body was embalmed, so the medical examiner had no way to assess whether he was under the influence of alcohol or drugs prior to the crash. However, there were no indications that he was impaired.

Both front airbags on the minivan deployed during the collision. However, the unrestrained front passenger was still exposed to major energy forces as he was flung first to his right while his occupant space was crushing inward. As the minivan rotated out of the collision, he was tossed about and he landed on top of the driver as the vehicle came to rest. He suffered severe head injuries and died at the scene. The driver was pinned by the collapsing dash, her right leg caught under her twisting bucket seat. As emergency help arrived, she was conscious but hysterical. Initial attempts to pull back the dash area were unsuccessful, so the top of the van was removed and she was extricated. She was transported to a hospital with life-threatening injuries.

The five year old girl in the back seat was restrained in a child safety seat. Although the seat was not available for inspection, an interview with one of the first emergency personnel to arrive revealed that she was buckled into a seat with a five point harness and that the seat back was well above the top of her head. The seat had been secured in the vehicle with a lap/shoulder belt routed through the proper path in the back of the molded plastic shell; however, it is unknown if the belt had been tightened properly. During the crash, her seat moved forward and

the front edge moved off the bottom of the bench. Consequently, the entire safety seat tilted forward, leaving the child secured but dangling within the harness. She was screaming and had blood coming out of her nose. Emergency workers cut the vehicle belts and lifted the seat, with the child still harnessed in it, through a side window. This little girl was transported to a hospital with serious injuries, but she survived.

Her four year old sister was not as fortunate. Although a forward facing, convertible type child restraint was available for this child, it was attached to the minivan only by a top tether, which would render it useless during any type of crash. Indeed, it could become a potentially dangerous object if it was tossed about inside the occupant compartment. The five point harness on this Evenflo seat was found with all the belts buckled; however, the little girl was discovered in the cargo area of the minivan. Instead of being restrained, it is likely she was simply sitting in the convertible seat or in the center position of the bench. Fractures and contusions to the right side of her body are consistent with her placement on the right side of the minivan and close to the area of initial contact. She was thrown into the back section of the cargo area after the initial collision, when the minivan was rotating to final rest. She died at the scene from severe neck trauma. This child's chances of surviving the crash would have been better if she had been properly harnessed in a seat that was secured correctly behind the front passenger, but they still would have been slim. The station wagon intruded significantly into that occupant space and the right side of the bench seat had been twisted and bent from the collision forces.

There is no evidence to indicate why the driver of the minivan initially allowed her vehicle to drift off the pavement, but her consequent overcorrection may have partially been due to the fact that the shoulder along this primary route is very narrow and slopes steeply to a drainage ditch that runs parallel to the adjacent railroad track. Her fear of having the vehicle roll completely down the hill, or even tip over, may have led her to turn the wheels sharply the left instead of trying to gradually regain the road. This created a situation where the vehicle not only crossed into the lanes for oncoming traffic, but also rotated, exposing the passengers on the right side to the full forces of the impact. Lateral collisions, because they occur at one of the structurally weakest points on a vehicle, are more likely than any other type of crash to result in fatal injuries. Side airbags and improvements in the design of vehicle frames are newer safety features that help to protect the occupants in such circumstances, but they are not a cure-all. Ultimately, drivers must pay close attention to their driving task and work to make the right decisions when faced with unexpected situations.