NATIONAL TRANSPORTATION SAFETY BOARD
OFFICE OF HIGHWAY SAFETY
WASHINGTON, D.C.

TECHNICAL RECONSTRUCTION GROUP CHAIRMAN'S FACTUAL REPORT

A. CRASH INFORMATION

Location:	Intersection of State Route 30A and State Route 30, Schoharie, Schoharie County, New York
Vehicle 1:	2001 Ford Excursion "Stretch" Limousine
Operator 1:	Prestige Limousine Chauffeur Service
Vehicle 2:	2015 Toyota Highlander
Operator 2:	Private citizen
Date:	October 6, 2018
Time:	Approximately 1:55 p.m. EDT
NTSB #:	**HWY19MH001**

B. TECHNICAL RECONSTRUCTION GROUP

Robert Squire – Highway Crash Investigator, Group Chairman
NTSB Office of Highway Safety
490 L'Enfant Plaza East, S.W., Washington, DC 20594

C. CRASH SUMMARY

For a summary of the crash, refer to the *Crash Summary Report* in the docket for this investigation.

D. DETAILS OF THE TECHNICAL RECONSTRUCTION INVESTIGATION

The Technical Reconstruction Group for this investigation was convened for the purpose of providing on-scene documentation of the crash location and involved vehicles and to assist in the analysis of collision events and causation factors. In support of these tasks the group reviewed documentation provided by the New York State Police (NYSP) and New York State Department of Transportation (NYSDOT).

Factual reports prepared by other NTSB investigative groups should be consulted for information related to other areas of the investigation.

1. Introduction, Collision Site and Highway Description

The initial collision between the Ford limousine and the Toyota Highlander occurred off the highway, south of the intersection between New York State Route 30 (NY-30) and New York State Route 30A (NY-30A) when the Ford, traveling southbound on NY-30 at a high rate of speed, passed through the intersection without stopping for the posted stop sign, departed the highway and collided with the rear of the parked Toyota. Following the collision with the Toyota, the Ford continued southward where it impacted the backslope of a ravine and several trees in the ravine. The Toyota, which was unoccupied and stationary when struck by the Ford, was propelled to the opposite side of the ravine. As the Toyota was propelled forward, it struck two persons outside the vehicle.

The Toyota had been parked in a grass-covered field adjacent to a paved and gravel driveway for the Apple Barrel Country Store, a local business located near the southeast quadrant of the intersection.

The NTSB Technical Reconstruction Group documented the collision site and highway approach over several days after arriving onsite October 7, 2018. The site and other relevant features were documented through photographs and laser scanning. Three-dimensional laser scanning documentation included the intersection, the area of final rest for the two vehicles and the two involved vehicles.[1] The highway approach to the intersection was also documented by video. Additional documentation was conducted using small unmanned aircraft system (sUAS) platforms by both NYSP and NTSB investigators.[2] This data was further augmented by a centerline survey conducted by the NYSDOT.

1.1. Basic Highway Description

The highway aspect of the investigation primarily focused on the approximate 1.81-mile segment of NY-30 between the intersections of NY-7 to the north and NY-30A to the south.[3] The collision between the two vehicles and the ravine occurred off the highway south of the intersection. Along the Ford's heading in the southbound direction, NY-30 exhibits four discernible curves – one rightward curve and three leftward curves with long tangent segments between the curves. The highway curves exhibit radii that ranged from 1,432 feet to 3,000 feet with cross slopes up to 6%. As referenced by the NTSB Highway Factors Group, the curve radii and superelevations were satisfactory for the posted speed limit of 55 mph.

A discernable descending grade begins approximately 5,400 feet north of the NY-30A intersection. Survey and highway design data for the entire route provided by NYSDOT identified several changes in vertical grade that ranged between less than one percent and 11.35 percent. The more significant vertical grade of five percent or greater covered a total distance of about 4,285 feet. While trucks are restricted from traveling south on NY-30 between NY-7 and NY-

[1] Three-dimensional scanning was conducted using the FARO Focus^{3D} X330 laser scanner.
[2] sUAS – "small unmanned aircraft system" as defined by 14 CFR Part 107. Also commonly referred to as a "drone".
[3] Measurements originate at approximate intersection centers.

30A, there are no restrictions in the northbound direction.[4] NY-30 intersects NY-30A at a right angle.

1.2. Collision Location and Vehicle Positions of Rest

After the Ford passed through the intersection and departed the southern edge of NY-30A, it collided with the rear of the Toyota that was parked in a grassy field adjacent the paved and gravel, arced driveway for the Apple Barrel Country Store. The area of impact was identified by a grouping of linear soil furrows beginning about 38 feet south of the highway edge.[5] The most pronounced area of furrowing extended southward about 10-15 feet. Furrow characteristics were insufficient to identify precisely where the Toyota was initially stopped, or which vehicle created a specific furrow. The original furrows as documented by NYSP photographs had been effaced through recovery of the Ford prior to the scene examination by NTSB investigators. The furrows appeared to be essentially perpendicular to the highway and their location indicated that the Ford likely overrode a portion of the driveway pavement. The grouping of furrows was offset from the NY-30 center line approximately 12-13 feet or about 10º from the center of the southbound NY-30 travel lane as measured from the stop line. The furrows did exhibit a slight southwestward orientation relative to a prolongation of the NY-30 center line.

The terrain on which the Toyota was parked exhibited a descending vertical grade from the highway edge. Immediately southward from the area of impact the surface exhibited few irregularities and an average descending grade of about three percent. Approximately 18 feet southward from the area of impact (as measured from the approximate middle of the furrow group) the descending grade increases to as much as 25º and the terrain became more irregular. This increase in grade began to define the ravine and stream bed. About 12 feet further southward the grade decreased to about 10-12° and then leveled at the stream bed, which was about eight feet wide.

At final rest the Ford was in a stream bed, roughly facing west, with its driver's side against the southern embankment or backslope of the ravine. The ravine backslope is about 86 feet from the pavement edge of the highway and 43-53 feet southward from the area of impact. The backslope features a very steep rise to a height of more than 8.5 feet above the stream bed. The crest of the backslope levels and joins the parking lot for the Apple Barrel Country Store. **Figure 1** depicts a cross section of the three-dimensional scan to illustrate the terrain profile.

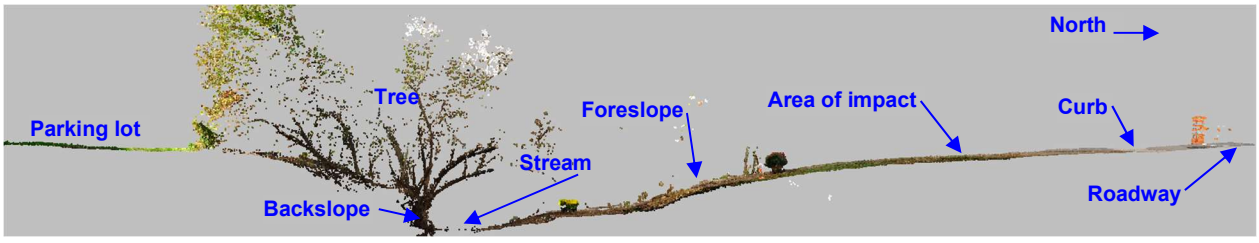

Figure 1: Cross section of 3D site scan depicting the terrain profile from north (right) to south (left). Also depicted is a tree impacted by the Ford.

[4] As defined by New York Vehicle and Traffic Law, the term "truck" is found in §158 and means "Every motor vehicle designed, used, or maintained primarily for the transportation of property".
[5] Measurements were extracted from the NYSP sUAS images after rendering into a 3D point cloud. Measurements originated at the curb edge to the area of onset for multiple furrows.

Rising from near the base of the backslope were several trees. Although numerous branches had been trimmed and removed to facilitate access to the Ford, the remaining tree trunks exhibited evidence of having been impacted by the Ford several feet above the steam bed. NYSP scene photographs depicted additional evidence of contact to overhanging branches that had been removed. The heading exhibited by the surface furrows was consistent with the Ford's impact into the trees.

At final rest, the Toyota was located in the parking lot of the Apple Barrel Country Store facing southeastward. The undercarriage of the vehicle had impacted the ravine backslope about one foot below the crest. It came to rest about 23 feet south of the crest and 72 feet from the center of the furrow grouping. The Toyota's final rest position exhibited an offset of about 22º from the heading exhibited by the surface furrows.

No collision related evidence was observed on the highway. **Figure 2** depicts an image of the three-dimensional point cloud rendered from the sUAS photographs taken by the NYSP.[6]

[6] The photographic images were rendered in the Pix4Dmapper® software.

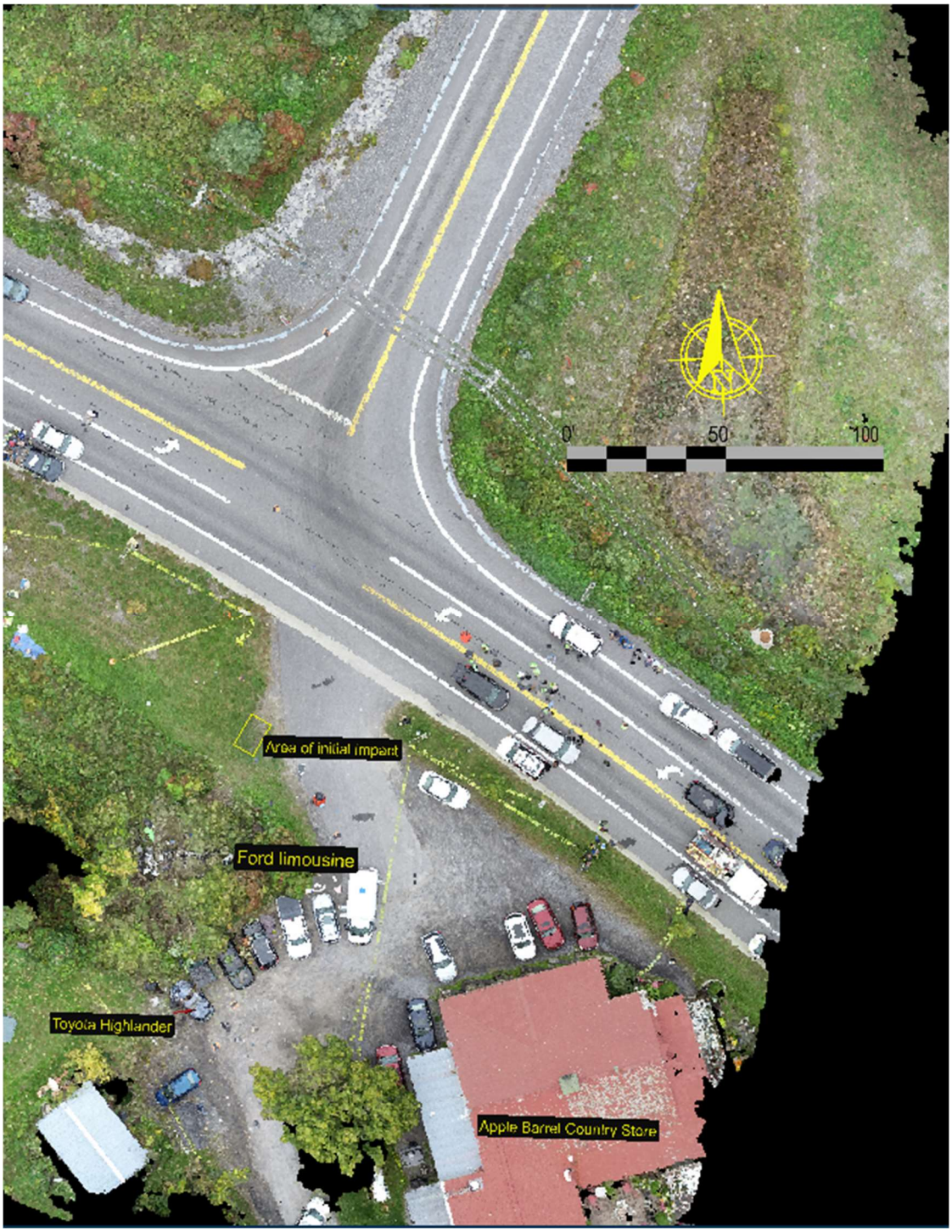

Figure 2: Screen capture image of 3D point cloud rendered from NYSP sUAS photographs.

2. Vehicle Documentation

The Technical Reconstruction Group photographed, and 3D-laser scanned the exteriors of both vehicles after they had been secured at a NYSP facility. NTSB investigators were unable to examine the vehicles in greater detail at that time. Further examination and documentation of the of the vehicles was undertaken by the NTSB Vehicle Factors Group at a later time. Additional information regarding vehicle damage is available in the factual reports prepared by the NTSB Vehicle Factors, and Survival Factors Groups.

2.1. Ford Limousine

The Ford limousine was based on the alteration of a 2001 Ford Excursion XLT full size sport utility vehicle. The base model vehicle featured an original wheelbase of 137.1 inches (11.43 feet) and an overall length of 226.7 inches (18.9 feet). The alteration involved an extension of the body by 144 inches (12.0 feet) that in turn extended the wheelbase to 281.1 inches (23.43 feet) and the overall length to 230.7 inches (30.89 feet). The extension was accomplished by inserting the 144-inch extension between the original B- and C-pillars.

The Ford exhibited extensive front-end damage consistent with a high energy impact into a rigid surface. As depicted in **Figures 3** and **4**, the frontal structures were substantially displaced rearward. The rearward displacement of the frontal structures included the firewall and floor pan at the front seats. The frontal surface of the vehicle exhibited a distinct vertical and leftward shift that resulted in the leading edge being oriented about 36º relative to an undamaged plane. Impact damage covered the full width of the vehicle. This shift and rearward displacement resulted in a decrease to the left (driver's) side wheelbase of almost 48 inches with some compression of the body structure about the driver's seating area. This was countered on the right (passenger's) side where the wheelbase was slightly extended by about nine inches. The front passenger seating position also exhibited substantial floor pan intrusion.

Figure 3: Photograph depicting front-end damage to the Ford as viewed from the left front.

Figure 4: Photograph depicting overhead view of Ford between the front-end and rear axle.

Examination of the 3D scans revealed no apparent displacement of the rear axle or body structure aft of the rear axle. **Figures 5** and **6** depict cross-sectioning of the three-dimensional scans of the vehicle exterior that depict an area extending vertically about 12 inches from the axle hubs.

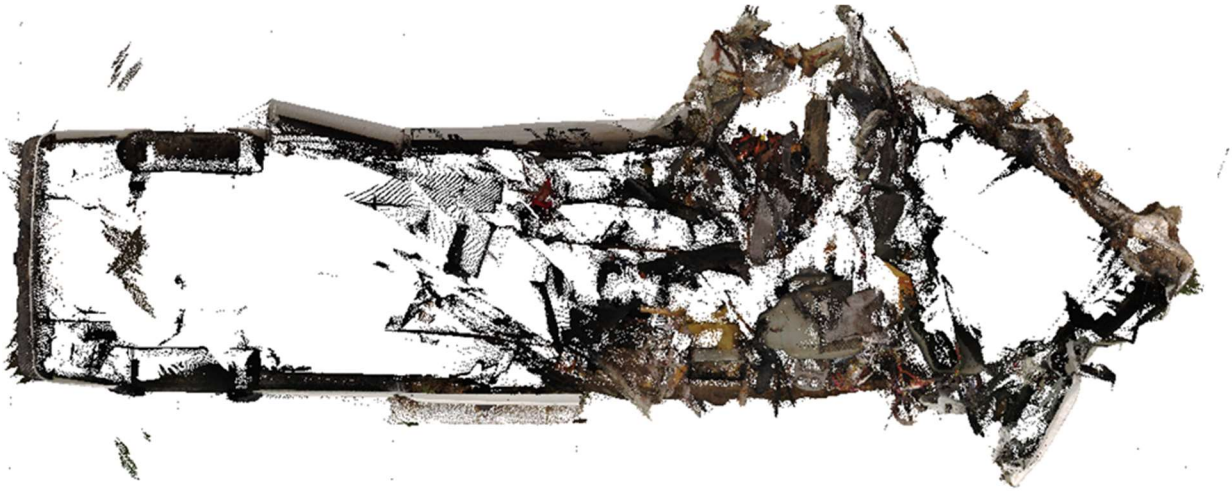

Figure 5: Image depicting a longitudinal cross section of the exterior 3D scan of the Ford limousine. The area depicted extends vertically about 12 inches above the axle hubs.

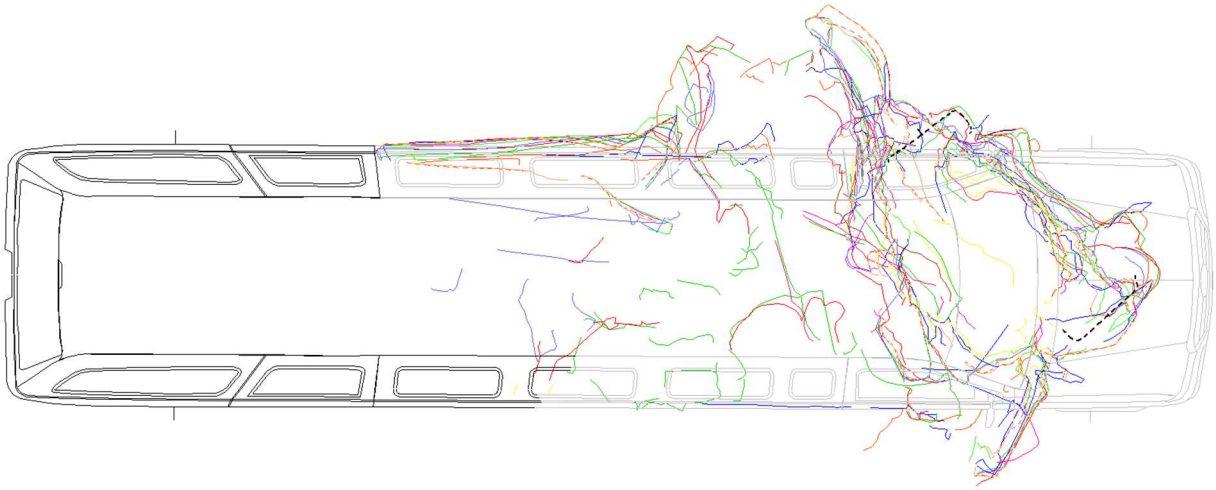

Figure 6: Image depicts the overall damage profile as outlined at six-inch vertical intervals between the axle hubs and roof. The profile is overlaid atop a sketch of the undamaged vehicle.

2.2. Toyota Highlander

The parked vehicle struck by the Ford was identified as a 2015 Toyota Highlander all-wheel-drive, sport utility vehicle. Post collision the vehicle exhibited extensive rear-end impact damage. The rear axle positions and body structure at the bumper level were pushed forward resulting in a decrease from the vehicle's undamaged length of about 48 inches. The body structure and roof above the area of direct contact overhung the impact damage. While the area of contact covered the entire vehicle width, the driver's side exhibited greater forward displacement. **Figure 7** depicts an image of the 3D point cloud as viewed from the driver's side of the vehicle. **Figure 8** depicts a cross section of the vehicle scan covering about 16 inches of vertical height above the axle hubs.

Manufacturer data indicated that the nominal overall vehicle length and wheelbase measured 191.04 inches (15.92 feet) and 110.04 inches (9.17 feet) respectively. Depending upon the reference source, the vehicle's curb weight ranged from 4,300 to 4,500 pounds. Measurements acquired from the 3D scan indicate a post-collision average overall length of about 143 inches (11.9 feet). The driver's side exhibited a slightly greater reduction in wheelbase than the passenger side. Post-collision the driver's side wheelbase measured about 82.8 inches, a decrease of 27.2 inches from the undamaged dimensions. The passenger side wheelbase measured 87.6 inches, a decrease of 22.4 inches.

Figure 7: Image depicting the 3D point cloud rendering of the Toyota Highlander as viewed from the driver side. Foliage debris that remained embedded in vehicle damage as a result of the collision were not removed pending inspection by NYSP investigators.

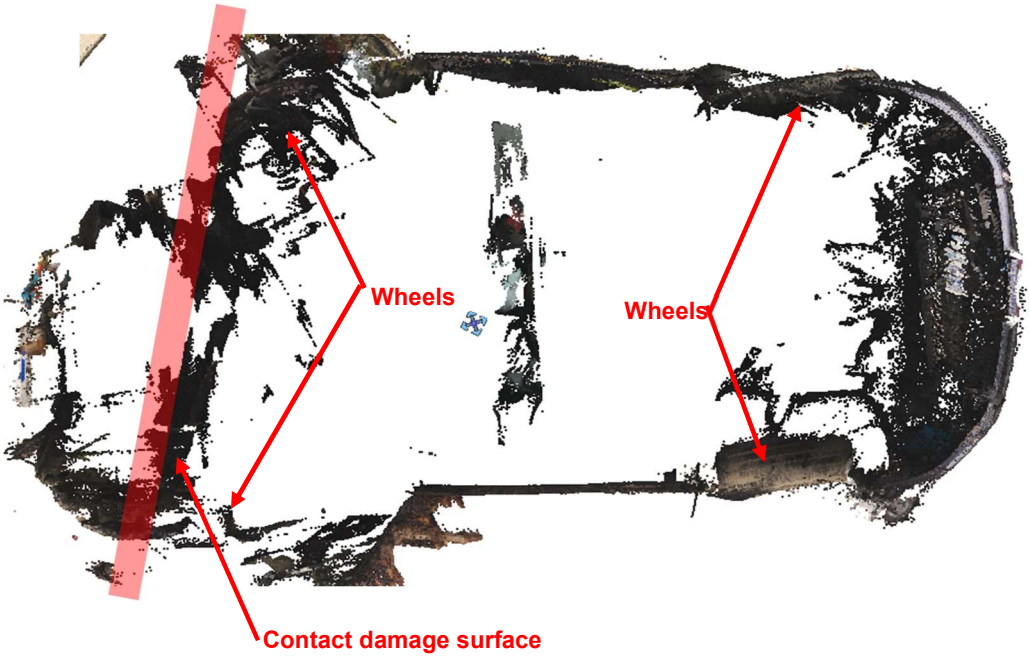

Figure 8: Image depicting a longitudinal cross section of the exterior 3D scan of the Toyota Highlander. The area depicted extends vertically about 16 inches above the axle hubs. The red color shaded box indicates the area of direct contact and forward displacement of the rear-end. The structure extending further rearward is the body overhanging the area of contact.

Additional contact damage was observed to the vehicle hood with the leading edge and upper surface exhibiting distinct areas of direct contact. The hood was displacement rearward with greater displacement visible at the driver side. The upper radiator support and surrounding features also exhibited rearward displacement. The front windshield was fractured with the fractures exhibiting characteristics of direct contact damage. The vehicle undercarriage rearward of the front suspension and axles displayed deposits of dirt. **Figure 9** depicts the damage to the vehicle hood and windshield.

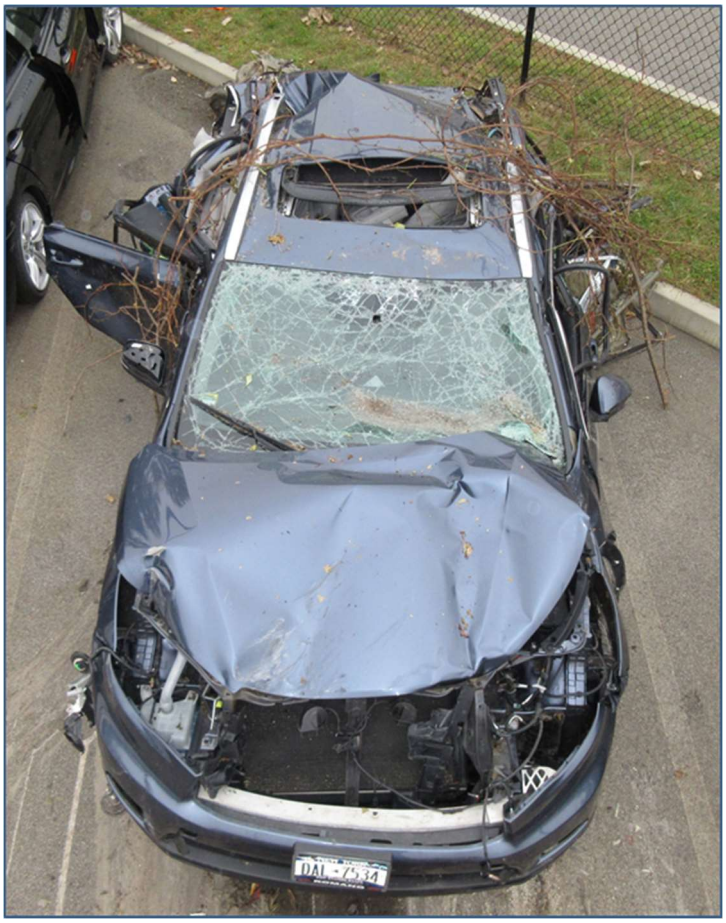

Figure 9: Photograph depicting damage to the hood and windshield on the Toyota Highlander.

3. Pedestrian Contact

Investigative information indicated that as many as three persons were standing or walking in the area of the Toyota at the time of the collision. Information conveyed to the Technical Reconstruction Group indicated that two persons were struck during the collision event. While the pedestrian post-impact positions of rest were not conveyed, as depicted in scene photographs at least one victim was located adjacent to the parking lot driveway about 50-65 feet southward of the area of impact between the two vehicles. It is not known whether this location represents the position of rest or a location to which they may have been moved for treatment. Their location and proximity to the vehicle at the time of being struck is unknown.

4. Electronic Event Data

Both the Ford and Toyota were equipped with pyrotechnically deployed supplemental occupant restraint systems where deployment or activation of the restraint devices are commanded by an electronic control module based on a programmed algorithm that analyzes acceleration relative to time. While the electronic module is generally identified as an *airbag control module*

(ACM), Ford identifies their module as a *restraint control module* (RCM). In the event of a deployment command, or where the deployment algorithm has enabled but no deployment is commanded, certain data can be recorded (event data recording - EDR - functionality). The modules must be energized – by direct vehicle power or a temporary reserve within the module – to deploy a device and record data. The Toyota, being a more recent model year vehicle, featured EDR functionality compatible with the requirements of 49 Code of Federal Regulations Part 563.[7] The Ford RCM predated Part 563. Since the Toyota was parked with the engine off at the time of the collision, no supplemental restraints deployed, and no data were recorded. NYSP investigators imaged the Ford RCM and recovered supplemental restraint deployment data.[8]

This particular Ford RCM recorded only the crash impulse in the form of longitudinal acceleration and a calculated cumulative change in velocity.[9] No pre-collision data is recorded. While the maximum run time for this module can be 116 milliseconds after the deployment algorithm is enabled, the recorded crash data covered 106 milliseconds. One deployment event was recorded, and the data file was locked. The Ford was known to be equipped with frontal airbags and seat belt pretensioners and the data indicated a deployment timing of 11.75 milliseconds after algorithm enable. The record reported the occurrence of no diagnostic trouble codes.

In the data report, the longitudinal acceleration and cumulative change in velocity (Δv) were reported at one millisecond intervals. The data indicate that as the run time of the recording was nearing the end, the acceleration values, reported in g's or the equivalent of gravitation force, were approaching zero indicating the crash pulse was ending and the vehicles had attained maximum engagement. However, at the final data sample the acceleration value increased substantially. The computed cumulative change in velocity, expressed as a scaler quantity in miles per hour, peaked at 29.36 (mph) at the 106-millisecond point. Prior to the spike in acceleration at the final sample, the Δv had peaked at 27.79 mph at 95ms. At 105ms the cumulative Δv was 27.60 mph.

While a copy of the download report was provided by NYSP to NTSB investigators, the copy appeared to be a scan of an original printed version which rendered portions of the data graph illegible. The tabular data were legible and used to reproduce the data graph depicted in **Figure 10**.

[7] In summary, 49 CFR Part 563 defines an Event Data Recorder as a device or function in a vehicle that records the vehicle's dynamic time-series data during the time period just prior to a crash event (e.g., vehicle speed vs. time) or during a crash event (e.g., delta–V vs. time), intended for retrieval after the crash event. This regulation defines the minimum data set that must be collected if a manufacturer decides to voluntarily install an EDR in their vehicle, along with requirements for the range and accuracy of the data. Part 563 is applicable to vehicles manufactured after September 1, 2010 and applies to vehicle with a GVWR of 8,500 pounds or less.

[8] Imaging of the RCM was conducted using the Bosch Crash Data Retrieval system. No specifics of the imaging procedure were provided to NTSB investigators, but it was presumed to be a bench top (out of vehicle) download considering the condition of the vehicle post-collision.

[9] The cumulative change in velocity represents the integration of acceleration during the impact over the duration of the impact.

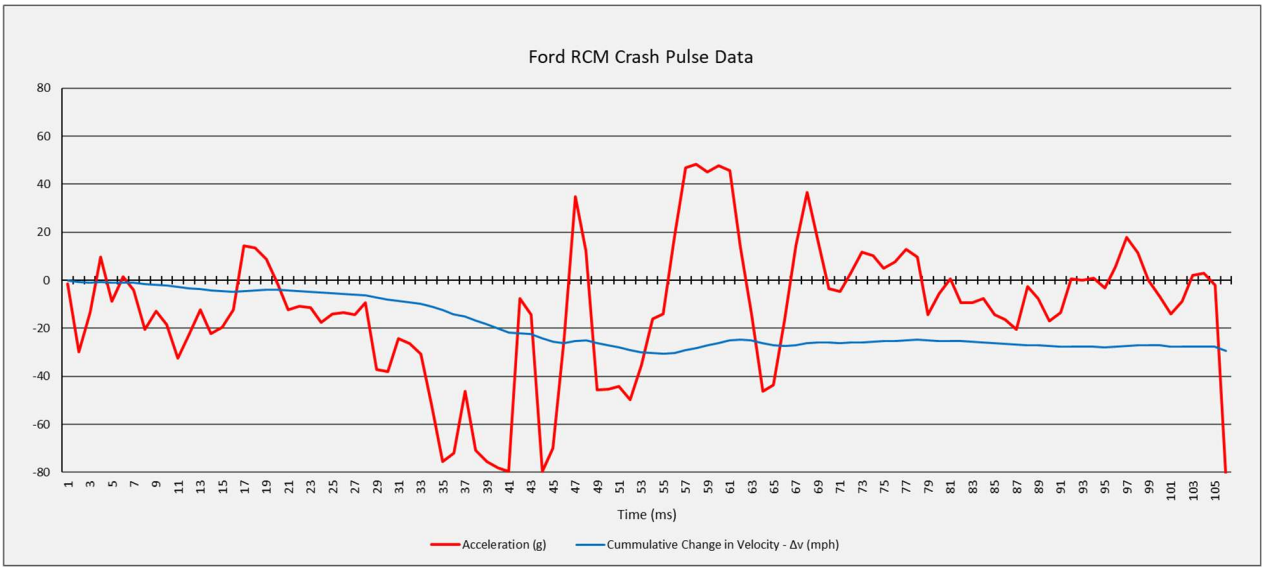

Figure 10: Graphical depiction of Ford ACM acceleration and cumulative change in velocity data. Time zero represents wake-up of the supplemental restraint system deployment command algorithm.

5. Vehicle Certification and Federal Motor Vehicle Safety Standard 105

Post-collision examination of the accident limousine revealed that it had been *altered* from a standard model year 2001 Ford Excursion. Originally manufactured by Ford Motor Company in October 2000 as a complete vehicle, the Excursion had been originally built with a 137.1-inch wheelbase and a designated gross vehicle weight rating (GVWR) of 8,600 pounds. The original vehicle was certified by Ford as compliant with all Federal Motor Vehicle Safety Standards (FMVSS) applicable at the time of manufacture. The alteration involved the insertion of a 144-inch (12 foot) extension of the body and interior between the original B- and C-pillars. The alteration resulted in an increase in the vehicle's wheelbase and overall length to 281.1 inches (23.4 feet) and 370.7 inches (30.8 feet) respectively. The alteration would also, by necessity, increase the vehicle weight above the original design. Additionally, the alteration increased the vehicle seating capacity that would also add to the gross vehicle weight (GVW).

Post-collision the limousine and its recoverable components were weighed by the NYSP. Their data indicate that the post-collision overall weight of the vehicle was 10,000 pounds.[10] This metric indicates that as altered, the vehicle curb weight would exceed the GVWR established by Ford for that model Excursion. Investigative information indicates that the altered seating capacity could have included up to 18 persons including a driver.[11] At the time of manufacture, GVWR as referenced in the October 2000 edition of the Code of Federal Regulations (CFR) under 49 CFR Part 567.4, *Requirements for manufacturers of motor* vehicles, "shall not be less than the sum of the unloaded vehicle weight, rated cargo load, and 150 pounds times the vehicle's designated

[10] The vehicle and non-displaced components were weighed at 9,300 pounds with an additional 700 pounds of displaced components. The presence and quantities of fluids were not described.
[11] See NTSB factual investigative reports prepared by the Motor Carrier Group, Vehicle Factors Group and Survival Factors Group.

seating capacity. 49 CFR Part 571.3, *Federal Motor Vehicle Safety Standards* (FMVSS) definitions, was less descriptive in defining GVWR as "the value specified by the manufacturer as the loaded weight of a single vehicle." Excluding capacity for cargo, the alteration would necessitate a potential increase in the GVWR to at least 12,850 pounds. Using post-collision data that included passenger weight, the operating weight of the vehicle at the time of the crash was established at 13,565 pounds. Whether the potential or actual vehicle weight is applied, the alteration likewise created a situation where the original front axle weight rating was exceeded.[12] While other aspects of the NTSB investigation revealed past state registration data citing vehicle weights for the limousine in excess of 10,000 pounds, no information on how 21st Century Coachworks, the altering company, defined or managed the GVWR was found.

The revelation that the alteration changed both the GVWR and the classification of the vehicle meant that certain FMVSS and other federal regulations related to the certification of the original vehicle were no longer applicable. The Technical Reconstruction Group is primarily concerned with how the application of FMVSS 105 (49 CFR Part 571.105), *Hydraulic and electric brake systems* and other regulations such as 49 CFR Part 567, *Certification*, and 49 CFR Part 568, *Vehicles manufactured in two or more stages*, were affected. Although the definition of the terms *altered vehicle* and *alterer* did not specifically appear in the CFR until 2006, the requirements for the certification of an altered vehicle are cited in 49 CFR Part 567.7, *Requirements for persons who alter certified vehicles* and 49 CFR Part 568.8, which is similarly titled, *Requirements for persons who alter certified vehicles*, at the time the vehicle was altered.

Section 568.8 requires, "a person who alters a vehicle that has been **previously certified in accordance with § 567.4** or § 567.5, other than by the addition, substitution, or removal of readily attachable components such as mirrors or tire and rim assemblies, or minor finishing operations such as painting, or who alters a vehicle in such a manner that its stated weight ratings are no longer valid, before the first purchase of the vehicle in good faith for purposes other than resale, **shall ascertain that the vehicle as altered conforms to the standards which are affected by the alteration** and are in effect on the original date of manufacture of the vehicle, the date of final completion, or a date between those two dates (emphasis added). That person shall certify the vehicle in accordance with § 567.7 of this chapter".[13]

Regarding the other sections referenced in § 567.7 and 568.8, section 567.4, *Requirements for manufacturers of motor vehicles*, is the section pertaining to the original manufacturing of the Excursion, which was a *complete vehicle*.[14,15] Under section 567.4, the manufacturer of a complete vehicle must affix a certification label identifying the manufacturer, certain vehicle attributes and

[12] Original axle weight ratings designated by Ford were 4,700 pounds on the front and 7,000 pounds on the rear with a weight distribution of 49.9% front and 50.1% rear. The actual front axle weight could have exceeded 6,000 pounds.
[13] Emphasis was added. See 49 CFR Chapter V, 10/01/2000 edition. Section 567.5 applies to vehicles manufactured in two or stages. Also see footnote 6.
[14] The term manufacturer is defined in section 30102 of the National Traffic and Motor Vehicle Safety Act of 1966 - 49 USC Chapter 301, section 30102 - as a person (A) manufacturing or assembling motor vehicles or motor vehicle equipment; or (B) importing motor vehicles or motor vehicle equipment for resale.
[15] As defined by 49 CFR Part 568.3, a *Completed vehicle* means a vehicle that requires no further manufacturing operations to perform its intended function, other than the addition of readily attachable components, such as mirrors or tire and rim assemblies, or minor finishing operations such as painting. This section likewise defines *incomplete vehicle, final-stage manufacturer, intermediate manufacturer* and *incomplete vehicle manufacturer*.

a statement of conformance with applicable FMVSS.[16] As specified by this section, the "certification" label must contain:

- Name of the manufacturer or assembling corporation assuming responsibility for standards conformance.
- Month and year of manufacture.
- Gross vehicle weight rating.
- Gross axle weight rating (optional to specify multiple tire/rim combinations).[17]
- Text stating "this vehicle conforms to all applicable Federal motor vehicle safety standards in effect on the date of manufacture shown above."
- Vehicle Identification Number (VIN).
- The type classification of the vehicle as defined in § 571.3 of this chapter (e.g., truck, MPV, bus, trailer).

Section 567.7 conveys language similar to section 568.8 pertaining to the alteration of a previously certified vehicle, with the exception of additional text referencing the requirement to "ascertain that the vehicle as altered conforms to the standards which are affected by the alteration**".** This section requires the person conducting the alteration to affix an additional label, leaving in place the original certification label required by §567.4. Information required on the additional label must include:

- Name of individual or corporation that altered the vehicle.
- Month and year of alteration were completed.
- Text stating "as altered this vehicle it conforms to all applicable Federal Motor Vehicle Safety Standards affected by the alteration and in effect in (month, year).''
- Statement of revised GVWR and/or GAWR if different from the original manufacturer.
- Statement of revised type classification if different from the original manufacturer.

By definition, an alterer is not a manufacturer.

The certification statement required of an alterer must include revisions in GVWR and vehicle classification that may have occurred due to the alteration. Although NTSB investigators found no evidence of a secondary certification label applied by 21st Century Coachworks, the characteristics of the vehicle demonstrated that one was required. As observed, the vehicle would exhibit a change in GAWR, GVWR and vehicle classification. The altered vehicle design with

[16] Also see 49 USC Chapter 301, section 30115, *Certification of compliance*.
[17] As cited in 49 CFR Part 571.3, *Gross axle weight rating* or *GAWR* means the value specified by the vehicle manufacturer as the load-carrying capacity of a single axle system, as measured at the tire-ground interfaces.

seating capacity in excess of ten persons would redefine the vehicle under section 571.3 as a "bus."[18]

With regard to continued conformance with FMVSS, aside from other potential areas that could have been affected, the altered vehicle exhibited a GVWR that exceeded the original brake system certification. FMVSS brake system performance standards are cited in 49 CFR 571.105, which prescribe a series of performance-based tests to achieve compliance. Ford Motor Company, the original vehicle manufacturer, provided the NTSB with copies of FMVSS 105 performance test reports for the Excursion model covering the 2001 model year. Those reports corroborated that the vehicle model used as the basis for the limousine was certified at a gross vehicle weight of 8,600 pounds, which mirrored the GVWR specified for the vehicle. While the certification tests do not represent the maximum capacity of the vehicle brake system, the increased GVWR of the altered vehicle would invalidate Ford's original certification. To affix the secondary certification label specifying the altered GVWR, the alterer (21st Century Coachworks) would need to establish a means to support a statement of compliance with FMVSS 105.[19]

In February 2005, NHTSA issued a final rule (Federal Register Volume 70, Number 29, February 14, 2005, pages 7414-7436) making changes to sections of Parts 567 and 568. While the final rule primarily addressed vehicles manufactured in two or more stages, altered vehicles and alterers were referenced. As part of NHTSA's response to comments, the agency affirmed that they do not disfavor altered vehicles "provided the alterer certifies the vehicle as continuing to comply with the FMVSS affected by the alteration." NHTSA commented that the alterer "should be treated no differently than a final-stage manufacturer" wherein compliance testing or engineering analyses may be necessary to confirm compliance with FMVSS. NHTSA likewise noted that a manufacturer, distributor, dealer, or motor vehicle repair business, may not knowingly make inoperative any part of a device or element of design supporting any applicable FMVSS (also see 49 USC Chapter 301, section 30122).[20] This prohibition would apply to an alterer. As promulgated under the final rule NHTSA expanded the list of definitions provided in Part 567.3. Those definitions included the terms *Altered vehicle* and *Alterer*. The provisions of the final rule became effective September 1, 2006. While these terms were now specifically defined, the definitions did not change the understanding of those terms as previously conveyed in Parts 567 and 568.

The terms *Altered vehicle* and *Alterer* are defined as:

- *Altered vehicle* means a completed vehicle previously certified in accordance with § 567.4 or § 567.5 that has been altered other than by the addition, substitution, or removal of readily attachable components, such as mirrors or tire and rim assemblies, or by minor finishing operations such as painting, before the first purchase of the vehicle other than for resale, in such a manner as may affect the conformity of the

[18] As defined by 49 CFR Part 571.3 (10/2000 edition), *Bus* means a motor vehicle with motive power, except a trailer, designed for carrying more than 10 persons.
[19] NHTSA staff advised NTSB staff that compliance could be demonstrated through vehicle performance testing or engineering analysis.
[20] See 49 USC Chapter 301, section 30122, *Making safety devices and elements inoperative*. NHTSA may grant exceptions.

vehicle with one or more Federal Motor Vehicle Safety Standard(s) or the validity of the vehicle's stated weight ratings or vehicle type classification.

- *Alterer* means a person who alters by addition, substitution, or removal of components (other than readily attachable components) a certified vehicle before the first purchase of the vehicle other than for resale.

This rule also introduced changes to Part 567.7 - *Requirements for persons who alter certified vehicles*. The descriptions that had originally defined an alterer and altered vehicle were relocated to section 567.3, *Definitions*, and additional requirements were placed on those who alter certified vehicles. That section now states that an alterer (1) has a duty to determine continued conformity of the altered vehicle with applicable Federal motor vehicle safety, Bumper, and Theft Prevention standards, and (2) assumes legal responsibility for all duties and liabilities for certification under the Vehicle Safety Act. This change more clearly defined the responsibility of an alterer to "ascertain that the vehicle as altered conforms to the standards which are affected by the alteration" as previously described in section 568.8. With the restructuring of section 567.7, the final rule removed section 568.8 from the CFR.

In May 2006, NHTSA responded to a petition for reconsideration related to the February 2005 final rule (Federal Register Volume 71, Number 93, pages 28168-28197). While the petition focused primarily on safety recall responsibilities related to vehicles manufactured in two or more stages, NHTSA did reiterate background information that "an alterer must certify that the vehicle remains in compliance with all applicable FMVSS affected by the alteration."

Considering the relevant sections of 49 CFR Parts 567 and 568 and communications with NHTSA staff, 21st Century Coachworks was considered an alterer who was required to affix an additional certification label confirming compliance with FMVSS affected by the alteration. As such, the additional label should have specified the change in GVWR, GAWR and vehicle classification. Furthermore, with respect to FMVSS 105 (hydraulic brake system), 21st Century Coachworks could not certify compliance based on pass-through certification by Ford and would have needed a method to affirm compliance.

5.1. Ford Excursion Original Certification

At the request of NTSB investigators, Ford provided documentation for Ford's FMVSS 105 performance tests for the 2001 model year Excursion. Ford also provided additional information for the Excursion model that included material related to FMVSS 102, *Transmission shift lever sequence, starter interlock, and transmission braking effect* and FMVSS 114, *Theft protection*. Additionally, Ford provided FMVSS 105 material for certain F-series trucks beginning with model year 1999.

Regarding the Excursion model, the original performance tests and documentation were for the 2000 model year, but as permitted, the compliance results were carried over to the 2001 model year. For the Excursion platform, Ford documents identified the use of two brake families.

- 2000-13-J: F-250 Heavy Duty Wagon 4x2/4x4 SRW with Gas Engine 8500 < GVW < 10,000

- 2000-13-K: F-250 Heavy Duty Wagon 4x2/4x4 SRW with Diesel Engine 8500 < GVW < 10,000

As indicated, the brake families used on the Excursion model specified a vehicle GVWR range between 8,500 and less than 10,000 pounds. Ford did provide test summary reports for the Excursion tested at 8,600 and 9,200 pounds with the difference being whether the model was two- or four-wheel-drive. Four-wheel-drive models featured the 9,200-pound GVWR. FMVSS requires the vehicle be tested at its GVWR and under a lightly loaded condition. Both the vacuum assist and hydro-boost brake boosters were included in each combination with the hydro-boost appearing on the diesel engine applications. The test reports corroborated compliance with Ford's FMVSS 105 test plan as well as compliance with the standard.

The FMVSS 105 materials for F-series trucks began with model year 1999 and carried over through the 2001 model year. Similar brake families were identified for the F-250 and certain F-350 model trucks where the specified GVWR was under 10,000 pounds. While Ford could not provide a component-level description for each of the brake families, identical brake components as recorded on the test summary reports did identify an F-350 model tested to a GVW of 11,253 pounds.[21]

In general, FMVSS 105 is applicable to hydraulically braked vehicles having a GVWR greater than 7,716 pounds. Under the requirements for compliance (see 49 CFR Part 571.105 S5) six general areas of performance are cited. These include minimum stopping distance (S5.1.1), partial system failure (S5.1.2), inoperative power assist (S5.1.3), fade recovery (S5.1.4), water recovery (S5.1.5), and spike stops (S5.1.6). Vehicles having a GVWR under 10,000 pounds are required to satisfy all six areas while those with a GVWR of 10,000 pounds or greater must only satisfy the first three - S5.1.1 through S5.1.3. The final three areas, S5.1.4 through S5.1.6, are optional. Ford documents indicate that their F-series trucks having a GVWR over 10,000 pounds were tested under all six criteria. As altered, the limousine would need compliance with the standards pertaining to vehicles with a GVWR over 10,000 pounds.

To assist alterers and modifiers, which includes equipment upfitters, Ford regularly publishes technical guides for specific model year vehicles that can accommodate certain alterations and modifications. Examples of the publications available for the Excursion at the time it was altered included the 2001 Body Builder Layout Book (current editions are titled Body Builders Guide). At some point Ford introduced the Excursion into their QVM program and issued a QVM Builders Guide.[22]

In addition to vehicle technical data, these publications provide definitions and details related to federal regulations pertaining to alteration and modification methodology, and compliance with federal certification and safety compliance regulations. FMVSS certification is discussed in detail, including directions on maintaining certification and compliance such as with standard 105 – vehicle brakes. Information on FMVSS 105 includes guidance on maintaining OEM certification including the preservation of appropriate vehicle parameters, including gross

[21] Identical components included brake caliper type (F/R), brake rotor size (F/R), master cylinder piston size, brake pedal ratio, brake pad type (F/R), and power-assist booster type.

[22] A copy of the 2001 QVM Builders Guide for the Ford Excursion was unavailable at the time of this report. An exemplar version of the QVM Builders Guide for the Lincoln (Town Car) Limousine/Hearse was provided for review.

vehicle weight and weight distribution. The Builders Guide specifically cautions vehicle alterers that they have the responsibility for compliance certification where the alterations increase the vehicle weight above that certified by Ford. The alterer is likewise directed to the applicable sections of the Federal Code of Regulations. In situations where the alteration could have affected the original FMVSS certification by Ford, the document notes that testing by the alterer for compliance certification is warranted.

The document likewise provides significant guidance on secondary labeling requirements as outlined by federal regulations (e.g., 49 CFR Parts 567 and 568).

6. Limousine Pre-Crash Route

Most of the attention to the limousine's route focused on the final segment covering about 1.8 miles, including a descending grade, before the vehicle departed the highway. NYSP investigators conveyed to the NTSB that the contracted portion of the trip with the passenger's originated in Amsterdam, NY approximately 18 statute miles, or about half of the roadway mileage covered, north-northeast of the crash site. As conveyed in the NTSB Vehicle Factors Group factual report, the vehicle exhibited evidence of likely and substantial brake system degradation. As such, brake usage over the entire pre-crash route could affect the functionality of the system during the descent along the final vertical grade.

As conveyed by NYSP investigators, the limousine departed Amsterdam eventually entered Interstate-90 and traveled west toward NY-30A around Fultonville, NY. Travel along I-90 is estimated to have covered about 8.2 miles where the vehicle exited the interstate at Exit 28 and continued less than a mile westward on Riverside Drive to NY-30A. The limousine continued south on NY-30A an estimated 21.8 miles to NY-7 where it turned left and continued about 3.1 miles east to the intersection with NY-30. At the NY-30 intersection the Ford made a right turn and reportedly made a brief stop, on the northern side of the I-88 overpass, before continuing along the final segment of the route.

Examination of satellite imagery depicting the highway topography depicted the initial approximate 12 miles along NY-30A as what could be described as rolling terrain with frequent changes in vertical grade, although the overall grade was ascending. About 12.7 miles after entering NY-30A the highway exhibited a descending grade that covered about 2.3 miles with an elevation decrease of more than 700 feet. Segments of this descending grade exhibited grade percentages similar to those measured along the final grade on NY-30. An overall average was estimated at about six percent. Additionally, while descending this grade the Ford would have encountered one stop sign and one traffic signal (intersection of NY-20). Overall, while traveling the route from I-90 to NY-7 (mostly along NY-30A) the Ford would have encountered three (3) stop signs and two (2) traffic signals.[23] The route also featured numerous curves, some of which would require a speed reduction for safe navigation.

[23] Stop signs were located at the intersections of Riverside Drive and the Exit 28 off-ramp, NY-30A and NY-162, and NY-30A and NY-7. Traffic signals, where stops may have been necessary, were located at the intersections of Riverside Drive and NY-30A and NY-30A and NY-20.

The eastward segment of NY-7 between the intersections with NY-30A and NY-30 exhibited a slight ascending grade, although another stop sign would be encountered.[24] After turning from NY-7 southward on NY-30 and before continuing into the final descending grade, a witness reported that the limousine made a brief stop on the shoulder of NY-30.

Specific details of the pre-crash route will be discussed in greater detail as part of the follow-up vehicle performance testing.

7. Follow-up Vehicle Testing

Examination of the pre-crash route covered by the limousine and the crash dynamics indicate a potential loss of functional brake capacity as the vehicle descended the final segment of NY-30. While the potential for functional degradation along the initial portions of the route are not known, continued brake use may have influenced system effectiveness further into the trip. To better understand the influence that elements such as highway environment, vehicle loading, brake system component condition and other factors may have had on the brake system effectiveness, the NTSB contracted for exemplar vehicle testing and brake system simulation studies.

The NTSB proposed using certain performance criteria of FMVSS 105 as a baseline to understand the braking performance of an exemplar Excursion with properly functional braking loaded to the accident weight. The NTSB established a testing objective and awarded a contract to Greening Testing Laboratories, Inc., of Detroit, MI to manage and conduct the test program. The exemplar testing was conducted by the Nevada Automotive Test Center (NATC) of Carson City, Nevada. The exemplar testing was also used to determine vehicle-specific parameters that were then used in route situations with a dual-end dynamometer (conducted by Greening) to evaluate braking performance along the known route traveled by the accident limousine and loaded to the accident weight. In both testing regimes Ford recommended brake components for the OEM Excursion model were used.[25]

The FMVSS 105 procedures included sections and procedures covering minimum stopping distance, partial system failure, brake booster failure and fade recovery in addition to pedal pressure parameters. Exemplar testing was also used to identify brake cooling and coast-down (drag) curves for use in the route simulations. The test objective did not cover the entire FMVSS 105 protocol, as the results were intended as an exemplar performance baseline and not to establish regulatory compliance.

Details of the test program, results and findings, and the implications that other elements related to brake system functionality may have played in the crash are summarized in the Brake Performance Study report prepared by the Vehicle Performance Division of the NTSB Office of Research and Engineering.

[24] The stop sign was part of a 4-way stop intersection at NY-7 and Zicha Road.
[25] GVWR of 8,600 pounds.

E. REFERENCES

- NTSB Highway Factors Group factual report
- NTSB Vehicle Factors Group factual report
- NTSB Human Performance Group factual report

F. DOCKET MATERIAL

The following attachments and photographs are included in the docket for this investigation:

LIST OF ATTACHMENTS

None

END OF REPORT

Robert J. Squire
Highway Accident Investigator

Appendix 1: Additional 3D Scan Images of Ford Limousine

Figure 11: Image of 3D scan depicting left (driver) side of the Ford limousine.

Figure 12: Image of 3D scan depicting left (driver) side of the Ford limousine.