



**HIGHWAY FACTORS GROUP CHAIRMAN'S
FACTUAL REPORT**

Williston, Florida

HWY16FH018

(13 pages)

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

**HIGHWAY FACTORS GROUP CHAIRMAN'S
FACTUAL REPORT**

A. CRASH INFORMATION

Location: US-Alt 27, milepost 29, near Williston, Levy County, Florida

Vehicle #1: 2015 Tesla Model S 70D

Operator #1: Private operator

Vehicle #2: 2014 Freightliner Cascadia truck tractor in combination with a
2003 Utility 3000R refrigerated semitrailer

Operator #2: Okemah Express, LLC
Palm Harbor, FL

Date: May 7, 2016

Time: 4:36 PM EDT

Fatalities: 1

NTSB #: HWY16FH018

B. HIGHWAY FACTORS GROUP

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NTSB Office of Highway Safety
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C. CRASH SUMMARY

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

D. GENERAL ROAD DESCRIPTION

This Highway Group Factual Report begins with a description of the crash location. To characterize traffic on the roadway, sections on traffic volume, traffic speed, and crash history for US 27A at the intersection of NE 140th Court and for US 27A 5 miles east and west of the intersection are included. Florida Department of Transportation (FDOT) conducted an intersection signal warrant analysis that is summarized in Section 5. The balance of the report summarizes highway design characteristics.

1. Crash Location

The crash occurred in the eastbound travel lane of US 27A at mile marker 29.076, in Levy County, Florida. The global position system (GPS) coordinates for the crash are 29.4106 N / -82.53979 W for the area of impact; 29.409516 N / -82.537291 W for the location of the Tesla sedan at rest. US 27A is also designated on Florida DOT construction documents as State Road (SR) 500. **Figure 1** is a crash map that illustrates the crash location approximately 5 miles west of Williston, Florida. Attachment 1 is a redacted copy of the Florida Highway Patrol crash report for this event.

According the Florida Department of Transportation (FDOT) Crash Analysis Reporting System (CARS), State Road 500 (US 27A) at the location of the crash, is a rural 4-5 lane road with a divided, raised median. As a classification, Florida refers to the road as “other limited access,” a term comparable to FHWA’s class of “other principal arterials.” This class provides mobility through rural areas directly serving abutting land uses, including driveways to specific parcels and at-grade intersections with other roadways.



Figure 1 – Image of the crash intersection showing the eastbound route of the Tesla Model S in blue and the route of the westbound tractor trailer turning south in yellow. (Source: Google Earth modified)

2. Traffic Volume

Table 1 summarizes the average daily traffic volumes on US 27A in the vicinity of the crash between mile post 24 and 34. Years 2010 and 2015 were from traffic counts, 2011-2014 are based on an average daily traffic (ADT) from Florida’s Crash Analysis Reporting System (CARS).¹ Note that traffic counts for 2015 were taken on Wednesday, 4/8/2015 and Thursday, 4/9/2015; no Saturday traffic volumes for that year were available.² Road construction documents for the last major resurfacing of US 27A in 2013 cited an ADT of 7,900.

¹ The Florida Department of Transportation Safety Office receives crash records from the Department of Highway Safety and Motor Vehicles (DHSMV). The long-form reported crashes along with location coordinates are uploaded to the Crash Analysis and Reporting (CAR) database.

² The May 7, 2016 crash occurred on a Saturday.

Table 1 – Average Daily Traffic Volumes on US 27A from FDOT.

| US 27A | Average Daily Traffic Volumes (vehicles per day) |
|-------------------|---|
| 2010 | 8,200 |
| 2011-2014 average | 7,938 |
| 2015 | 8,800 |

Traffic volume measurements associated with the intersection of the crash were obtained by FDOT on Tuesday, September 13, 2016 and Saturday, September 17, 2016. Metrics were taken in 15-minute increments for a 12-hour period of 7 AM to 7 PM. For September 13, morning peak hour began at 7:00 AM and afternoon peak hour began at 4:45 PM. For September 17, morning peak hour began 10:15 AM and afternoon peak hour began at 3:15 PM. Morning peak hour vehicle counts for Tuesday, September 13 were 170 westbound, 253 eastbound along US 27A; afternoon peak hour vehicle counts along US 27A were 305 westbound and 206 eastbound. Morning peak hour vehicle counts for Saturday, September 17 were 268 westbound and 235 eastbound; afternoon peak hour was 249 westbound and 257 eastbound. Attachment 2 provides the most recent average daily traffic volume for US 27A (also identified by FDOT as State Road 500).

A delay study of the intersection was conducted on September 13, 2016 and September 17, 2016. The average delay for Tuesday afternoon turning traffic queues for all directions was 7.56 seconds (52 vehicles counted) and for Saturday afternoon the average stopped time was 11.35 seconds (49 vehicles counted). Attachment 3 contains FDOT Delay Study for the intersection.

Traffic classification counts to categorize the percentage of truck and bus traffic were conducted for a 24-hour period on US 27A on Tuesday, September 13, 2016 and Saturday, September 17, 2016. For Tuesday, September 13, 2016, eastbound traffic for all vehicle types totaled 3,651; westbound traffic for all vehicles totaled 3,624. Truck and bus traffic east bound was 16.5 percent of the total traffic vehicles; westbound truck and bus traffic was 16.1 percent. For Saturday, September 17, 2016 eastbound traffic for all vehicle types totaled 3,809; westbound traffic for all vehicles totaled 3,757. Truck and bus traffic eastbound was 8.6 percent; westbound truck and bus traffic was 9.8 percent. Attachment 4 contains FDOT Vehicle Classification counts for traffic on US 27A.

3. Traffic Speed

The latest 85th percentile speed study was conducted on 8/24/2016 from 1:59 PM to 3:15 PM while pausing for law enforcement in the area from 2:17 PM to 2:51 PM. The speed study was located on US 27A on both eastbound and westbound lanes near the intersection with NE 140th Court. The 85th percentile speed was 69 miles per hour (mph). The range of speed was generally 50 mph – 74 mph; of the 208 vehicles sampled, 4 vehicles, all west bound, were recorded at speeds of 76 mph or higher. This section of the roadway was reconstructed from a two-lane to a four-lane roadway in 2003 to a design speed of 68 mph. It was resurfaced in 2013 to a design speed of 70 mph. (Florida DOT State Project 34010-3539). At the time of the crash the speed limit was posted at 65 mph. Attachment 5 contains FDOT Speed study.

4. Traffic and Fatal Crash Summary

Table 2 summarizes the traffic and fatal accident summary on US-Alt 27 within 5-miles each and west of the intersection from 2010 through 2014. Attachment 6 contains FDOT Crash Data.

Table 2 – Traffic and Fatal Accident Summary on US-27A

| Crash Year | Fatal Crashes | Fatalities | Injury Crashes | Injuries | Property Damage Only | Total Crashes |
|---------------|---------------|------------|----------------|-----------|----------------------|---------------|
| 2010 | 0 | 0 | 8 | 12 | 4 | 12 |
| 2011 | 2 | 4 | 7 | 15 | 3 | 12 |
| 2012 | 1 | 2 | 1 | 2 | 4 | 6 |
| 2013 | 1 | 1 | 11 | 18 | 10 | 22 |
| 2014 | 0 | 0 | 22 | 33 | 10 | 32 |
| Totals | 4 | 7 | 49 | 80 | 31 | 84 |

According to FDOT, in the past 5 years there were 84 crashes in the 10-mile segment of US 27A that centers around the intersection;³ of those, 4 were fatal crashes involving 7 fatalities. Property damage only crashes accounted for 37% of crashes. Based on milepost designation, 7 non-fatal crashes in the 5 years of data were in close proximity to the intersection of US-Alt 27 and NE 140th Court and 3 were designated at the intersection.

Table 3 shows a record of recent individual crashes that occurred at the intersection of US-27A and N.E. 140th Court. Figure 2 on the following page shows the locations of those events.

Table 3 – Recent traffic crashes at intersection of US-27A and N.E. 140th Court.

| Crash Date | Fatal Crash | Fatalities | Vehicles Involved | Injuries |
|------------|-------------|------------|-------------------|----------|
| 3/8/2015 | no | 0 | 2 | 2 |
| 11/23/2015 | no | 0 | 2 | 2 |

³ At the time of this report, traffic crash data was incomplete for 2015.

| | | | | |
|-----------|-----|---|---|---|
| 5/7/2016 | yes | 1 | 2 | 0 |
| 5/28/2016 | no | 0 | 2 | 4 |
| 7/22/2016 | yes | 1 | 2 | 1 |



Figure 2. Depiction of vehicle movements for five recent crashes occurring at the intersection location. Image and graphic overlays courtesy of FDOT.

In addition to the crash that is the subject of this report, there was a fatal crash at the same intersection on July 22, 2016 at 8:14 pm. Florida Highway Patrol indicated that the light conditions were “dusk,” road conditions were dry, and the weather was clear. The 48-year-old female driver of a 2001 Ford Explorer, traveling north on County Road N.E. 140th Court made a left turn in front of a 2005 Dodge Ram pickup pulling a livestock trailer traveling on east US-27A. The 24-year-old male driver of the pickup took evasive action to the left but struck the Ford Explorer and they both came to rest in the intersection median of US 27A at the end of the west turn lane. The fatally injured driver of the Ford Explorer was unrestrained; she was pronounced deceased at the hospital later the same evening of the crash.

5. Signal Warrant Analysis

Data necessary for a signal warrant analysis was collected by FDOT on October 3, 2016.⁴ Of the 9 warrants, 4 were found to not apply the subject intersection. Of the 5 applicable warrants, none were met for the intersection of US Alt 27 / SR 500 at NE 140th Court. The

⁴ Using FDOT Traffic Engineering Form 750-020-01, last revised October 2105, that references the Manual on Uniform Traffic Control Devices, <http://mutcd.fhwa.dot.gov/pdfs/2009r1r2/part4.pdf>.

following metrics were used in the signal analysis. The eight highest hour volumes averaged 487 vehicles per hour (both directions) on US 27A, the major roadway. The four highest hour volumes on the major street were 459, 394, 583, and 568; the four highest hour volumes on the minor street (one direction only) were 59, 45, 37, and 47. Peak hour traffic for the signal warrant study was consistent with the September traffic analysis, which occurred between 4:45 PM and 5:45 PM. There were no pedestrian crossings and within that category there were no student crossings (students are a special category for signal warrant calculations). Reported crashes, of types susceptible to correction by signal, that occurred within a 12-month period totaled 4. The intersection volume was 587-647, well below the roadway network criteria of 1,000 vehicles/hour peak hour. There is no nearby railroad grade crossing. No measures for an intersection traffic signal were warranted. Attachment 7 contains FDOT Traffic Signal Warrant Analysis.

6. Highway Functional Classification

US-27A in the vicinity of the crash is a Rural, Other Principal Arterial road, as defined by Florida DOT according to *A Policy on Geometric Design of Highways and Streets, (The Green Book)*.⁵ The functional classification describes the procedures and processes for assigning functional categories to roadways and characterizes roadway design, including its expected speed and capacity. AASHTO has 7 categories of functional classification: Interstates; Freeways and Expressways; Other Principal Arterials; Minor Arterials, Major Collectors, Minor Collectors and Local Roads. For each of these road classifications, there are sub-categories for urban and rural. Other Principal Arterials play a unique role in providing a high degree of mobility and carrying a high proportion of travel for long distance trips. These facilities carry the major portion of trips entering and leaving an activity center, as well as the majority of through movements that either go directly through or bypass the area.⁶ Unlike their access-controlled counterparts, abutting land uses can be served directly. Forms of access for Other Principal Arterial roadways include driveways to specific parcels and at-grade intersections with other roadways.⁷

The Federal Highway Administration guidance in *Highway Functional Classification: Concepts, Criteria and Procedures* summarizes the relationship between the design concepts and the three broad categories of functional classification. The characteristic of traffic access is described for Interstates as fully controlled, for Freeways and Expressways as fully/partially, and Other Principal Arterials as partially/uncontrolled.⁸

⁵ American Association of State Highway and Transportation Officials, 6th Edition, Chapter 7, 2011

⁶ Highway Functional Classification: Concepts, Criteria and Procedures, FHWA, page 3.

⁷ Highway Functional Classification: Concepts, Criteria and Procedures, FHWA, page 15.

⁸ Highway Functional Classification: Concepts, Criteria and Procedures, FHWA, Table 3-5, page 22.

7. Highway Design

Approaching the crash intersection, both east and west, US 27A is a 6 lane cross section consisting of 2 eastbound travel lanes, an eastbound left turn lane, 2 westbound travel lanes, and a westbound left turn lane. Turn lanes extended for a length of approximately 550 feet both east and west of the intersection with N.E. 140th Court. The county road, N.E. 140th Court, runs due north, intersecting US-27A at a 109 degree angle. The paved median cross over intersection opening between the two travel directions on US-27A extends approximately 129 feet, skewed to favor turns on the northwest and southeast corners of the intersection. Its geometry resembles a parallelogram.

Each of the travel lanes widths were approximately 12 feet, (although at some points the left turn lane appeared to be slightly less, possibly a function of variability in application of the striping lines). The left and right shoulder widths are about 2 feet and 5 feet respectively, for a paved surface cross section of approximately 31 feet (12+12+2+5) along through lanes without turn lanes. The travel lanes were separated by wide grass median, the width of which varied but is approximate 60-feet. The left turn lanes are offset from the travel lanes. The total width of the 6-lane cross section was approximately 146 feet with an additional 20 feet of cleared right of way containing a drainage ditch on each side of the road.

In the vicinity of the crash, travel lanes were marked with 6-inch white lines on the right-hand side of the outer roadway. Lane separations were designated by dashed 6-inch center lines and raised reflectors. The inner lanes adjacent to left turn lanes were marked with 6-inch solid yellow lines. Grooved rumble strips bordered the outside lane markings. The 12-foot wide-turn lanes were delineated from the through lanes with 6-inch solid white lines and raised reflectors; the turn lanes were marked with five repeated turn arrows centered in the turn lanes. In the median, adjacent to the left travel lane there was a green reflector pole to indicate where a turn could begin.

Approaching the intersection from both directions, located in the median adjacent to the turn lane, were “one-way” arrow signs facing the turn lanes; backed by “yield” triangle signs facing the intersection’s crossing traffic. The paved intersection between the sets of travel lanes contained no markings. Attachment 8 contains the roadway plan sheets and signing and pavement marking plan sheets (reference file pages 21-22 for plan sheets 200-201 showing the intersection of US 27A and N.E. 140th Court).

7.1 Horizontal Alignment

The horizontal alignment immediately preceding the intersection, both east and west, was straight.

7.2 Vertical Alignment

The intersection area of impact was near the bottom of a slight descending grade. A vertical profile approaching the intersection and area of impact was developed using GPS. The elevation was recorded over a distance of 3767 feet, (west) before the area of impact and continued 377 feet past (east) the area of impact, for a total distance of 4144 feet. There were 66 points recorded over that distance, with an average distance between the points of 63 feet.⁹ Field measurements were consistent with FDOT road plans.

The vertical alignment in the eastbound travel lane of US-27A immediately preceding the intersection consisted of an ascending grade of 0.51% which crests approximately 1132 feet west of the intersection (center). The roadway then exhibits a 1459 foot descending grade of 2.15% through the intersection. The descending grade terminates about 325 feet east of the intersection.

FDOT conducted a series of locked wheel friction tests on US 27A on 11/17/2016. Skid tests using a standard ribbed tire were conducted at a speed of 40 miles per hour in the left wheel path using a standard two-wheel trailer towed by a one-ton pick-up truck conforming to ASTM E 274 requirements.¹⁰ The temperature was 85 degrees and the weather was clear. Measurements (81) westbound averaged a skid number of 39.1, with the lowest value recorded at 32.9. Measurements (82) eastbound averaged a skid number of 37.9, with the lowest value recorded at 33.4. According to FDOT criteria, a roadway is determined to have adequate available surface friction when the skid number is 28 or greater for a posted speed limit of 45 miles per hour or less, and a skid number of 30 or greater for a posted speed limit greater than 45 miles per hour.

⁹ While the specific elevation numbers recorded by the GPS are unlikely to represent the actual elevation of the highway surface, they reflect the relative difference in vertical height between the points and therefore, provide a representation of the vertical profile. Degradation of GPS accuracy is more likely with measuring height, but the presumption is that any loss of accuracy would apply equally to all points measured.

¹⁰ ASTM International Standard E 274-65T. Tentative Method of Test for Skid Resistance of Pavements Using A Two-Wheel Trailer. Current edition approved Dec. 1, 2015. Published January 2016.



Figure 3. View looking west of the US-27A eastbound travel lane approaching the intersection with NE 140th Court. This is the travel path of the car.



Figure 4. View looking east on US-27A in the travel lane used by the car. This photo orientation is from the car driver's point of view.



Figure 5. View looking west of the US-27A along the westbound travel lane approaching the intersection with NE 140th Court. This is the travel path for the truck.

8. Visibility Sight Distance

Analysis of sight lines available to both drivers are contained in this investigation's Reconstruction Report.¹¹ This highway factual report reflects the road dimensions and metrics used for that analysis.

9. Weather Conditions

On 5/7/2016, the day of the crash, the weather was sunny and the temperature reached a high of 83 degrees. Solar noon was at 1:22 PM; at the time of the crash, the sun would have been high in the sky, from the secondary-intercardinal direction of west-southwest (WSW) behind the route of car headed east.

¹¹ Reconstruction Report contained in the NTSB public docket for this investigation.

E. DOCKET MATERIAL

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

LIST OF ATTACHMENTS

Highway Attachment 1 – Florida Highway Patrol Officer’s Crash Report for May 7, 2016

Highway Attachment 2 – FDOT, District 2 traffic volume metrics

Highway Attachment 3 – Florida Department of Transportation traffic delay study

Highway Attachment 4 – Vehicle Classification Count on US 27A in the vicinity of the crash

Highway Attachment 5 – FDOT Speed Study

Highway Attachment 6 – Traffic crash summary and fatal crash summary within a 5-mile radius of the crash for the last 5 years

Highway Attachment 7 – A traffic signal warrant for the intersection US-27A/SR-500 based on the Manual on Uniform Traffic Control Devices (MUTCD)

Highway Attachment 8 – FDOT US 27A Highway Design Plans, Signage Plans

END OF REPORT

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