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

HIGHWAY FACTORS GROUP CHAIRMAN'S FACTUAL REPORT

GREENVILLE, ALABAMA – HWY21MH009

A. CRASH INFORMATION & CRASH SUMMARY

Refer to the *Crash Information and Crash Summary Report* in the docket for this investigation.

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C. DETAILS OF HIGHWAY INVESTIGATION

This Highway Group Chairman's Factual Report is based on reports, photographs, documents, and data provided by the Alabama Department of Transportation (ALDOT) and the Alabama Law Enforcement Agency (ALEA), as well as information and photographs gathered at the crash location by NTSB investigators. Data was obtained that included a construction history, daily traffic volumes, vehicle classification data, crash summaries, and highway design plans. Unless otherwise specified, all measurements, speeds, and times are approximate. Vehicle-based references are oriented from the driver's seat looking forward, and directions left or right are based on the perspective of a driver traveling in the typical travel direction for that portion of the roadway. Measurements to and/or from pavement markings (painted lines) were made to the center of the line's width.

1. CRASH LOCATION

The collision occurred in the northbound travel lanes of Interstate Highway 65 (I-65), at mile marker 138.18 near the north end of the northbound bridge structure over Pigeon Creek near Greenville, Butler County, Alabama. The crash location, shown in **Figure 1**, was located approximately 8.8-miles north-northeast of the City of Greenville, Alabama. An annotated orthomosaic aerial image of the crash location is shown in **Figure 2**.[1]

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[1] See *Highway Photograph 1 – Orthomosaic Aerial Image of Crash Location from sUAS*. An orthomosaic image is a map-quality overhead image created through the combination of numerous individual images which have been processed by computer software such that the photographs have been geometrically corrected for scale and to remove distortion.

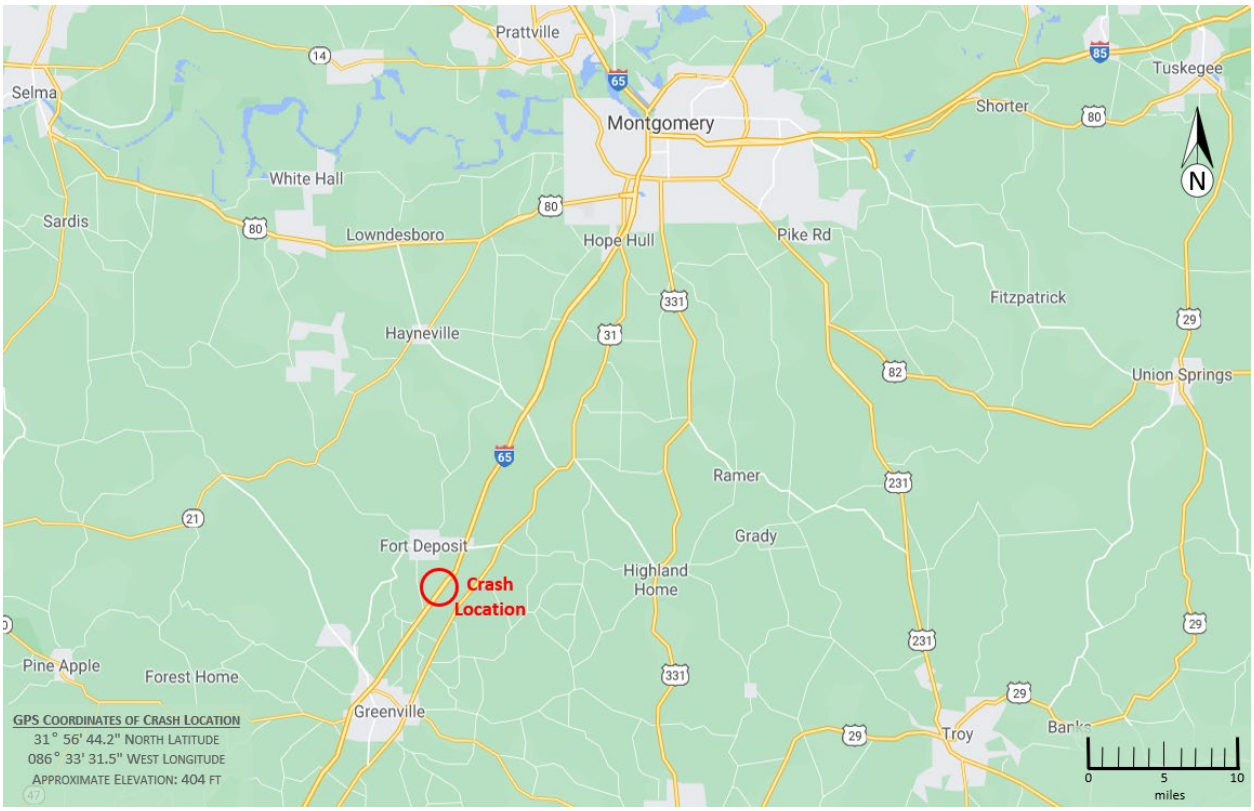

Figure 1: Map of Crash Location (modified from Google Maps)

Figure 2: Orthomosaic Aerial Image of Crash Location

2. HIGHWAY DESIGN

In the area of the collision, I-65 was a four-lane divided asphalt paved highway, consisting of two travel lanes each in the northbound and southbound directions.[2] The multi-vehicle crash occurred in the northbound travel lanes in the area of the north end of the twin bridge structures supporting the northbound and southbound roadways over Pigeon Creek.[3] North and south of the bridge structure, both the northbound and southbound asphalt travel lanes were approximately 12-feet wide and were flanked on the right and left sides by 10.5-foot and 4.5-foot-wide asphalt paved shoulders, respectively.

[2] See *Highway Photograph 2 – I-65 Northbound Travel Lanes Near Crash Location – Facing Northeast.*
[3] See *Highway Attachment – Selected Pages from Roadway Design Plans for I-65 in the Vicinity of the Crash Location and Bridge Design Plans for the Twin Bridge Structures Over Pigeon Creek.*

The reinforced Portland cement concrete twin bridge structures were 272-feet-long and 33.2-feet wide. Each of the bridge structures were made up of eight (8), 34-foot-long spans. On the concrete bridge decks, each of the northbound and southbound travel lanes were 11.5-feet wide. On the bridge decks, the travel lanes were flanked on the right and left sides by 2.5-foot-wide shoulders. The bridge deck shoulders were further flanked by 31-inch-wide, 11-inch-high concrete curbs. Atop each of the concrete curbs, set in 1-inch from the outside edge of the structure, were 12-inch-wide, 27-inch-high reinforced concrete bridge rail support posts, which in turn were connected by 8-inch-wide, 14-inch-high reinforced concrete bridge rails along their interior faces.

Channelizing chevron patterns were marked on the left and right shoulders of the northbound travel lanes of I-65 for approximately 585-feet prior to the south end of the bridge structure to alert motorists to the transition from the 12-foot-wide travel lanes south of the bridge structure to the 11.5-foot-wide travel lanes on the bridge structure.[4] The channelizing chevron patterns consisted of 24-inch-wide retro-reflective pavement markings in combination with multiple raised reflectors along the leading (south) edge of the pavement markings. The length of the channelizing chevrons were dictated by the width of the shoulder at each chevron location.

Approximately one and a half sections of the reinforced concrete bridge rail along the left side of the northbound bridge structure were struck during the collision sequence and were damaged.[5] The total length of damaged bridge rail was approximately 25-feet long, and the damage began 50.8-feet south of the north end of the bridge rail terminus. Damage included the outward displacement of the damaged sections of bridge rail with the effected bridge rail support posts leaning about 30-degrees beyond vertical. Significant concrete spalling was observed with exposed reinforcement steel at the connections between the bridge rail support posts and the bridge deck curb.[6] A 37-inch-long segment of crushed bridge rail with exposed reinforcement steel was present at the northern most end of the damaged bridge rail sections.[7] None of the vehicles involved in the collision penetrated the bridge rail. Repairs to the damaged sections of bridge rail and their connections to the bridge deck began on June 22, 2021, and were completed on June 28, 2021, while NTSB investigators were still in the Greenville, AL area.[8]

A depressed earthen median separated the northbound and southbound roadways. The median was approximately 46-feet-wide from the northbound edge of pavement to southbound edge of pavement, or approximately 55-feet wide measured from solid yellow line (edge of traveled way) to solid yellow line (edge of traveled way). Also present in the median both north and south of the bridge structures was a four-strand high tension cable median barrier.[9]

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[4] See *Highway Photograph 3 – Channelizing Chevron Pavement Markings Along Northbound I-65 Approach to Bridge Structure – Facing Northeast*

[5] See *Highway Photograph 4 – Damaged Sections of Northbound Left Bridge Rail Near North End of Bridge Structure – Facing Southwest.*

[6] Spalling is the flaking, breaking, or peeling away of small particles of concrete from the surface portions of finished concrete.

[7] See *Highway Photograph 5 – Damaged Portion of Northbound Left Bridge Rail Showing Exposed Reinforcing Steel – Facing North Northwest.*

[8] See *Highway Photograph 6 – Repaired Sections of Northbound Left Bridge Rail Near North End of Bridge Structure – Facing Southwest.*

[9] See *Highway Photograph 7 – Four-Strand High-Tension Cable Median Barrier Along the Northbound Travel Lanes of I-65, South of the Pigeon Creek Bridge Structure – Facing West Southwest*.

Due to the combined horizontal and vertical geometry of the roadway in this area, the grades and cross-slopes for the northbound lanes and shoulders were obtained from ALDOT in the form of roadway cross-section drawings. Roadway cross-sections were provided corresponding to locations approximately every 100-feet beginning 2,000-feet prior to the south end of the northbound bridge structure and ending 2,000-feet beyond the north end of the northbound bridge structure, for a total of 47 diagrams.[10] Pavement cross-slopes and other dimensional data for three locations along the northbound lanes of I-65 have been reproduced from the data provided by ALDOT and are shown in **Figures 3** thru **5**. **Figure 3** shows the cross-slopes of the northbound roadway approximately 680-feet south of the south end of the northbound bridge structure, or approximately 95-feet south of the beginning of the channelizing chevron pattern on the left and right shoulders of the northbound roadway south of the bridge structure. **Figure 4** shows an approximate cross-section of the northbound bridge deck as well as the average cross-slopes of the northbound roadway on the bridge.[11] **Figure 5** shows the cross-slopes of the northbound roadway approximately 250-feet north of the north end of the bridge structure. In the area of the crash, I-65 had a posted speed limit of 70 miles per hour (mph) for both travel directions.

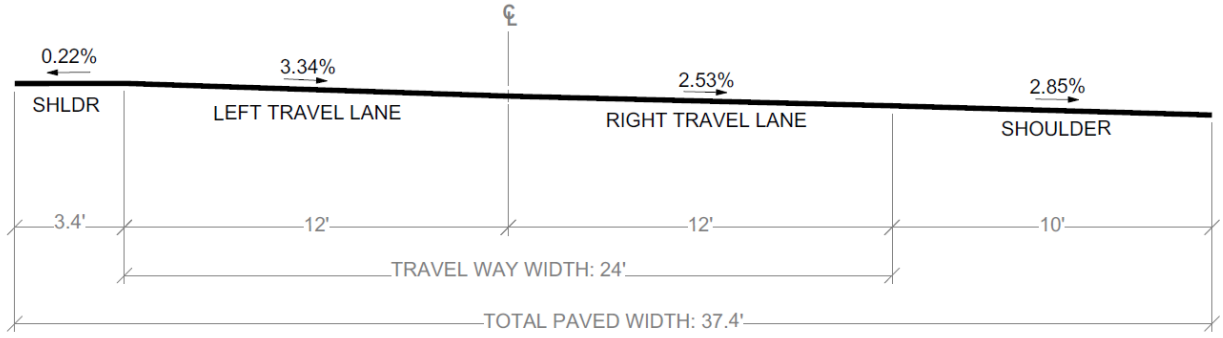

Figure 3: Roadway Cross-Section for I-65 Northbound Near Milepost 138.055, Approximately 680-feet South of Bridge Structure (source: NTSB, based on ALDOT data)

[10] See *Highway Attachment – ALDOT Roadway Cross-Section Diagrams for Northbound I-65 in the Vicinity of the Collision*.

[11] The cross-sectional profile of the travel lanes and shoulders on the bridge deck were formed during the original construction of the structure to be in the shape of a 2 ¼-inch parabolic crown. Average cross-slopes are shown at multiple locations across the travel lanes and shoulders because the actual cross-slope at any given point along the profile is changing due to the parabolic shape of the crown.

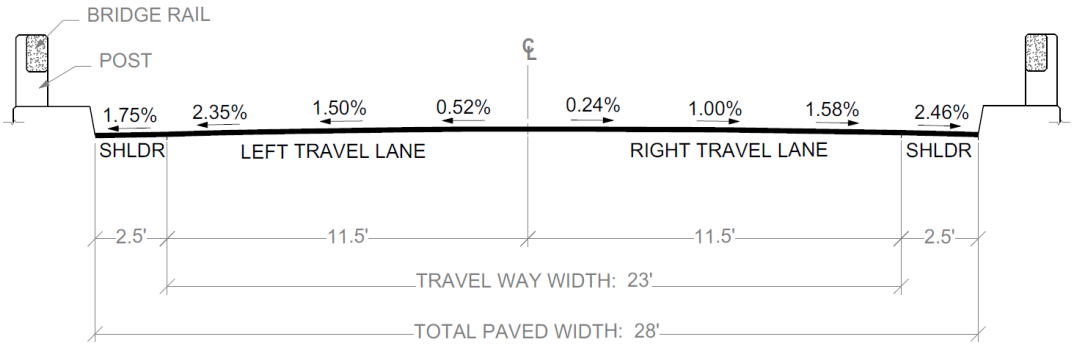

Figure 4: Bridge Structure and Roadway Cross-Section for I-65 Northbound Near Milepost 138.207, Near Area of Impact Between Car Hauler and Ford Explorer (source: NTSB, based on ALDOT data)

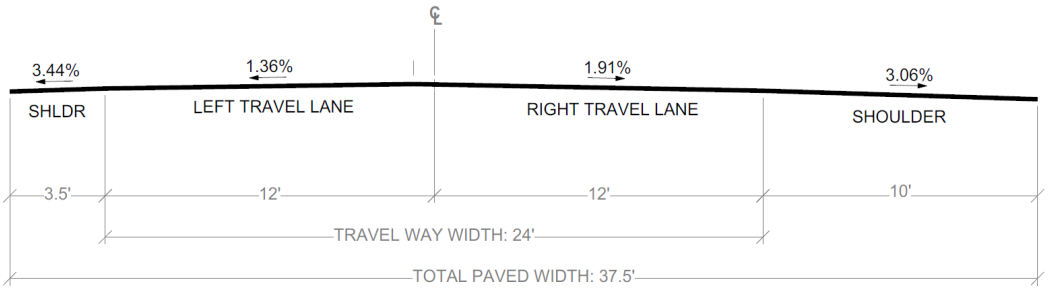

Figure 5: Roadway Cross-Section for I-65 Northbound Near Milepost 138.283, Approximately 250-feet North of Bridge Structure (source: NTSB, based on ALDOT data)

3. HORIZONTAL AND VERTICAL ALIGNMENT

Horizontal Alignment – The crash occurred 321-feet into a horizontal tangent (straight) section of the highway after having negotiated a 2,440-foot-long right-hand horizontal curve.[12] The horizontal curve had a radius of 11,420-feet for the northbound lanes. The horizontal tangent section continued for 1.5-miles in the northbound direction from the crash location.

Vertical Alignment – The crash occurred 521-feet into a 1,600-foot-long Type I sag vertical curve[13] providing a transition between a descending grade of -2.90%, and an ascending grade of +0.86%. The grade at the approximate location where the collision between the car hauler and the Ford Explorer occurred was -1.68% (descending).

4. WEATHER AND RAINFALL CONDITIONS

For details about the weather and rainfall conditions near and at the crash location, please refer to the *Meteorology Specialist's Factual Report*.[14]

[12] See *Highway Attachment – Selected Pages from Roadway Design Plans for I-65 in the Vicinity of the Crash Location and Bridge Design Plans for the Twin Bridge Structures Over Pigeon Creek*.
[13] A Type I sag vertical curve connects a descending grade to an ascending grade.
[14] See *Meteorology Specialist's Factual Report*, which is available in the docket for this investigation.

5. PAVEMENT TEXTURE DEPTH TESTING

On June 25, 2021, and July 8, 2021, the ALDOT conducted testing to determine the pavement texture depth of the I-65 northbound travel lanes in the area of the collision.[15] Testing was performed in both the left and right travel lanes beginning about 250-feet south of the south end of the northbound bridge structure and ending about 250-feet north of the north end of the bridge structure. For the purposes of the testing, each travel lane within the test area was broken into 14 segments with multiple tests being conducted in each segment. The overall average mean texture depth (MTD) results for the travel lane wheelpaths are summarized in **Table 1**. For reference, an orthomosaic aerial image of the northbound bridge structure with the bridge spans labeled is shown in **Figure 6**.

Table 1: Pavement Texture Depth Measurements for Northbound I-65 in Vicinity of Crash Location.

Roadway Segment	Overall Average Mean Texture Depth	
	Left Lane Wheelpaths (inches)	Right Lane Wheelpaths (inches)
140' - 240' South of Bridge[1]	0.02510	0.02310
40' - 140' South of Bridge[2]	0.02680	0.02850
0' - 40' South of Bridge[3]	0.03290	0.03190
Bridge Span 1	0.01920	0.01980
Bridge Span 2	0.01720	0.02310
Bridge Span 3	0.02210	0.02360
Bridge Span 4	0.02030	0.02320
Bridge Span 5	0.02390	0.02220
Bridge Span 6	0.02250	0.02300
Bridge Span 7	0.01890	0.02100
Bridge Span 8	0.01900	0.02050
0' - 50' North of Bridge	0.03000	0.03490
50' - 150' North of Bridge	0.02590	0.03110
150' - 250' North of Bridge	0.02690	0.02670

[1] Segment distances given are for left lane. Right lane distances are 150' - 250' South of Bridge.

[2] Segment distances given are for left lane. Right lane distances are 50' - 150' South of Bridge.

[3] Segment distances given are for left lane. Right lane distances are 0' - 50' South of Bridge. (This segment consisted of the south bridge end slab.)

[15] See *Highway Attachment – Pavement Macrotexture Depth Test Results for I-65 N/B in Vicinity of Crash Location*. The tests were conducted in accordance with the test methods established by the American Society for Testing and Materials (ASTM) standard E965-15 "*Standard Test Method for Measuring Pavement Macrotexture Depth Using a Volumetric Technique*", using calibrated equipment. Testing was conducted on the inside lane of both the roadway and bridge deck on June 25, 2021, and was conducted on the outside lane of both the roadway and bridge deck on July 8, 2021.

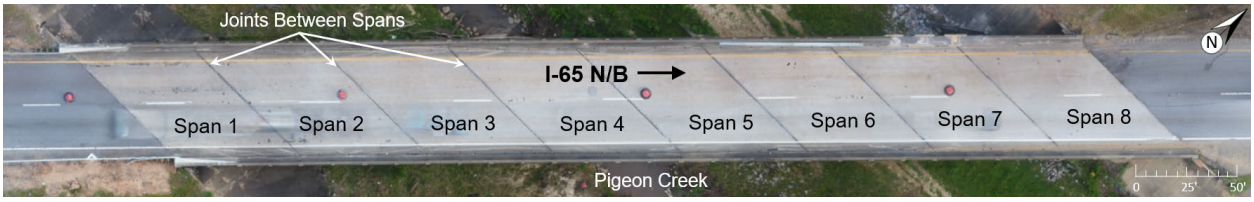

Figure 6: Orthomosaic Aerial Image of I-65 Northbound Bridge Structure

6. ROADWAY DRAINAGE

Drainage appliances were present on the bridge deck and in the median in the general vicinity of the crash location. Three-inch-diameter circular scupper drains were located on both the left and right sides of both bridge decks, within the paved shoulders and adjacent to the curbs.[16] There were 24 scupper drains regularly spaced along each curb on the interior six of the eight bridge spans making up each bridge structure, for a total of 48 scupper drains per bridge structure. The reinforced concrete bridge decks were designed and constructed with a 2.25-inch parabolic crown to channel rainwater to the scupper drains. The scupper drains were examined by NTSB investigators, and all of them were found to be clear of any debris. Several scupper drains are shown in **Figure 7**.[17]

Concrete lined drainage channels and area drains were located along the centerline of the median. One set of drainage channels and an area drain were located to the south of the bridge structures, and one set of drainage channels and an area drain were located north of the bridge structure near the bottom of the sag vertical curve. The drainage channels south of the bridge structures consisted of a 34-inch-wide, 5-inch-deep, 680-foot-long flat bottom concrete drainage channel south of the area drain and a 34-inch-wide, 5-inch-deep, 55-foot-long flat bottom concrete drainage channel north of the area drain. The drainage channels were sloped to drain water toward an approximate 34-inch by 18-inch area drain located approximately 150-feet south of the top edge of the south sloped concrete retaining wall between the twin bridge structures. Another set of drainage channels and an area drain were located north of the bridge structure near the bottom of the sag vertical curve. The drainage channels north of the bridge structures consisted of a 34-inch-wide, 5-inch-deep, 250-foot-long flat bottom concrete drainage channel south of the area drain and a 34-inch-wide, 5-inch-deep, 600-foot-long flat bottom concrete drainage channel north of the area drain. The drainage channels were sloped to drain water toward an approximate 34-inch by 18-inch area drain located approximately 590-feet north of the top edge of the north sloped concrete retaining wall between the twin bridge structures.

[16] A scupper is an opening through the bridge deck or at the base of the bridge rail that allows water to drain to the open air below, rather than pooling on the deck.
[17] See *Highway Photograph 8 – Scupper Drains through Bridge Deck Along Northbound I-65 Bridge over Pigeon Creek – Facing Northeast*.

Figure 7: Scupper Drains through Bridge Deck

7. HIGHWAY SIGNS AND MARKINGS

Highway signs along the northbound approach to the crash location were documented for approximately 8-miles using photographs and video.[18] According to ALDOT, there were no Changeable Message Signs (CMSs), or Portable Changeable Message Signs (PCMSs) located along northbound I-65 in the 50-miles preceding the crash location on the day of the crash. Also, according to ALDOT, there were no Highway Advisory Radio (HAR) transmitters located along northbound I-65 in the 50-miles preceding the crash location on the day of the crash. The closest speed limit sign to the crash location for northbound traffic was located approximately 7.5-miles to the south. The posted regulatory and warning signs, and their locations relative to the crash site, are summarized in **Table 2**.

The northbound travel lanes of I-65 in the vicinity of the crash contained a 5-inch-wide solid yellow line separating the left travel lane from the left shoulder; and a 5-inch-wide solid white line separating the right travel lane from the right shoulder. The two travel lanes were separated by 5-inch-wide broken white lines that were each approximately 10-feet long and had approximate 30-foot spaces between them. All the pavement markings were retroreflective. The two travel lanes were further delineated by raised bi-directional reflective pavement markers placed midway between every other broken white line for an approximate distance of 80-feet between markers. The raised pavement markers had a white retro-reflective surface exposed to traffic traveling in the correct direction, and a red retro-reflective surface exposed to traffic traveling the wrong way (against traffic).

[18] See *Highway Attachment – Northbound Approach Video – I-65, Milepost 130.3 to Milepost 138.5*.

Beginning approximately 575-feet prior to the northbound bridge structure and 600-feet prior to the southbound bridge structure, 2-foot-wide angled encroachment markings were present on the left and right paved shoulders. The markings were spaced approximately 40-feet apart and were yellow in color on the left shoulder, and white in color along the right shoulder. The leading edge of the markings were further emphasized by raised retroreflective pavement markers with colors that matched the pavement markings. The markings served to help move drivers into the center of their travel lanes in preparation for entering the bridge deck, where the lane widths temporarily reduce from 12-feet-wide to 11.5-feet wide.

Table 2: Regulatory and Warning Signs Along Northbound I-65 Approach to Crash Location

Sign	MUTCD Designation	Description	Placement	Milepost	Distance to Crash Location
	R2-1	Speed Limit	Right Shoulder	130.68	7.53 miles
	N/A	BRIDGE MAY ICE IN COLD WEATHER	1 Each on Left and Right Shoulders	131.43	6.77 miles
	N/A	BRIDGE MAY ICE IN COLD WEATHER	1 Each on Left and Right Shoulders	131.83	6.37 miles
	W4-1	Merge	Right Shoulder	133.00	5.20 miles
	R16-6	LIGHTS ON WHEN RAINING	Right Shoulder	133.19	5.01 miles
	N/A	MOVE OVER FOR STOPPED EMERGENCY VEHICLES WHEN CLEAR	1 Each on Left and Right Shoulders	133.35	4.85 miles
	N/A	BRIDGE MAY ICE IN COLD WEATHER	1 Each on Left and Right Shoulders	133.53	4.67 miles
	N/A	BRIDGE MAY ICE IN COLD WEATHER	1 Each on Left and Right Shoulders	137.97	0.23 miles (1,241 feet)

8. RUMBLE STRIPS

Longitudinal rumble strips were scored into both the left and right asphalt paved shoulders north and south of the twin bridge structures. Each rumble strip groove was approximately 6-inches long and 16-inches wide. The grooves were spaced approximately 12-inches on center and the grooves were approximately ½-inch deep. The rumble strip grooves were offset approximately 20-inches from the edge of the left travel lane, and approximately 17-inches from the edge of the right travel lane. The rumble strips along the northbound shoulders of I-65 ended 101-feet and 52-feet south of the bridge structure on the left and right shoulders respectively. The rumble strips along the northbound shoulders resumed 9-feet and 30-feet north of the bridge structure on the left and right shoulders respectively.

9. HIGHWAY CONSTRUCTION AND MAINTENANCE HISTORY

The original construction of I-65 in the area of the crash was completed under two main projects. The project for the construction of the twin bridge structures was let in ALDOT's fiscal year (FY) 1965, while the paving project was let in FY 1967.[19] The highway was most recently reconstructed during a project that let in FY 1995. Included in this project was the rubblization of the existing concrete pavement, installing an asphalt overlay, guardrail upgrades, and drainage improvements. The roadways were most recently resurfaced during a project that was let in FY 2013 and consisted of milling the existing pavement and the application of a stone matrix asphalt (SMA) top layer.[20] The roadway surfaces are routinely monitored. Preventative maintenance items are conducted as needed between reconstruction and resurfacing cycles to maintain pavement integrity.

Prior to this crash, ALDOT had already planned, let, and awarded a pavement preservation project for the segment of I-65 in Butler County between CR-41 and a point approximately 1-mile south of the Lowndes County line. The project was let on April 30, 2021, and the approximate $2.9M contract was awarded on May 21, 2021. The project is to include the application of an open graded friction course (OGFC) on top of a traditional wearing surface.[21] Work to start the resurfacing project began on July 13, 2021, with the majority of the resurfacing work being completed by October 17, 2021. Some resurfacing work requiring milling and placement of the OFGC layer near the project bridge ends (approximately 100 feet for each bridge end) remains outstanding, with project completion estimated to occur in September 2022.

Following the collision, maintenance crews from the Alabama Department of Transportation (ALDOT) responded from the District 64 office in Greenville, AL to assist with traffic control, roadway closure, and detour routes. The northbound and southbound travel lanes

[19] When government entities plan major expenditures, such as the construction of public buildings or highways, a competitive bidding process is typically required and follows a well-defined public process to receive and award the bids. This process is commonly referred to as the "letting" of a public contract. The terms "let" or "letting" are commonly used to refer to the bidding process from which the contract can be awarded to the lowest qualifying bidder.
[20] A stone matrix asphalt surface uses larger aggregate to provide better wearability and longer service life, while still allowing for some water permeability and surface drainage.
[21] An open graded asphalt friction course is a layer of hot-mix asphalt designed to be water permeable with interconnecting voids which provide improved surface drainage during rainfall events.

of I-65 were shut down between Exit 130 in Greenville (eight miles south of the crash location) and Exit 142 in Fort Deposit (four miles north of the crash location).

10. ROADWAY SURFACE FRICTION

Historical roadway surface friction test results taken in the right travel lane of northbound I-65 in the vicinity of the crash between 2016 and 2021were provided by ALDOT. At the request of NTSB investigators, additional post-crash surface friction testing was conducted in both the left and right travel lanes of northbound I-65 in the vicinity of the crash.[22] The tests were conducted in accordance with the test methods established by the American Association of State Highway and Transportation Officials (AASHTO) standard T242-96 (2013) using calibrated equipment and a ribbed tire on June 28, 2021.[23] The average friction number (FN)[24] test results of the historical tests conducted between 2016 and 2021 are summarized in **Table 3**.[25] The average FN test results for the additional post-crash tests conducted in both travel lanes are summarized in **Table 4**.

Table 3: Historical Pavement Friction Numbers for Northbound I-65 in Vicinity of Crash Location

Test Location (mile marker)	Test Year					
	2016	2017	2018	2019	2020	2021
137.50	33	38	39	40	38	37
138.00	33	35	40	41	37	38
138.20 (Bridge)	43	46	50	51	46	49
138.50	35	38	40	41	38	38
139.00	36	37	41	42	39	36

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[22] See *Highway Attachment – Roadway Surface Friction Test Data for I-65 in Vicinity of Crash Location*.
[23] AASHTO standard T 242-96 (2013) "Standard Method of Test for Frictional Properties of Paved Surfaces Using a Full-Scale Tire". Except for a subsection on steel graded bridge decks and terminology, this test method is the same as AASHTO T 242-18.
[24] A friction number (also referred to as a skid number, or surface friction number) represents the frictional properties of the pavement. These numbers are used to evaluate the skid resistance of the pavement relative to other pavements and/or to evaluate the change in skid resistance of the pavement with time.
[25] The 2021 friction tests shown in **Table 3** were conducted on June 21, 2021, in the right lane only, by ALDOT employees to obtain annual friction testing of the roadways.

Table 4: Post-Crash Pavement Friction Numbers for Both Northbound Travel Lanes of I-65 in Vicinity of Crash Location

Left Lane		Right Lane	
Test Location (Mile Marker)	Average Friction Number (FN)	Test Location (Mile Marker)	Average Friction Number (FN)
137.53	38	137.53	38
137.57	38	137.57	37
137.63	37	137.63	37
137.68	39	137.68	38
137.73	39	137.73	38
137.78	39	137.78	38
137.83	38	137.83	37
137.88	37	137.89	37
137.93	38	137.93	37
137.98	37	137.99	37
138.03	37	138.03	38
138.08	38	138.08	38
138.13	39	138.13	39
138.18	38	138.17	38
138.23 (Bridge)	46	138.23 (Bridge)	46
138.28	43	138.28	46
138.34	40	138.34	41
138.39	39	138.38	40
138.43	39	138.44	40
138.49	39	138.49	39
138.54	39	138.54	38
138.59	39	138.59	39
138.64	39	138.65	38
138.69	37	138.69	38
138.74	37	138.73	37
138.79	38	138.79	38
138.84	38	138.83	39
138.88	38	138.89	38
138.94	37	138.93	38
138.98	39	138.99	39
139.04	39	139.03	38

11. PAVEMENT DEFORMATION TESTING

Historical transverse pavement profile test results taken in the right travel lane of northbound I-65 in the vicinity of the crash between 2016 and 2020 were provided by ALDOT. At the request of NTSB investigators, additional transverse pavement profile testing was conducted in both the left and right travel lanes of northbound I-65 in the vicinity of the crash on June 29, 2021.[26] The pavement deformation (rutting) parameters were derived from the test data in accordance with the standard practice established by AASHTO standard R 87-18.[27] The pavement deformation, or rutting, measurements for the historical tests conducted between 2016 and 2020 in the right travel lane are summarized in **Table 5**. The rutting measurements for the additional post-crash tests conducted in both travel lanes are summarized in **Table 6**.

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[26] See *Highway Attachment – Transverse Pavement Profile Test Data for I-65 in Vicinity of Crash Location*.
[27] Formerly AASHTO Provisional Standard PP 69, AASHTO standard R 87-18 "Standard Practice for Determining Pavement Deformation Parameters and Cross Slope from Collected Transverse Profiles" was first published as a full standard in 2018.

Table 5: Historical Pavement Rutting Data for Northbound I-65 in Vicinity of Crash Location[1]

Location (milepost)	2016		2017		2018		2019		2020	
	LWP[2] (inches)	RWP[3] (inches)	LWP (inches)	RWP (inches)	LWP (inches)	RWP (inches)	LWP (inches)	RWP (inches)	LWP (inches)	RWP (inches)
137.50	0.13	0.17	0.16	0.19	0.12	0.15	0.17	0.16	0.16	0.15
137.55	0.13	0.17	0.13	0.18	0.10	0.17	0.14	0.17	0.16	0.16
137.60	0.14	0.14	0.14	0.15	0.14	0.11	0.19	0.12	0.15	0.11
137.65	0.14	0.12	0.11	0.12	0.08	0.08	0.13	0.09	0.17	0.08
137.70	0.16	0.11	0.14	0.09	0.11	0.08	0.19	0.10	0.21	0.08
137.75	0.11	0.14	0.11	0.10	0.08	0.07	0.14	0.11	0.15	0.09
137.80	0.19	0.22	0.17	0.19	0.15	0.19	0.18	0.20	0.21	0.18
137.85	0.16	0.19	0.14	0.16	0.16	0.15	0.19	0.17	0.21	0.14
137.90	0.16	0.15	0.21	0.15	0.16	0.09	0.17	0.13	0.21	0.11
137.95	0.16	0.18	0.18	0.20	0.14	0.17	0.17	0.18	0.21	0.16
138.00	0.15	0.22	0.16	0.26	0.11	0.24	0.17	0.26	0.20	0.23
138.05	0.10	0.18	0.13	0.18	0.06	0.15	0.15	0.17	0.14	0.16
138.10	0.16	0.21	0.19	0.23	0.17	0.19	0.21	0.20	0.22	0.16
138.15	0.19	0.26	0.25	0.28	0.20	0.26	0.26	0.29	0.26	0.20
138.20	0.21	0.25	0.21	0.35	0.18	0.32	0.21	0.31	0.21	0.28
138.25					BRIDGE	DECK				
138.30	0.15	0.22	0.15	0.22	0.11	0.18	0.18	0.23	0.22	0.20
138.35	0.16	0.16	0.14	0.22	0.09	0.20	0.20	0.23	0.21	0.20
138.40	0.13	0.22	0.15	0.20	0.11	0.17	0.22	0.21	0.21	0.18
138.45	0.13	0.20	0.17	0.19	0.13	0.17	0.20	0.20	0.22	0.18
138.50	0.11	0.21	0.17	0.19	0.17	0.19	0.22	0.22	0.23	0.19
138.55	0.13	0.16	0.15	0.17	0.14	0.15	0.19	0.16	0.19	0.14
138.60	0.12	0.16	0.21	0.17	0.11	0.14	0.20	0.15	0.21	0.14
138.65	0.11	0.18	0.13	0.17	0.11	0.13	0.10	0.14	0.16	0.15
138.70	0.12	0.14	0.11	0.16	0.10	0.11	0.14	0.14	0.17	0.13
138.75	0.12	0.15	0.13	0.13	0.09	0.11	0.18	0.13	0.16	0.12
138.80	0.15	0.15	0.15	0.12	0.18	0.12	0.23	0.11	0.22	0.12
138.85	0.14	0.20	0.15	0.20	0.15	0.18	0.21	0.23	0.20	0.18
138.90	0.10	0.21	0.15	0.21	0.13	0.18	0.14	0.20	0.18	0.18
138.95	0.16	0.17	0.16	0.20	0.15	0.14	0.20	0.17	0.20	0.13
139.00	0.14	0.13	0.18	0.14	0.14	0.13	0.23	0.13	0.19	0.13

[1] All rutting measurements in this table were taken in the right traffic lane

[2] LWP = Left Wheel Path

[3] RWP = Right Wheel Path

Table 6: Post-Crash Pavement Rutting Data for Both Travel Lanes of Northbound I-65 in Vicinity of Crash Location

Location (milepost)	Left Lane		Right Lane	
	LWP[1] (inches)	RWP[2] (inches)	LWP (inches)	RWP (inches)
137.50	0.17	0.19	0.18	0.17
137.55	0.16	0.23	0.16	0.18
137.60	0.15	0.19	0.16	0.13
137.65	0.18	0.16	0.19	0.12
137.70	0.10	0.19	0.18	0.07
137.75	0.12	0.20	0.19	0.15
137.80	0.12	0.18	0.21	0.21
137.85	0.11	0.20	0.20	0.17
137.90	0.14	0.22	0.23	0.16
137.95	0.14	0.19	0.21	0.19
138.00	0.13	0.24	0.19	0.27
138.05	0.13	0.21	0.14	0.17
138.10	0.17	0.25	0.24	0.22
138.15	0.13	0.20	0.27	0.30
138.20	0.14	0.21	0.20	0.32
138.25		BRIDGE	DECK	
138.30	0.16	0.21	0.20	0.23
138.35	0.19	0.24	0.21	0.23
138.40	0.14	0.25	0.20	0.20
138.45	0.14	0.27	0.21	0.21
138.50	0.16	0.27	0.23	0.22
138.55	0.14	0.24	0.20	0.16
138.60	0.15	0.26	0.20	0.18
138.65	0.15	0.21	0.17	0.18
138.70	0.13	0.20	0.16	0.13
138.75	0.16	0.23	0.18	0.14
138.80	0.20	0.20	0.24	0.16
138.85	0.18	0.21	0.25	0.23
138.90	0.20	0.21	0.23	0.23
138.95	0.19	0.22	0.21	0.19
139.00	0.17	0.20	0.22	0.14

[1] LWP = Left Wheel Path

[2] RWP = Right Wheel Path

12. AVERAGE DAILY TRAFFIC VOLUMES

The most recent available annual average daily traffic (AADT) volumes for I-65 in the vicinity of the collision was provided by ALDOT.[28] Data was provided for five full years between 2016 and 2020. The total AADT volumes for each of these years is summarized in **Table 7**. ALDOT does not have detailed vehicle classification data for I-65, therefore the data was limited to commercial vehicle data which the Department uses for Highway Performance Monitoring System submittals. Passenger vehicles (FHWA classes 1-3) make up approximately 76.1% of the total traffic volume, while single unit commercial vehicles (FHWA classes 4-7) and combination unit commercial vehicles (FHWA classes 8-13) make up approximately 7.0% and 16.9% of the total traffic volume respectively.[29]

Table 7: Average Daily Traffic Volumes on I-65 near Crash Location

Year	Annual Average Daily Traffic	Single Unit Commercial Vehicles	Combination Unit Commercial Vehicles
2016	35,130	2,489	5,972
2017	35,220	2,466	5,988
2018	34,778	2,435	5,913
2019	33,902	2,303	5,594
2020	28,300	1,981	4,811

13. TRAFFIC AND FATAL CRASH SUMMARY

Traffic crash data was obtained for I-65 between mile marker 137 and mile marker 139 for the 5-year period between 2016 and 2020.[30] Of the 100 collisions that occurred during this timeframe, 75 (75%) occurred when the road surface was wet. Commercial Motor Vehicles (CMVs) were involved in 14 of the 100 collisions, and of those 14 CMV involved collisions, 9 resulted in no injuries, 1 resulted in a possible injury, and 4 resulted in serious injuries. There was one fatal collision during the 5-year period involving a single pickup truck that entered the median, traveled down the embankment between the twin bridge structures, and came to rest in the creek. Of the 75 wet roadway crashes, 19 (25%) were classified as rear-end crashes, and 46 (61%) were single vehicle crashes. Of the 19 crashes classified as rear-end collisions, as categorized by the reporting law enforcement officers, 4 were reported as 'driving too fast for conditions', 11 were reported as 'followed too close', and 1 was reported as 'misjudge stopping distance'. The crashes for this segment of I-65 between milepost 137 and milepost 139 during the 5-year period that occurred during all weather and roadway surface conditions are summarized in **Table 8**. Crashes

[28] See *Highway Attachment – Traffic Volume and Classification Data for I-65 in Vicinity of Crash Location*.
[29] FHWA vehicle classification classes 1-3 include passenger cars, light trucks, and motorcycles. FHWA vehicle classification classes 4-7 include busses, 2 axle, 6 tire, single unit trucks; 3 axle, single unit trucks; and 4 or more axle, single unit trucks. FHWA vehicle classification classes 8-13 include 4 or less axle, single trailer trucks; 5 axle, single trailer trucks; 6 or more axle, single trailer trucks; 5 or less axle, multi trailer trucks; 6 axle, multi trailer trucks; and 7 or more axle, multi trailer trucks.
[30] See *Highway Attachment – Crash History for I-65 in Vicinity of Crash Location*.

that occurred in the same area and during the same time period during only wet roadway surface conditions are summarized in **Table 9**.

Table 8: Summary of Crashes in All Weather Conditions on I-65 near Crash Location

Year	Fatal	Incapacitating Injury	Non-Incapacitating Injury	Possible Injury	No Injury	Total
2016	-	1	1	1	7	10
2017	1	2	1	1	15	20
2018	-	5	-	-	22	27
2019	-	-	1	2	17	20
2020	-	1	1	2	19	23
Total	1	9	4	6	80	100

Table 9: Summary of Wet Roadway Surface Crashes on I-65 near Crash Location

Year	Fatal	Incapacitating Injury	Non-Incapacitating Injury	Possible Injury	No Injury	Total
2016	-	1	1	1	3	6
2017	1	1	1	-	12	15
2018	-	4	-	-	17	21
2019	-	-	-	2	11	13
2020	-	1	1	2	16	20
Total	1	7	3	5	59	75

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D. DOCKET MATERIAL

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

LIST OF ATTACHMENTS

Highway Attachment - Selected Pages from Roadway Design Plans for I-65 in the Vicinity of the Crash Location and Bridge Design Plans for the Twin Bridge Structures Over Pigeon Creek

Highway Attachment - ALDOT Roadway Cross-Section Diagrams for Northbound I-65 in the Vicinity of the Collision

Highway Attachment - Pavement Macrotexture Depth Test Results for I-65 N/B in Vicinity of Crash Location

Highway Attachment - Northbound Approach Video – I-65, Milepost 130.3 to Milepost 138.5

Highway Attachment - Roadway Surface Friction Test Data for I-65 in Vicinity of Crash Location

Highway Attachment - Transverse Pavement Profile Test Data for I-65 in Vicinity of Crash Location

Highway Attachment - Traffic Volume and Classification Data for I-65 in Vicinity of Crash Location

Highway Attachment - Crash History for I-65 in Vicinity of Crash Location

LIST OF PHOTOGRAPHS

Highway Photograph 1 - Orthomosaic Aerial Image of Crash Location from sUAS

Highway Photograph 2 - I-65 Northbound Travel Lanes Near Crash Location – Facing Northeast

Highway Photograph 3 - Channelizing Chevron Pavement Markings Along Northbound I-65 Approach to Bridge Structure – Facing Northeast

Highway Photograph 4 - Damaged Sections of Northbound Left Bridge Rail Near North End of Bridge Structure – Facing Southwest

Highway Photograph 5 - Damaged Portion of Northbound Left Bridge Rail Showing Exposed Reinforcing Steel – Facing North Northwest

Highway Photograph 6 - Repaired Sections of Northbound Left Bridge Rail Near North End of Bridge Structure – Facing Southwest

Highway Photograph 7 - Four-Strand High-Tension Cable Median Barrier Along the Northbound Travel Lanes of I-65, South of the Pigeon Creek Bridge Structure – Facing West Southwest

Highway Photograph 8 - Scupper Drains through Bridge Deck Along Northbound I-65 Bridge over Pigeon Creek – Facing Northeast

END OF REPORT

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