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

TECHNICAL RECONSTRUCTION GROUP CHAIRMAN'S FACTUAL REPORT

A. CRASH INFORMATION & CRASH SUMMARY

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

B. TECHNICAL RECONSTRUCTION GROUP

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C. DETAILS OF THE TECHNICAL RECONSTRUCTION INVESTIGATION

The Technical Reconstruction Group was convened for this investigation to assist with on-scene documentation of the crash location and involved vehicles, examine certain roadway features, and to facilitate an analysis of collision events and causation factors. In support of these tasks the group relied upon information, data and documentation provided by the North Las Vegas Police Department and the City of North Las Vegas Department of Public Works, Traffic Engineering and Support office. Factual reports prepared by other NTSB investigative groups should be consulted for information related to other aspects of the investigation, including information referenced within this report.

1. Introduction, Location and Highway Description

The collision events occurred at the intersection of North Commerce Street and Cheyenne Avenue (NV State Route 574), in the city of North Las Vegas, NV. The collision initiated when a Dodge Challenger passenger vehicle, traveling northbound on N. Commerce Street entered the intersection on a red traffic signal and collided with the right side of a Toyota Sienna minivan that was traveling eastbound on Cheyenne Avenue and had entered the intersection on a green traffic signal. Four additional vehicles traveling on Cheyenne Ave – a Ford Fusion passenger vehicle, a Chevrolet Malibu passenger vehicle, a Hyundai Tucson sport utility vehicle, and a Mercedes Benz

GLE-350 sport utility vehicle – became involved in subsequent impacts. The Ford had been traveling eastbound while the Chevrolet and two SUVs were traveling westbound. The vehicles on Cheyenne Ave all faced green traffic signals.

The collision occurred 01/29/2022 at about 1512 hours PST, as reported by police investigators, under daylight and dry weather conditions.

1.1. Crash Location

The collision occurred within the city of North Las Vegas, Clark County, NV, within the intersection of Cheyenne Avenue and N. Commerce Street. **Figure 1** depicts an area map of North Las Vegas with the location of the crash highlighted by the red box.

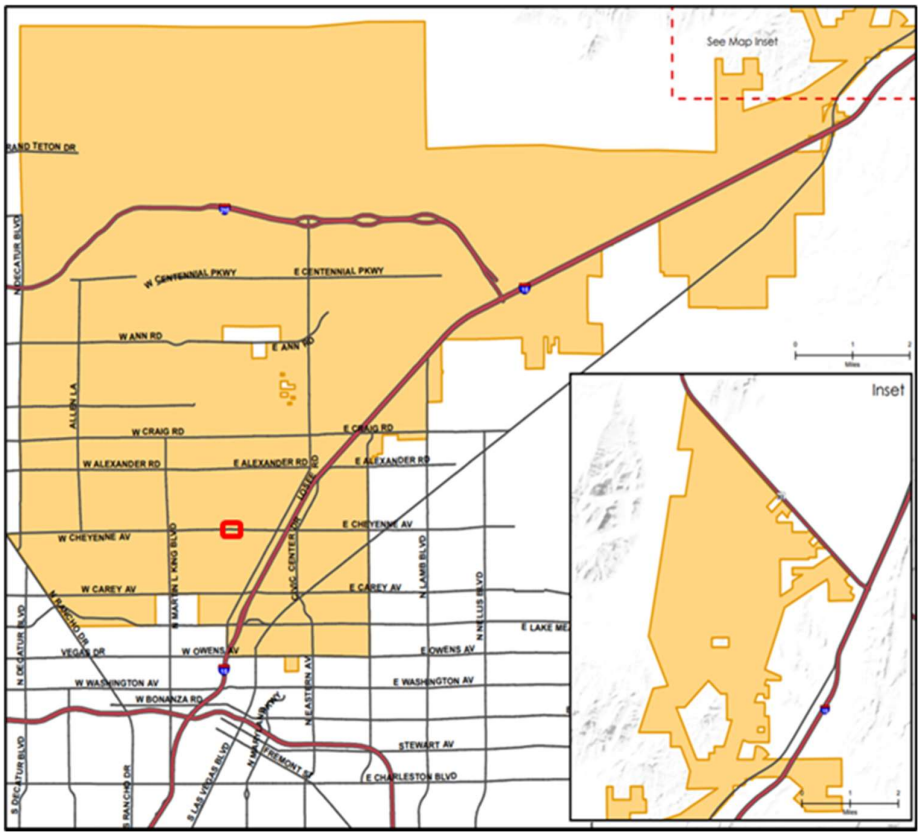

Figure 1: Area map depicting the boundary for the city of North Las Vegas. The red box highlights the area of the crash.

The area is substantially urban with a mix of commercial and industrial facilities. The parcel of land at the northeast corner of the intersection is undeveloped. City of North Las Vegas zoning maps indicate the area along the entire east side and west side (north of Brooks Avenue) of N. Commerce Street is zoned for heavy industry. Those areas feature numerous industries and commercial vehicle traffic is prevalent. The west side of N. Commerce Street south of Brooks Ave

is zoned for residential use. The on-scene investigation examined N. Commerce Street southward of the Cheyenne Ave intersection over a distance of about 5,400 feet (~1.02 miles) to the next major, signal controlled, intersection at W. Carey Avenue. **Figure 2** depicts a Google Earth image of the area including the segment of N. Commerce Street between Carey Ave and Cheyenne Ave.

Figure 2: Modified Google Earth image depicting land use zoning in the area of the crash.

1.2. Highway Data

1.2.1. Classification

Cheyenne Avenue (State Route 574) is an east–west highway approximately 10.7 miles in length that is functionally classified as a minor arterial.[1] Commerce Street is a north-south roadway that covers about 6.4 miles and is functionally classified as a minor collector.[2] The speed limits for Cheyenne Ave and N. Commerce Street are posted at 50 mph and 35 mph, respectively. In the northbound direction of N. Commerce Street two speed limit signs were in place between the intersections of Carey Ave and Cheyenne Ave. The first sign was erected just north of Carey Avenue about 5,270 feet before the Cheyenne Avenue intersection, and the second just south of W. Brooks Avenue about 2,948 feet before the intersection.

The City of North Las Vegas Department of Public Works (NLVDPW) reported no traffic volume or speed study data for N. Commerce Street (based on its classification).

1.2.2. Intersection and Traffic Control

The two roadways intersect at a right angle with movement through the intersection controlled by automatic traffic signals. N. Commerce Street exhibits both mast arm and pole-mounted back-plated signal heads with 12-inch diameter, LED indicators that control left turning and through traffic.[3] The signal heads relevant for each movement were erected on the far side of the intersection. Regarding northbound traffic along N. Commerce Street, there are four signal heads – two each for through and left turning traffic.

[1] FHWA Functional Classification Guidelines provide that the minor arterial street system should interconnect with and augment the urban principal arterial system and provide service to trips of moderate length at a somewhat lower level of travel mobility than principal arterials. This system also distributes travel to geographic areas smaller than those identified with the higher system.

[2] FHWA Functional Classification Guidelines provide that the collector street system provides both land access service and traffic circulation within residential neighborhoods, commercial and industrial areas. It differs from the arterial system in that facilities on the collector system may penetrate residential neighborhoods, distributing trips from the arterials through the area to the ultimate destination. Conversely, the collector street also collects traffic from local streets in residential neighborhoods and channels it into the arterial system. In the central business district, and in other areas of like development and traffic density, the collector system may include the street grid which forms a logical entity for traffic circulation.

[3] LED – light emitting diode light source.

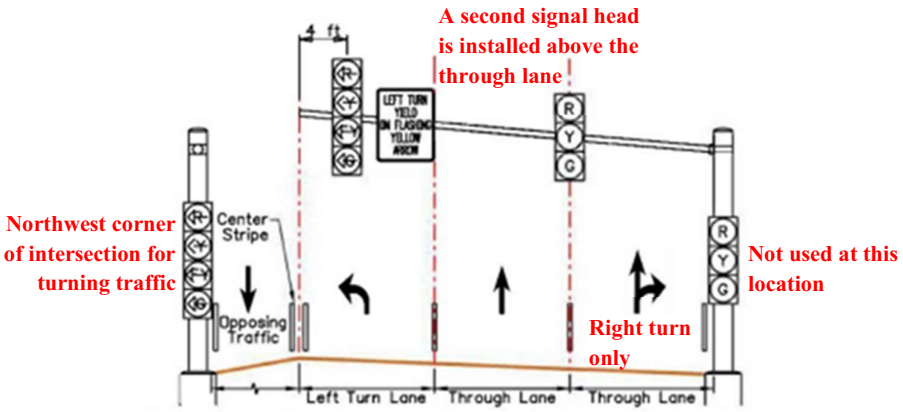

Figure 3: Illustration of similar northbound N. Commerce Street signal head layout at intersection, with modifications noted. (See Nevada DOT *Signal, Lighting, and ITS Design Guide, Signal Head Display, 2019*.

NLVDPW provided signal timing (seconds) for the various signal phases governing the intersection traffic signals.[4] **Table 1** depicts a table summarizing the timing relevant to each movement direction or phase (note – information on phase sequencing was not provided but is inconsequential for this investigation based on other data).

Table 1: Signal Phase Timing for Cheyenne Ave and N. Commerce Street Intersection

Interval	Direction / Phase							
	North left turn	South	West left turn	East	South left turn	North	East left turn	West
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Initial	3.0	5.0	3.0	5.0	3.0	5.0	3.0	5.0
Passage[5]	2.0	2.6	2.0	3.7	2.0	2.6	2.0	3.7
Yellow	3.0	3.6	3.0	4.7	3.0	3.6	3.0	4.7
Red Clearance	2.4	2.7	2.0	1.4	2.4	2.8	2.0	1.5
Max 1	20.0	25.0	20.0	45.0	20.0	25.0	20.0	45.0
Max 2	10.0	15.0	10.0	25.0	10.0	15.0	10.0	25.0

[4] Phases are directions of movement grouped together to create that efficient and safe movement of vehicles, pedestrians, and other traffic. A vehicular phase is defined as a phase that is allocated to one or more vehicular traffic movements, as timed by the control unit.

[5] The passage time interval establishes the maximum time gap between vehicle detections that can occur without losing the green indication to a call waiting.

Left turns from N. Commerce Street provide a protected/permissive movement with flashing yellow arrows activated during permissive turning movements that run concurrent with through traffic movement. Video detection is used to identify the presence and passage of traffic at the intersection.

The eastbound direction of Cheyenne Ave exhibited three mast arm supported signal heads and one pole mounted signal head adjacent to the right curb for through traffic. Dedicated left turn signals included one mast arm supported signal and pole mounted signal at the left corner of the intersection. Westbound Cheyenne Ave exhibited a similar signal arrangement although there were only two mast arm supported signal heads for through traffic.

1.2.3. Right-of-Way and Alignment

NLVDPW provided investigators with a copy of certain survey plans for N. Commerce Street between the intersections of Cheyenne Ave and Duchess Ave, a distance of approximately 4,050 to the south.[6] Generally, N. Commerce Street exhibited a right-of-way width of 80 feet at the intersection with Cheyenne Ave but began tapering to 60 feet just over 300 feet south of the intersection.[7] Cheyenne Ave exhibited a right-of-way of 100 feet.

The plans depicted a north-south orientation for N. Commerce Street with no changes in horizontal alignment. Vertical alignment dimensions depict changes generally less than two percent, although an area of vertical change between 2.3 and 2.7 percent was identified between 2,400 and 2,600 feet south of Cheyenne Ave.

Beginning about 575 feet south of the Cheyenne Ave intersection, N. Commerce Street exhibits a descending vertical grade in the northbound direction that averages about 0.76%. The descending grade terminates about 56 feet before the intersection center. The crest of a 60-foot-long vertical curve is located 575 feet south of the intersection. Southward from the vertical curve, northbound N. Commerce Street exhibits an ascending grade. From Brooks Ave, about 1,360 feet south of Cheyenne, N. Commerce Street exhibits an average ascending grade of about 1.29%. South of Brooks Ave the ascending northbound grade averages about 1.11%. As a result, the change in vertical elevation between the intersections with Duchess Ave and Cheyenne Ave is about 15.8 feet.

The intersections with Brooks and Cheyenne Avenues were essentially level except for pavement cross slopes.

Cheyenne Avenue is oriented east/west. While the roadway exhibits an increase in vertical elevation in the westbound direction, the immediate approach to the intersection appears relatively level for several hundred feet.

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[6] Titled *Commerce Street Improvements West Cheyenne Avenue to Duchess Avenue, City of North Las Vegas*, July 2019. Information included certain right of way and centerline survey (including vertical alignment) data, limited typical section data, and pavement striping plan.

[7] Unless otherwise noted, all distance measurements derived from the highway documents and relative to an intersection use the intersection midpoint as a datum.

1.2.4. Typical Section and Pavement Delineation

N. Commerce Street exhibited an asphalt surface having a general cross slope of two percent or less. Concrete gutters and raised sidewalks are contiguous with the roadway pavement.[8] South of Cheyenne Ave, N. Commerce Street was generally delineated into two (through) travel lanes in each direction north of Brooks Ave. Survey plans indicate nominal lane widths of 11 feet with a few locations increasing to 11.9 feet. At the Cheyenne Ave intersection, the N. Commerce Street right-of-way widens to include a 10-foot-wide left turn lane. Pavement markings delineating the transition for the left turn lane begin about 370 feet south of the intersection. Of the two northbound travel lanes, the left lane serves as a through lane at the intersection to continue north while the right lane is designated as right-turn-only beginning about 557 feet south of Cheyenne Ave. In the southbound direction, beginning about 198 feet before Brooks Ave., the far right lane is designated as right-turn-only.

Southward from Brooks Ave., N. Commerce Street exhibits a single lane of travel in each direction, with varying lane widths as indicated by pavement marking. While highway plans note two lane widths for northbound N. Commerce Street on the south side of the Brooks Ave intersection, the physical delineation of two lanes was not indicated on the plans and no roadway markings delineated more than a single lane. Approximately 50 feet south of Brooks Ave the lane widths narrow as markings created a center two-way left turn lane. At this point centerline pavement markings transition to a 12-foot-wide center two-way left turn lane that continues south about 1,335 feet. Where the two-way left turn exhibits its full width, the travel lane widths range from 13- to just over 17- feet. South of the two-way left turn lane, N. Commerce Street is delineated into two travel lanes by a double-yellow centerline pavement markers. The approximate lane widths are 21 feet.

Raised pavement markers (RPMs) are used for lane delineation[9]. RPM colors included yellow for centerline features and white for same-direction lane delineation. Painted pavement markings included stop lines, crosswalks and turn lane direction arrows.[10] Painted pavement markings appeared somewhat faded but were otherwise visible. **Figure 4** is a photograph depicting the northbound approach to the Cheyenne Ave intersection.

[8] Sidewalk areas were nominally five feet in width and were contiguous with full length of Commerce Street except for certain areas on the east side just north and south of Brooks Ave.
[9] Standards note that RPMs are arranged in 10-foot-long segments with 30-foot gaps between segments.
[10] While the intersection of Cheyenne Ave and N. Commerce Street is at a right angle, the addition of an eastbound Cheyenne Ave right turn lane creates an angled or skewed intersection threshold for N. Commerce Street. The northbound N. Commerce Street stop lines were similarly applies at an angle, approximately parallel with the threshold. As measured from scene documentation, the northbound stop line setbacks from the intersection were approximately 30 feet for the through and right turn lanes and 49 feet for the left turn lane, respectively.

Figure 4: Photograph depicting immediate northbound N. Commerce Street approach to the intersection with Cheyenne Ave.

Survey plans for Cheyenne Ave were not acquired. At the intersection with N. Commerce Street, Cheyenne Ave exhibited three lanes of travel in each direction as well as dedicated left turn lanes. Eastbound Cheyenne Ave also featured a dedicated right turn lane for Commerce Street. The left turn lanes in both the east- and westbound directions were separated from opposing traffic by 3.2- to 3.6-foot-wide raised concrete medians. As with N. Commerce Street, RPMs were used for lane delineation on Cheyenne Ave. Stop lines, crosswalks and turn lane direction arrows were painted on the pavement surface.

2. Brooks Ave

Excluding business driveways, the nearest intersection south of Cheyenne Ave (through which the Dodge traveled) is Brooks Avenue at a distance of approximately 1,360 feet. Significant to Brooks Ave is that the four-direction approach is an all-way stop. In the northbound direction, the stop sign (MUTCD R1-1) is positioned near the right edge of the sidewalk approximately 6-7 feet south of the crosswalk and 28 feet south of the intersection threshold. In addition to the painted stop line, a painted crosswalk traverses N. Commerce Street on the south side of the intersection. A *Stop Ahead* advance warning sign (MUTCD W3-1) is positioned approximately 108 feet before the stop sign.

3. Sightline

As noted, northbound N. Commerce Street exhibited minor changes in vertical grade – initially ascending then descending beginning about 575 feet before the Cheyenne Ave intersection. The vertical grade presented no effective obstruction to driver line of sight as the traffic signal heads and mast arm could be discerned from a distance exceeding 3,500 feet when visually searched for. While the signal heads and mast arm could be detected at an extended distance, discerning the signal color (cycle) at an extended distance would likely be observer dependent.

Industrial facilities located at the southeast and southwest corners of the intersection exhibited a vertical stone wall that ran parallel with the east and west sides of Commerce Street and the south side of Cheyenne Ave. The walls were set back from the roadway about 18-26 feet and did not appear to impede intersection sight lines as specified in the Clark County, NV *Uniform Standard Drawings for Public Works Construction, Offsite Improvements*.

4. Crash History – N. Commerce Street and Cheyenne Ave Intersection

Crash history data was provided by the Nevada Department of Transportation via a web-based request application. Search parameters returned data for crashes coded as "at-intersection" and for distances up to 50 feet outside the intersection. Data, which included calendar years 2018 through 2020, were returned in Excel spreadsheet format. In total, the data report a total of 29 crashes involving 25 two-vehicle collisions, 3 three-vehicle collisions and 1 pedestrian collision (classified as a single vehicle hit and run). **Table 2** depicts certain reported crash elements for the calendar years examined.

Table 2: Cheyenne Ave and N. Commerce Street Vehicle Crash History Summary (2018-2020)

Element	Year			Totals
	2018	2019	2020	
Total Crashes	12	12	5	29
Property Damage Only	6	7	3	16
Injury Crash	6	5	2	13
Fatality Crash	0	0	0	0
At-Intersection	9	6	3	18
Angle Crash	5	6	0	14
Rear-end	5	5	2	13
Non-Collision	1	0	0	1
Rear-to-Side	0	1	0	1

Regarding environmental conditions, ten crashes were reported during daylight hours, 13 during hours of darkness, one at dusk and five were unspecified. Only one crash reported adverse weather – snow – at the time of a crash.

Of the 29 total crashes, 11 crashes were coded in some context as "fail to yield right way" or "disregarding traffic sign, signal or marking." Those classifications were specifically termed as "*failed to yield right of way: disregarded traffic signs, signals, road markings;" "failed to yield*

right of way;" and *"disregarded traffic signs, signals, road markings."* Of these 11 crashes, six resulted in injuries and five were property damage only. Two crashes occurred outside the intersection, both of which were rear-end crashes. The remaining 9 crashes were coded as "angle" crashes. Of these 9 crashes two involved vehicles traveling northbound on N. Commerce Street. In one crash the second vehicle was traveling southbound on N. Commerce Street. In the other crash, the second vehicle was traveling westbound on Cheyenne Ave. This second crash was also coded as driver "had been drinking."

5. Highway Evidence Documentation

Tire friction marks, road surface gouging and marking paint applied by NLVPD investigators were observed by NTSB investigators at the scene. The roadway evidence was within the Cheyenne Ave intersection and appeared to originate near the intersection of the northbound N. Commerce Street left turn and through lane, and the center travel lane of eastbound Cheyenne Avenue. The evidence of impact was approximately 23 feet into past the northbound N. Commerce Street intersection threshold and 53 feet past the through traffic stop line. As measured from the eastbound Cheyenne Ave intersection threshold, evidence of impact was about 30 feet into the intersection. The evidence extended northeastward and departed the highway at the northeast corner of the intersection. A chain-link fence bordering undeveloped property at the northeast corner was damaged and evidence of vehicle positions of rest was observed on the property ranging from about 19.6-45.6 feet off the roadway travel surface. The road surface evidence was consistent with an impact and post-impact vehicle movement. No pre-collision roadway evidence, such as tire friction marks, was observed. **Figure 5** is a photographic image taken by police investigators depicting roadway collision evidence that progressed northeastward from the apparent area of impact.

Figure 5: Modified photographic image taken by police investigators depicting roadway evidence from the vantage of an aerial ladder fire truck. One of the involved vehicles, the Chevrolet Malibu, is depicted at its position of rest.

The post-collision positions of rest for the vehicles involved in the collision were identified through photographs and a terrestrial three-dimensional scan project provided by police investigators. **Figure 6** depicts a screen capture of the 3D point cloud of the intersection as viewed from the southwest corner at an oblique angle. **Figure 7** represents a two-dimensional diagram of the intersection depicting the final positions of rest for the involved vehicles.

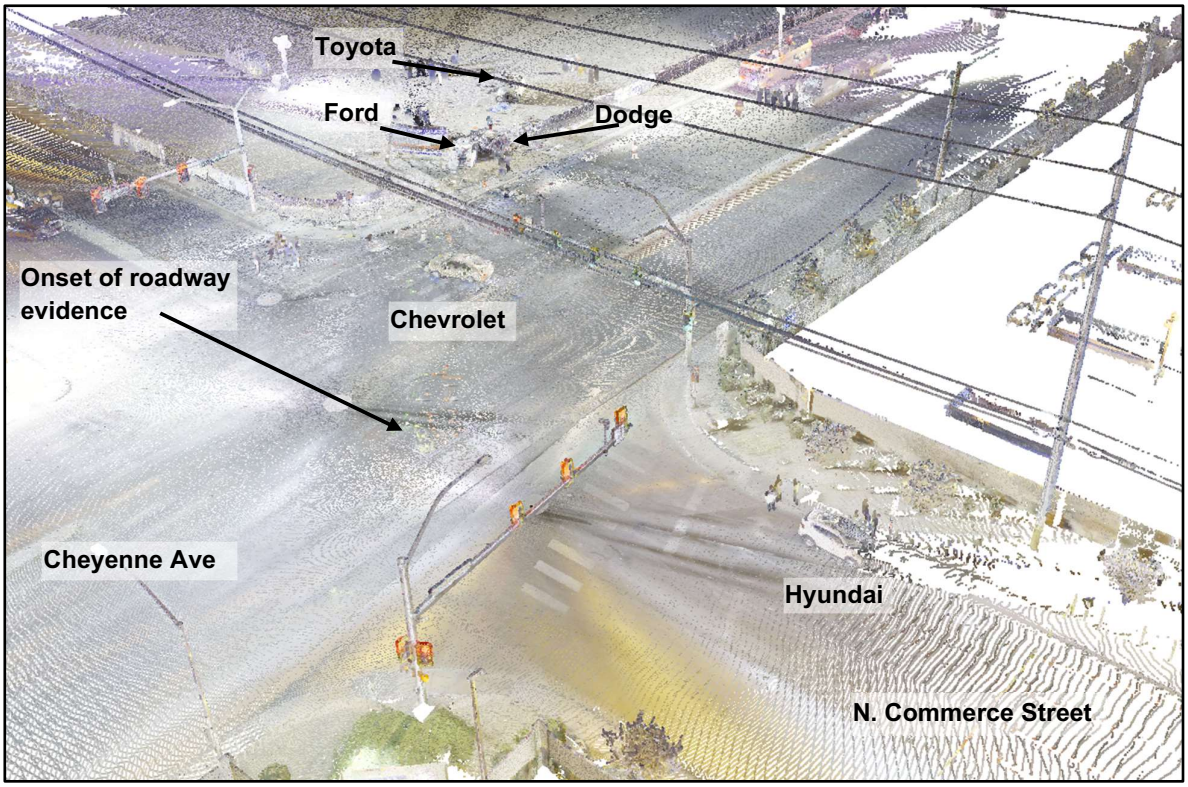

Figure 6: Unmodified screen capture image (to be replaced with 2D diagram) of intersection post-crash as viewed at an oblique angle from the southwest corner.

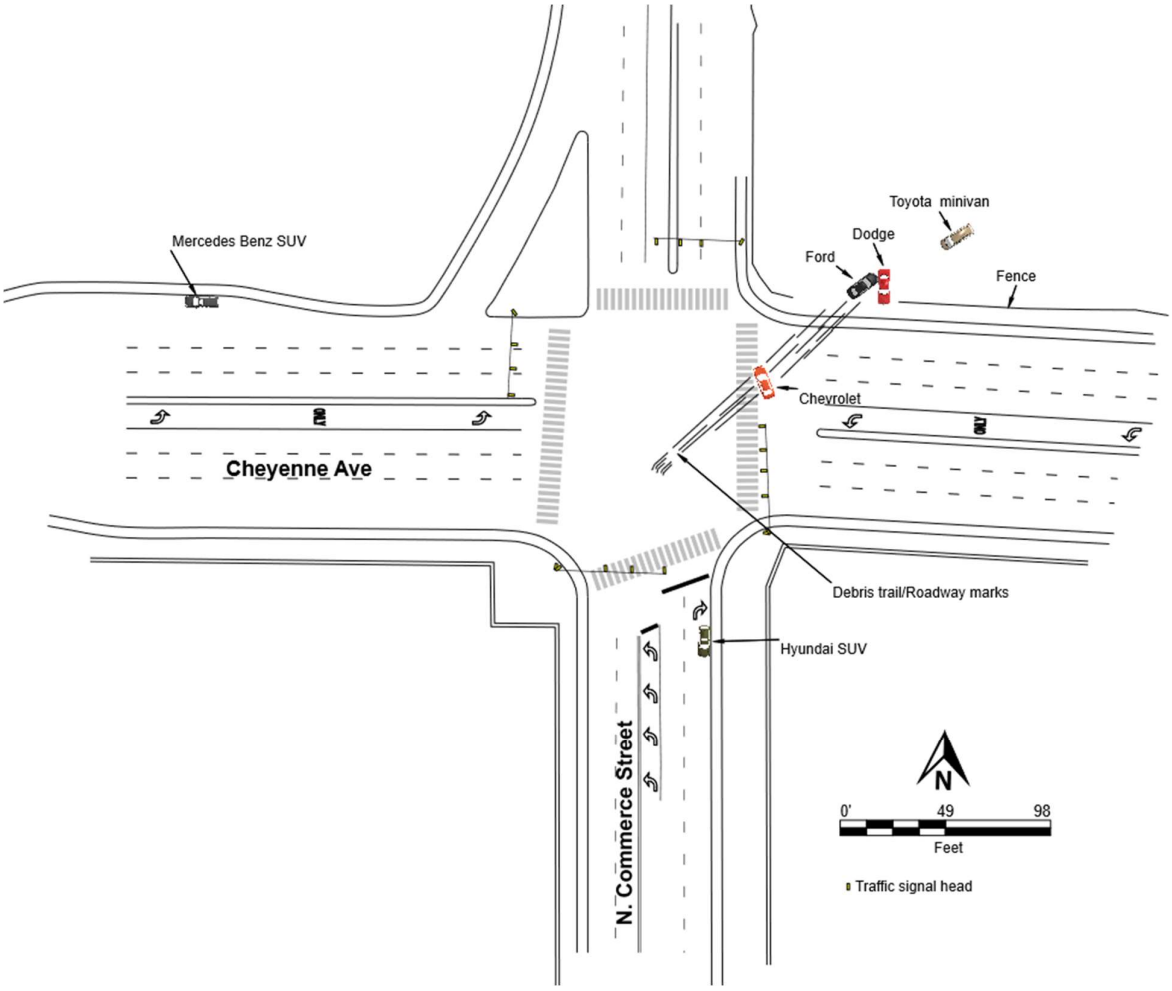

Figure 7: Diagram depicting vehicle positions of final rest following the collision events. Lane widths were extracted from highway plans as the delineation RPMs were not visible in the 3D scan documentation. Lane markings as drawn do not accurately depict the delineation RPMs.

6. Vehicle Data

A total of six motor vehicles were identified as having been involved in the crash events. Those vehicles included:

- 2018 Dodge Challenger, two-door sedan
- 2013 Toyota Sienna, minivan
- 2016 Ford Fusion, four-door sedan
- 2016 Hyundai Tucson, sport utility vehicle
- 2005 Chevrolet Malibu, four-door sedan
- 2021 Mercedes Benz GLE-350, sport utility vehicle

Except for the Mercedes – which was released at the scene - the vehicles were impounded by police investigators following the crash and subsequently made available to NTSB investigators for examination.

6.1. 2018 Dodge Challenger

The Dodge, which had been identified by police investigators as having been traveling northbound on N. Commerce Street, exhibited evidence of contact damage to the front, rear and driver (left) side. The most substantial impact was at the front, which induced deformation to the vehicle body throughout the entire occupant compartment. At the passenger side of the front bumper cover, near the cutout for the driving/fog light, an impression in the painted surface consistent with the design of a Toyota wheel center cap was observed. Evidence of additional contact was observed at, and just aft of the driver's door with these areas also exhibiting areas of white-colored material transfer. Contact damage at the rear of the vehicle exhibited a passenger to driver side displacement. Embedded in the rear bumper bar, remnants of bumper energy absorption material consistent with that found on the Chevrolet was observed at the passenger side edge. The rear bumper cover and lower fascia from the Dodge were entrapped beneath the Chevrolet.

Emergency responders had removed both doors. The occupant compartment supplemental restraint airbags were observed to have been deployed.

At its position of final rest, the Dodge was upright, facing southward, positioned about 138 ft northeastward of the apparent area of impact and just over 19 feet off the roadway pavement. **Figures 8** and **9** depict images of the 3D point cloud rendered from laser scanning of the Dodge.

Figure 8: Screen capture image depicting colorized 3D point cloud of Dodge as viewed from left side of vehicle.

Figure 9: Screen capture image depicting colorized 3D point cloud of Dodge as viewed from right side of vehicle.

6.2. 2013 Toyota Sienna

The Toyota exhibited substantial contact damage to the passenger side of the vehicle. Another area of contact damage was noted at the driver side rear. In addition to the areas of contact damage, the vehicle body, generally above the windowsill line, exhibited displacement toward the passenger side. Other exterior body surfaces such as the roof, hood and driver side exhibited scarring and paint displacement consistent with a rollover event. Upper body surfaces including the roof, hood and door frames exhibited scarring primarily oriented passenger front to driver rear, although the hood surface exhibited additional scarring that was oriented driver front to passenger rear.

Emergency responders had removed the front and rear driver side doors. Deployment of supplemental airbag restraints was observed.

At its position of final rest, the Toyota was upright, facing southwestward, positioned about 179 ft northeastward of the apparent area of impact and just over 45 feet off the roadway pavement. **Figures 10** and **11** depict images of the 3D point cloud rendered from laser scanning of the vehicle.

Figure 10: Screen capture image depicting colorized 3D point cloud of the Toyota as viewed from right side of vehicle.

Figure 11: Screen capture image depicting colorized 3D point cloud of the Toyota as viewed from right side of vehicle.

6.3. 2016 Ford Fusion

The Ford exhibited contact damage at the passenger side front that resulted in a lateral displacement of the hood and other front-end structures toward the driver side. The passenger side front wheel assembly was skewed but did not separate from the vehicle. Contact damage appeared to extend across about one-third of vehicle width at the front with some indication of downward vertical displacement. Contact damage was also observed at the rear of the vehicle, near the center, and at the upper driver side corner of the trunk lid. Red-colored material transfer was observed within the trunk lid area of damage. Deployment of supplemental airbag restraints was observed.

At its position of final rest, the Ford was upright, facing northeastward, positioned about 124 ft northeastward of the apparent area of impact and just over 19 feet off the roadway pavement. The Ford was positioned west of and appeared in contact with the Dodge. **Figure 12** depicts a photographic image of the vehicle's passenger side.

Figure 12: Photographic image of the Ford's passenger side.

6.4. 2016 Hyundai Tucson

The Hyundai SUV sustained contact damage, characteristic of a sideswipe impact, which extended rearward along the driver side from about the front axle to the rear of the vehicle. Damaged areas included the doors, upper door frames and roof edge, and rear quarter panel. Some evidence of white-colored material transfer was observed on the dark areas of the door window frames. The damage appeared sufficient to render the doors inoperable. Deployment of supplemental airbag restraints was observed.

Following the collision, the driver moved the vehicle to its position of final rest where it was stopped along the east curb of N. Commerce Street, south of the intersection. **Figure 13** depicts a photographic image of the vehicle's driver side.

Figure 13: Photographic image of the Hyundai's driver side.

6.5. 2005 Chevrolet Malibu

The Chevrolet exhibited contact damage at the passenger side front of the vehicle. The damage extended laterally across the front of the vehicle to about the centerline from the outboard edge, although additional front-end components were also displaced. Front-end components at the passenger side front including the fender were also displaced outward from the vehicle. The displaced fender was observed to be in contact with the front tire. The rear bumper cover and fascia from the Dodge was observed entrapped beneath the vehicle.

Black-colored material transfer was observed on the bumper cover at the driver side rear corner of the vehicle. A portion of the material transfer was arc shaped. Deployment of supplemental airbag restraints was observed.

At its position of final rest, the Chevrolet was facing mostly northward at the east side of the intersection. The vehicle was positioned atop and slightly west of the stop line while straddling the left and center through lanes of the westbound roadway. **Figure 14** depicts a photographic image of the vehicle's passenger side.

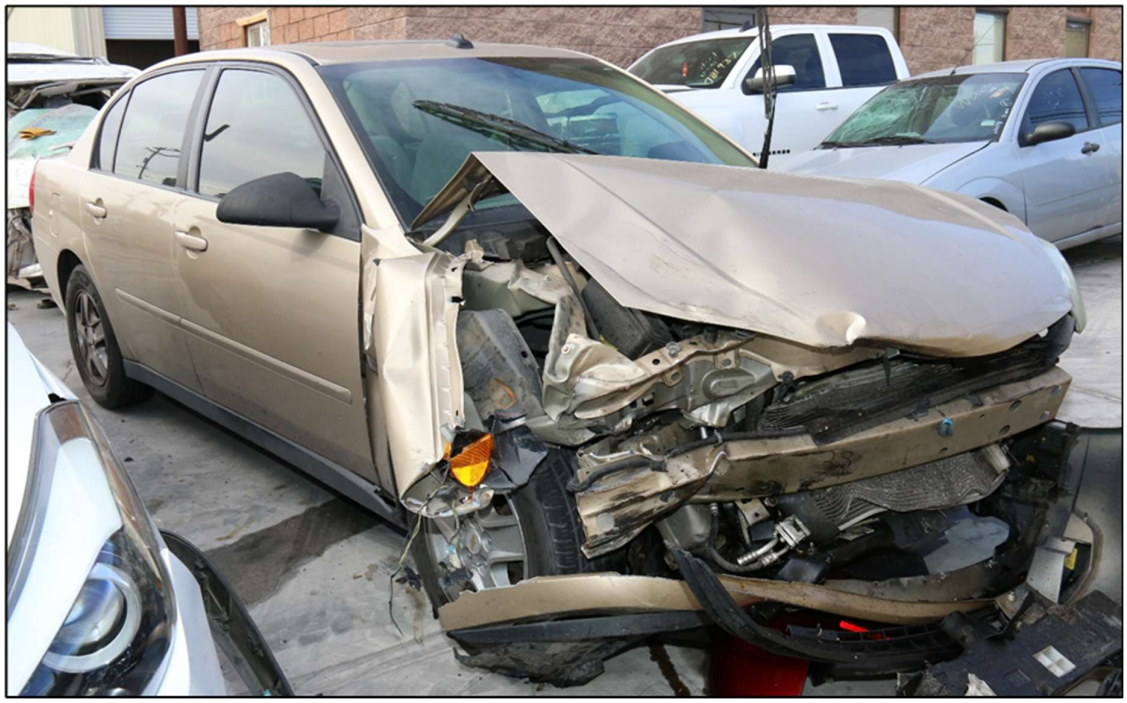

Figure 14: Photographic image of the Chevrolet depicting the passenger side front of the vehicle.

6.6. 2021 Mercedes Benz GLE-350

The Mercedes Benz SUV was not impounded by police investigators and was unavailable for examination. Photographs provided by NLVPD depicted the vehicle as having sustained damage along the left (driver) side. Material transfer that appeared consistent with biological substance splatter was observed on the driver side front fender and driver side of the hood. The driver side of the front windshield exhibited scrapes, minor debris deposits and other evidence consistent with an impact. Black-colored scuffing and material transfer was observed near the bottom of the driver's door below the handle. The driver side rear door exhibited material transfer and contact damage. The damage extended rearward to encompass the C-pillar and included the shattering of the small window aft of the C-pillar.

Scene photographs provided by police investigators indicate that following the crash events, the vehicle was brought to a controlled stop along the westbound roadway right curb west of the intersection. **Figure 15** depicts a photographic image of the vehicle's driver side.

Figure 15: Photographic image depicting the driver side of the Mercedes Benz. (Source NLVPD)

7. Electronic Crash Data

With limited exceptions, light duty vehicles (GVWR of 3,855 kg/8,500 pounds or less) manufactured on or after September 1, 2012, if equipped with an event data recorder must comply with rules promulgated under 49 Code of Federal Regulations Part 563. As defined by Part 563, an event data recorder (EDR) means 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). The regulations define data elements, sample rate, range, accuracy, and resolution. In most all cases, the light duty EDR function is contained within the vehicle supplemental restraint system (SRS) control module – typically the airbag control module (ACM). EDR records are initiated or triggered when the ACM interprets that an event threshold is met based on data received by sensors within or connected to the module. ACM EDR data can generally be read by commercially available equipment although not all vehicles can be accessed by the same equipment. For this crash, police investigators were able to image data from all the vehicles that had been impounded following the crash. The Mercedes was not examined.

In most instances crash data generally depicting the crash pulse and certain precrash data were available from a successful ACM download. Most ACM EDRs are capable of recording multiple events depending upon acceleration direction and magnitude. Events not reaching a threshold for being "locked" can be overwritten by subsequent events of greater magnitude. When data is "locked," subsequent events may not be recorded. As a result, data depicting multiple events may not include all events in the chain of events and may not completely describe the chronology of the multiple event crash.

With exception of the Hyundai SUV, the four remaining vehicles were imaged by police investigators using the Bosch Crash Data Retrieval (CDR) system. The Hyundai required the use of the GIT Hyundai EDR Tool kit. Only a brief summary of the imaged data is provided in this section - the individual image reports should be consulted for specifics.

7.1. 2018 Dodge Challenger

Two records were recovered with both being related to the crash. The data indicate that imaging (data download) of the EDR occurred one ignition cycle after the crash with both events having occurred on the same ignition cycle.[11] The reported interval between the two events was one second. The last or most recent event depicted data consistent with a rear impact. The data conveyed a maximum longitudinal change in velocity of 8.1 mph (forward direction). During this event, a maximum lateral change in velocity of -5.0 mph (directed toward driver side) was also recorded.

The first event was consistent with a frontal impact and reported a maximum longitudinal change in velocity of -64.6 mph. The maximum lateral change in velocity of 28.0 mph (directed toward the passenger side) was also reported during this event. The frontal airbags deployed during this event with the first and second stages deploying at 3- and 8- milliseconds after time zero, respectively.[12]

The only diagnostic trouble code (DTC) reported preceded the second event citing a squib short that indicated the airbags pyrotechnics had fired.

Five (5) seconds of precrash data (up to time zero) that reported multiple vehicle performance parameters was also retrieved. The data was reported at a rate of 10Hz and overlapped both events. While about one additional second of data appeared relative to the second event, not all parameters were reporting as a result of the initial impact. Consequently, this additional second of data provided little useful information. Recorded data indicated that at five seconds before time zero the vehicle speed was reported as 88 mph. At about time zero, the reported speed had reached 103 mph. During the entire five-second precrash period, the engine throttle reported a 100%.[13] Similarly, the reported value of the accelerator pedal remained constant at 100% until about ½ second before time zero where some reduction was reported.[14] At about time zero, the accelerator pedal position data reported 78%. Throughout the five-second period there was no indicated service brake application and steering input remained consistent. **Figure 16** is a graph depicting certain precrash data.

[11] Occupant Restraint Controller (ORC) is the term used by Dodge (Fiat Chrysler Automobiles (now Stellantis (2021)) to identify their airbag control module.
[12] "Time zero" is defined as "beginning of the crash event" and is the time at which the ACM algorithm is activated, a specific Delta-V is exceeded, or a non-reversible restraint device is deployed. Time zero may be defined differently for front, side, rear, and roll-over events. All the precrash, event, cumulative change in velocity data, deployment times etc., are relative to "time zero".
[13] Indicates the actual position of the Engine Throttle blade.
[14] Indicates the actual position of the accelerator pedal.

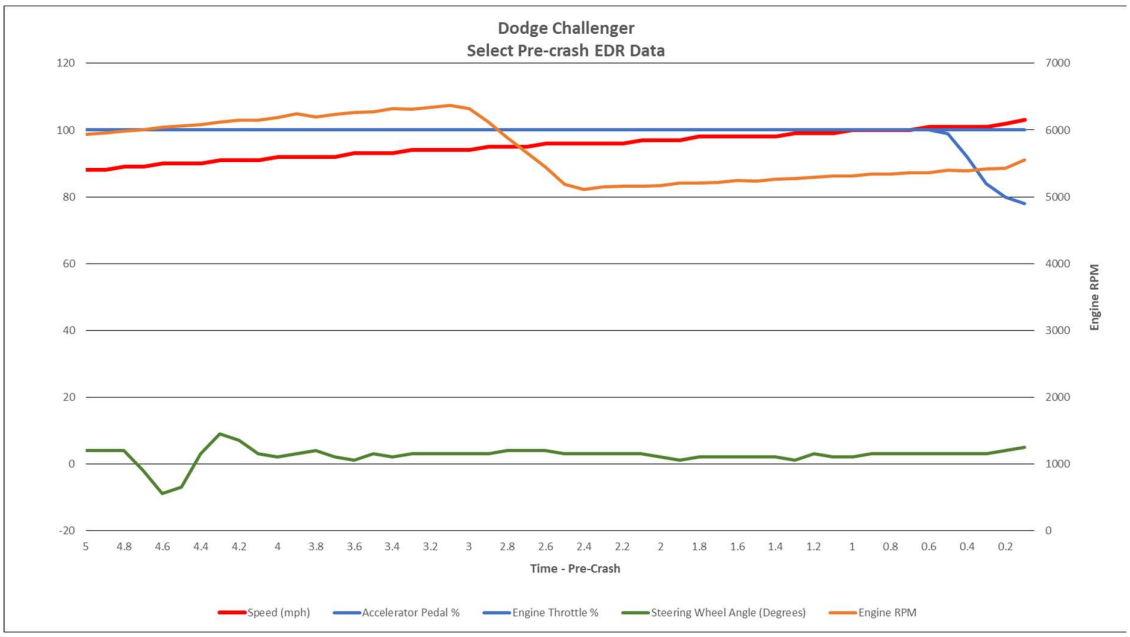

Figure 16: Graph depicting select precrash data from the Dodge Challenger EDR. Parameters are asynchronous.

Regarding occupant seat belt status, the record indicated a "belted" condition for the driver, although the right front seat occupant position was reported as "not buckled."

7.2. 2013 Toyota Sienna

The imaged airbag ECU (electronic control unit) acquired from the Toyota reported a total three trigger events and provided data for three records – two side and one front/rear event.[15] The first trigger event for this crash was reported as a right-side impact that triggered the deployment of the side curtain airbags at 2 milliseconds after module wake-up. The data reported a maximum lateral change in velocity for one side satellite sensor of -15.3 mph at 11 milliseconds.

The next recorded event was classified as a front/rear impact with a maximum change in velocity reported at -17.1 mph. The frontal airbags deployed as a result of this event with both driver and passenger side airbags stage 1 and stage 2 receiving a deployment command at 15- and 20- milliseconds, respectively. The time interval between this event and previous side impact was reported as 0.095 seconds (95 milliseconds).

Approximately one millisecond later the second right side impact trigger event was recorded. No deployment commands were issued for this event, although the supplemental restraints had already been deployed.

[15] The airbag ECU has two recording pages (memory maps) to store precrash data. Additionally, to store post-crash data, the airbag ECU has two recording pages for each accident type: two pages for frontal and rear crash, two pages for a side crash, and two pages for rollover event. Additionally, the recording trigger judgment threshold value differs depending on the collision type (i.e., frontal crash, rear crash, side crash, or rollover event).

Approximately five seconds of precrash data that recorded multiple vehicle performance parameters was also retrieved. The data was reported at a rate 2Hz and overlapped all recorded events. Vehicle speed was reported as 44.1 mph at the start of the recording. The accelerator pedal position remained fairly constant at 7-8% with the vehicle speed dropping slightly to 42.9 mph within the last second before time zero. No brake application was reported and engine RPMs remaining consistent during the five-second record.

Regarding occupant seat belt status, the record indicated a "belted" condition for both the driver and right front seat occupant.

7.3. 2016 Ford Fusion

Imaging of the Ford Restraint Control Module (RCM) EDR recorded one event. That event was consistent with a frontal impact where a maximum change in velocity of -28.6 mph (front to rear) was reported. A maximum lateral change in velocity of -22.4 mph (passenger to driver side) was likewise reported. The driver side frontal airbag received deployment commands for the first and second stages at 29.5- and 34.5- milliseconds after time zero, respectively. Similarly, the passenger side curtain airbag was also commanded to deploy at 29.5ms after time zero.

Approximately five seconds of precrash data that recorded multiple vehicle performance parameters was retrieved. The data was reported at a rate 2Hz. At the start of the recording, the vehicle speed was reported as 68.7 mph with the service brakes "on." About 3.5 seconds later or 1.5 seconds before the impact, the data indicate that the service brakes were released, and the vehicle speed had decreased to 62.4 mph.

7.4. 2016 Hyundai Tucson

Data from the Hyundai were imaged using the GIT Vehicle Communication Interface tool. There was no evidence of a frontal airbag deployment and although the report stated that there was no recorded deployment event, the driver side curtain airbag was observed to have deployed. The report did convey five seconds of pre-algorithm enable data that was presented in graphical form (no tabular data was provided).

At the start of the five-second series, the vehicle speed (reported in km/h) was approximately 6.2 mph and exhibited a steady increase to about 24.8 mph at time zero. During this time, the engine throttle exhibited a steady increase from about 15 to 30% with an accompanying accelerator pedal increase from about 35 to just under 50%. Of particular interest was the change in status for certain parameters about ½ second before time zero. At that time engine throttle and accelerator pedal percentages decrease suddenly. At that time sample the service brakes are also reported as "on."

7.5. 2005 Chevrolet Malibu

The Chevrolet Sensing and Diagnostic Module (SDM) recorded one event. That event was consistent with a frontal impact where a maximum change in velocity of -14.23 mph (front to rear) was reported. The driver side frontal airbag received deployment commands for the first and second stages at 14- and 16- milliseconds after time zero, respectively.

Approximately five seconds of precrash data that recorded multiple vehicle performance parameters were retrieved with the data reported at a rate of 1Hz. At the start of the recording, the vehicle speed was reported at 11 mph, which continued a steady increase to 27 mph at one second before time zero. During this time, the engine throttle exhibited a steady near constant rate of 24% initially with an increase to 30%. The accompanying accelerator pedal exhibited a similar data trend beginning at 42% and increasing to 50%. No data regarding service brake application was presented, however, at one second before time zero the steering wheel angle indicated an increase from 0° to -16° (indicating a counterclockwise movement).[16]

8. Surveillance Video

In early June 2022, NLVPD investigators provided NTSB investigators with surveillance video recordings that had been acquired from a local business. The video material originated with Republic Services, Inc., who operated facilities at both the southeast and southwest corners of the intersection. The positioning of the cameras was to provide surveillance of the business property but also captured portions of N. Commerce Street and the intersections at Cheyenne and Brooks Avenues. Two surveillance video files were provided, each supporting multiple cameras located on both the east and west sides of the N. Commerce Street roadway. A portion of the intersection with Cheyenne Ave was also visible through one camera from both an east- and west-side position. While no information regarding the surveillance system was provided, the video files exhibited the logo of "DW-Digital Watchdog, Inc.," a manufacturer and supplier of security and surveillance solutions. The video files were viewable using an embedded viewer application.

The video files were segregated as west and east, referencing the side of N. Commerce West on which the cameras were installed. The west-side file depicted five camera views although two were magnified views from two of the cameras. The cameras were positioned near the northern and southern ends of a building about 550 to 890 feet south of the Cheyenne Ave intersection and parallel with N. Commerce Street. The east-side file depicted three camera views with one being a magnified view from one of the cameras. The cameras were positioned near the northern end of a building about 300 feet south of the Cheyenne Ave intersection and parallel with N. Commerce Street.

Each view depicted a user-defined camera identification (location) name, a date (mm/dd/yyyy), and time of day (h:mm:ss am/pm). The individual cameras on either side of the roadway appeared to be time synchronized, however, the two sides of the roadway were not. The time displayed by the east side cameras was about 08min:35sec behind the west side cameras. The times displayed by the cameras were also noticeably different from the police-reported time of the crash. There was no indication that the time displayed in the video files had been synchronized to current time. Nonetheless, the video run times appeared accurate to the whole second. The video run time for the west-side cameras was about 59 seconds, while the east-side cameras run time was about 26 seconds. **Table 3** identifies the various camera identities (names) and a summary of their respective fields of view.

[16] For this SDM, the final one second data point before algorithm enable (time zero) represents the last data sample before AE. Data Sampling could occur at any time during the final second (not specifically at the whole second).

Table 3: Surveillance Camera Position Identification

Camera Name	Relative Location	Approximate Field of View Off Property
Wash Bay S/E	West side – southern end of building	Southeast to include Brooks Ave intersection
Wash Bay East		Northeast toward northern end of N. Commerce Steet and Cheyenne Ave intersection
N/E Driveway Enter	West side – northern end of building	Eastward to include portion of N. Commerce Street near mid-block
CNG Yard	East side – northern end of building	Northwest toward northern end of N. Commerce Steet and Cheyenne Ave intersection
Commerce		Westward toward N. Commerce Street near mid-block

Tables 4 and **5** summarize certain events depicted within the various camera views relative to the time displayed on the image. While indicated time was to the whole second, multiple sequential events could occur within the one-second interval.

Table 4: Timeline of Events Observed in West Side Camera Views

Displayed Time	Camera Identification	Event
2:29:47 PM		▪ Video starts
2:29:47 PM	Wash Bay S/E	▪ Dodge visible within camera field of view, south of W Brooks Ave. trailing behind commercial refuse truck (identification of Dodge was confirmed later in video segment)
	Wash Bay East	▪ Northbound traffic signal at Cheyenne Ave is red. Both mast arm supported signal heads are display a red signal ▪ Traffic in motion on Cheyenne Ave. includes truck towing trailer completing a right turn from westbound Cheyenne onto northbound Commerce ▪ Several vehicles traveling southbound on N. Commerce Street from Cheyenne Ave intersection
2:29:49 PM	Wash Bay East	▪ Pedestrian begins crossing N. Commerce from east side of roadway (heading to Republic Services property)
2:29:56 PM		▪ 2nd pedestrian begins crossing N. Commerce from east side of roadway. 1st pedestrian still in roadway ▪ Eastbound Cheyenne Ave traffic begins to enter and travel through the intersection (Commerce Street signal is red)
2:30:01 PM	Wash Bay S/E	▪ Dodge, approaching Brooks Ave, is along left side of refuse truck ▪ Large refuse truck traveling southbound on Commerce Street reaches Brooks Ave and begins stopping. Three light vehicles are behind the truck are also slowing
2:30:05 PM		▪ Dodge enters Brooks Ave without stopping at stop sign. No visual indications of reducing speed ▪ Dodge exits intersection at speed apparently faster than when entered
	Wash Bay East	▪ Westbound Cheyenne Ave traffic begins to enter and travel through intersection
2:30:08 PM	Wash Bay S/E	▪ Dodge exits camera field of view
2:30:10 PM	Wash Bay East	▪ Dodge enters camera field of view ▪ N Commerce Street traffic signal at Cheyenne Ave remains red
2:30:12 PM	N/E Driveway Enter	▪ Dodge enters camera field of view
2:30:13 PM		▪ Dodge exits camera field of view
2:30:16 PM	Wash Bay East	▪ Dodge enters Cheyenne intersection and impacts right side of white minivan traveling eastbound ▪ Cloud of debris develops and obscures vehicles ▪ Vehicles and debris cloud move eastward
2:30:18 PM		▪ Vehicles involved in collision pass behind property wall on southeast corner of intersection ▪ Debris cloud dissipates ▪ A white SUV is then stopped in intersection facing south ▪ A 2nd SUV enters camera field of view traveling westbound from behind 1st white SUV

2:30:34 PM		▪ SUV stopped in intersection begins slowing moving south toward east side of N Commerce Street
2:30:46 PM		▪ Video ends

Table 5: Timeline of Events Observed in East Side Camera Views

Displayed Time	Camera Identification	Event
2:21:34 PM		▪ Video starts
2:21:37 PM	Commerce	▪ Dodge enters camera field of view
2:21:39 PM		▪ Dodge exits camera field of view
2:21:40 PM	CNG Yard	▪ Dodge enters camera field of view
2:21:41 PM		▪ Dodge enters Cheyenne intersection and impacts right side of white minivan traveling eastbound ▪ White sedan traveling eastbound just behind and to the left of the white minivan ▪ After impact, debris cloud ensues ▪ White sedan begins to rotate counterclockwise ▪ White minivan impacted by Dodge begins to tip – left side leading ▪ A white SUV traveling westbound enters intersection
2:21:42 PM		▪ Dodge, moving eastward from impact, moves behind property wall on southeast corner of intersection ▪ Eastbound white sedan has rotated past 90°, then moves behind property wall ▪ The white SUV traveling westbound rotates counterclockwise in intersection, comes to stop ▪ A 2nd white SUV traveling westbound passes behind 1st white SUV
2:21:49 PM		▪ 2nd white SUV traveling westbound stops at northwest corner of intersection.
2:21:00 PM		▪ 1st white SUV that had been traveling westbound begins moving southward on N Commerce Street from stopped position
2:22:00 PM		▪ Video ends

9. Toyota Sienna Occupant Ejections

Police investigators reported that three rear seat occupants in the Toyota had been fully ejected from the vehicle before it came to final rest. Scene photographs depict one occupant on the ground immediately in front of the Toyota at its position of final rest. The other two occupants were reportedly found in right westbound travel lane and on the sidewalk that was contiguous with the westbound right lane. Their positions of rest were documented by the placement of traffic cones in police investigative photographs. Those positions were within the debris field and post-collision path of travel for the Toyota, Dodge and Ford.

D. DOCKET MATERIAL

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

- Traffic signal timing chart for the intersection of Cheyenne Ave and N. Commerce Street, dated 06/01/16.
- Select highway plan pages titled *City of North Las Vegas, Commerce Street Improvements – West Cheyenne Avenue to Duchess Avenue*, dated 07/2019
- Copy NV DOT spreadsheet depicting motor vehicle crash data for the intersection of Cheyenne Ave and N. Commerce Street, January 01, 2018, through January 1, 2021.

END OF REPORT

Robert J. Squire
Highway Accident Investigator
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