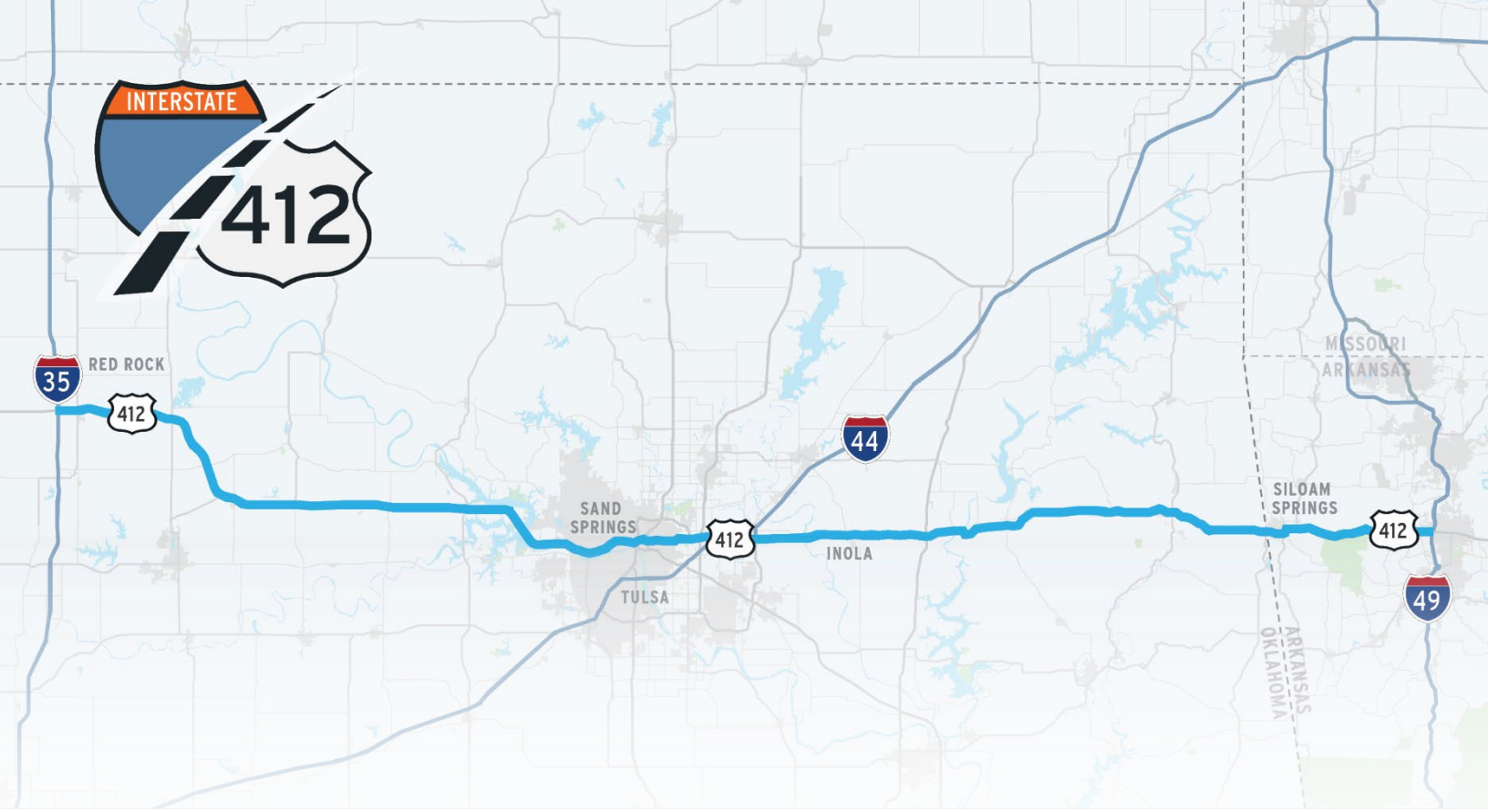

OKLAHOMA Transportation

ARDOT ARKANSAS DEPARTMENT OF TRANSPORTATION

OKLAHOMA Turnpike Authority

U.S. Department of Transportation Federal Highway Administration

U.S. 412: from I-35 in Noble County, Oklahoma
to I-49 in Benton County, Arkansas

Planning and Environmental Linkages Study

Traffic, Safety and Engineering Constraints Report

June 2023

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1.0 Introduction

The Oklahoma Department of Transportation (ODOT) and Arkansas Department of Transportation (ARDOT) are initiating a Planning and Environmental Linkages (PEL) Study of U.S. 412. The PEL Study limits are from I-35 in Noble County, Oklahoma to I-49 in Benton County, Arkansas, a distance of 190 miles. The overarching goal is to develop a master plan to support the transition from a U.S. Highway to an interstate, in accordance with the Infrastructure Investment and Jobs Act (IIJA).

This Traffic, Safety and Engineering Existing Constraints report documents existing and future no-build traffic, existing safety and existing engineering issues and constraints along the U.S. 412 corridor.

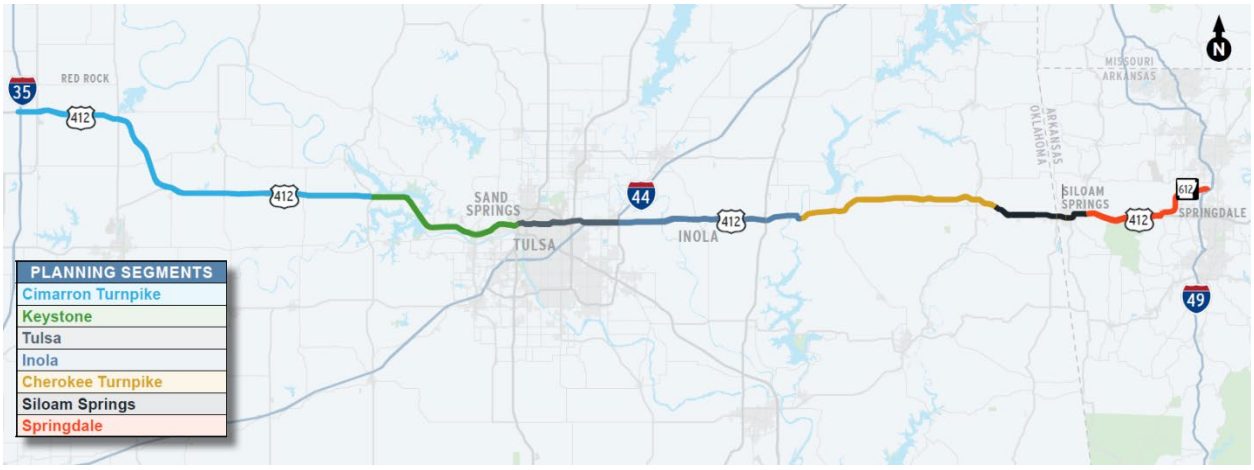
ODOT and ARDOT anticipate incorporating recommendations made as part of the PEL study into future National Environmental Policy Act (NEPA) studies, per Title 23 of the U.S. Code, Part 168.

1.1 PEL Study Area

As shown in **Figure 1**, the 190-mile U.S. 412 corridor has been divided into seven planning segments.

- **Cimarron Turnpike** – This 59 mile fully access controlled turnpike segment has a posted speed of 75 mph.
- **Keystone** – This 24.7 mile segment is almost entirely access controlled. Diamond Head Drive (between Keystone Lake and the Corp of Engineers Dam) is an existing at-grade crossing. The posted speeds in this section are 55 mph, 65 mph, and 70 mph.
- **Tulsa** – This 14.7 mile segment through Tulsa is highly developed and fully access controlled. The route has a dual designation of I-244 with posted speeds of 55 mph and 65 mph.
- **Inola** – This 26.6 mile segment is not access controlled with many at-grade crossings. The posted speeds in this section are 65 mph and 70 mph.
- **Cherokee Turnpike** – This 33.1 mile fully access controlled turnpike segment has a posted speed of 75 mph.
- **Siloam Springs** – This 8.5 mile segment traverses through the Siloam Springs community with many at-grade traffic signal-controlled intersections. The posted speeds are 45 mph, 50 mph, 70 mph, and 75 mph.
- **Springdale** – This 23.4 mile segment utilizes the planned and partially constructed Springdale Northern Bypass. The study alignment would follow the approved Springdale Northern Bypass with posted speeds of 35 to 55 mph.

Figure 1: U.S. 412 PEL Planning Segments



Source: Study Team, 2023.

2.0 Existing and Future No-Build Traffic

A summary of existing and future no-build traffic conditions is provided in the following sections. The existing and future no-build conditions summaries are provided through documentation of the existing and future no-build traffic demand, existing travel speeds and existing origin-destination travel characteristics.

2.1 Traffic Demand

This section provides a summary of existing traffic volumes for 2019, 2020, and 2021, as well as truck volumes for 2021. A weighted average annual daily traffic (AADT) for 2019 and 2021 is also included as part of the existing traffic demand analysis.

Traffic data was collected and compiled through a variety of sources to ensure accurate and complete data for the entire length of the corridor. The project team coordinated with ODOT, Oklahoma Turnpike Authority (OTA), Indian Nations Council of Government (INCOG), ARDOT, and the Northwest Arkansas Regional Planning Commission (NWARPC) to gather existing traffic volumes. Data was provided in Excel, pdf, geographic information systems (GIS) file, and web-based geospatial database formats, and used to establish base year volumes.

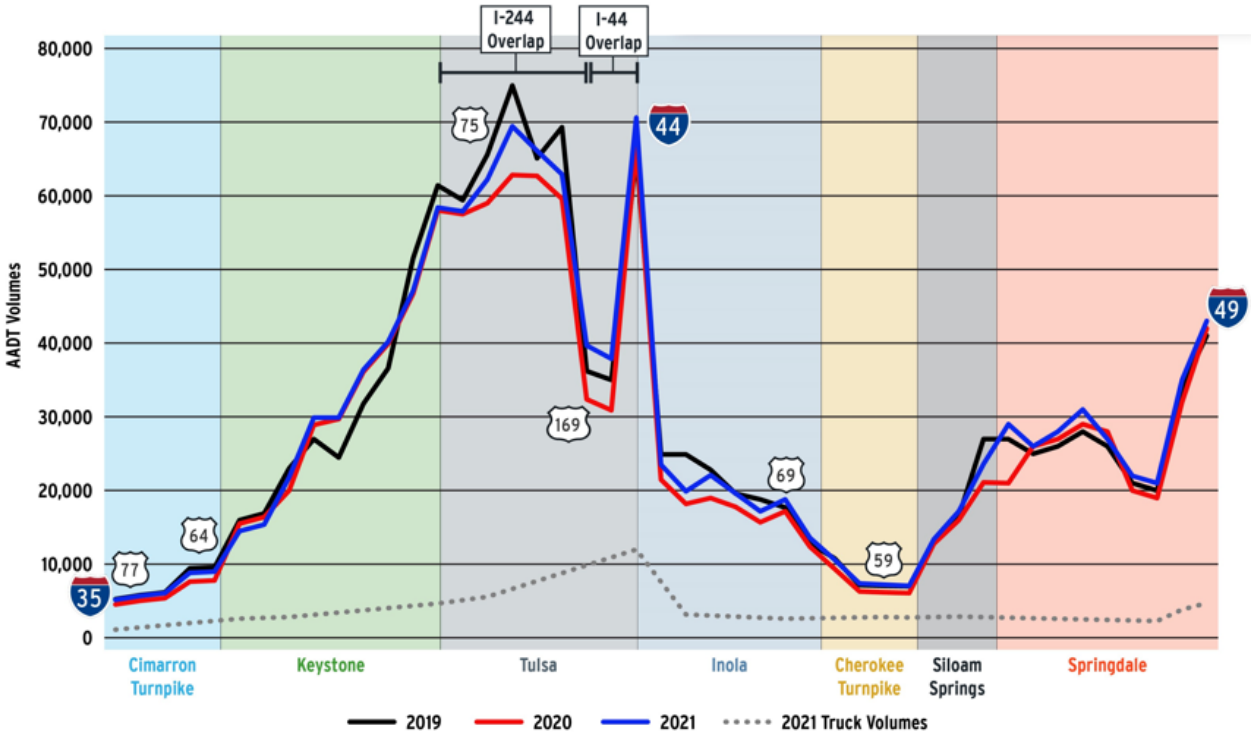
Existing Traffic Volumes

The project team gathered and organized existing traffic volume data for 2019, 2020, and 2021. The team received data in a variety of formats that allowed the project to verify data points against multiple sources to ensure accuracy. Additionally, the project team identified truck volumes for 2021. Figure 2 displays existing traffic volumes across the corridor for each year, through each of the seven planning segments.

Volumes generally reflect urban/rural environments, with the highest traffic volumes located in more populated areas with more dense economic development in and around Tulsa and Springdale. Lower traffic volumes are located in less dense areas, west and east of Tulsa.

A corridor weighted AADT volume was developed. This process involved multiplying a data point's segment length by its daily traffic volume to yield daily vehicle miles traveled (DVMT), and then dividing the total DVMT by the corridor's total length. The project team verified each segment length by referring to data sets and measuring segments through a web-based geospatial mapping application. The weighted AADT for 2019 totaled 20,058 and 19,978 for 2021. 2020 was omitted due the COVID-19 pandemic's impact on daily traffic volumes.

Figure 2: U.S. 412 Existing Traffic Volume Profile



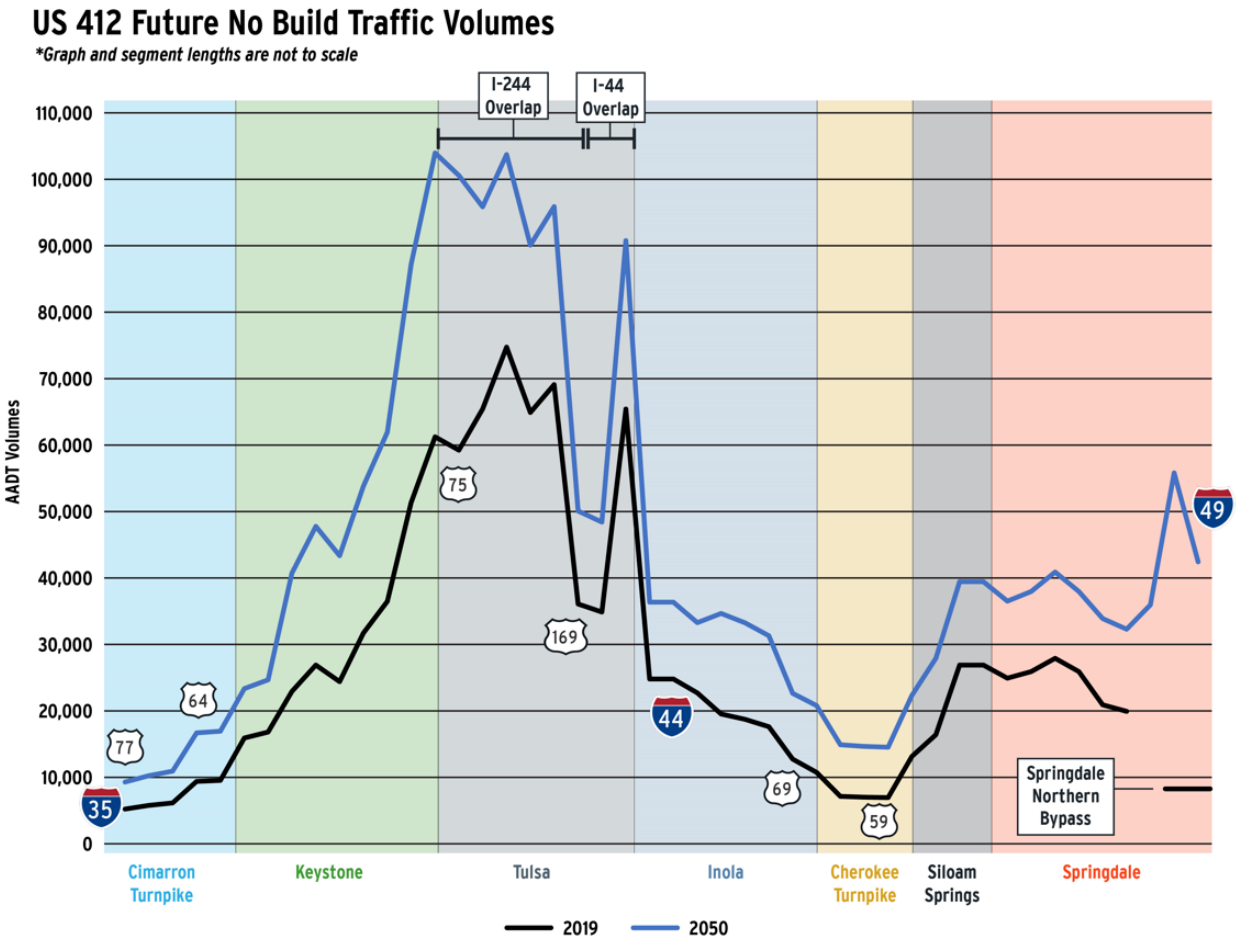
Note: Graph and segment lengths are not to scale
Source: ODOT, OTA, ARDOT, INCOG, NWARPC.

2050 Future No-Build Traffic Volumes

2050 future traffic volumes were developed along the project corridor by analyzing historical growth rates from ODOT and ARDOT websites and future growth rates gathered from available MPO models. Professional judgement was then used to determine future volumes that reasonably maintain similar volume patterns along the corridor between 2019 and 2050.

Figure 3 displays future no-build traffic volumes across the corridor for 2050, along the seven planning segments.

Figure 3: U.S. 412 Future No Build Traffic Volumes



Note: Graph and segment lengths are not to scale
Source: 2019 Volumes, ODOT, OTA, ArDOT, INCOG, NWARPC
2050 volumes were calculated by HNTB

2.2 Travel Speed

The existing U.S. 412 corridor travel speeds were obtained from the Federal Highway Administration (FHWA) supported National Performance Management Research Data Set (NPMRDS) for each of the seven planning segments. The data covers January 1, 2019 to December 31, 2019, Tuesday through Thursday (typical weekday), during the 7 AM to 9 AM and 4 PM to 6 PM peak periods. A summary of the speed conclusions is provided in **Table 1** with more detailed assessments of each segment in **Appendix A.** The summary highlights in red the segments that contain speeds that consistently drop to more than 20% below the posted speed limit in each planning segment.

Table 1: Summary of U.S. 412 Travel Speeds

Planning Segment	Travel Speed Summary	>20% below Posted Sped Limit
Cimarron Turnpike	The Cimarron Turnpike segment extends from I-35 to Highway 48. Eastbound and westbound average travel speeds for both passenger vehicles and trucks are roughly 5 mph below the posted speed limit of 75 mph on average throughout the segment. Speeds decrease significantly to 35 mph at U.S. 177 and to 40 mph at Highway 99 because of existing toll plazas. These toll plazas will be removed as part of the Turnpikes all electronic toll collection conversion.	
Keystone	The Keystone segment extends from Highway 48 to I-244. Eastbound and westbound travel speeds for passenger vehicles generally follow the posted speed limits of 55, 65, and 70 mph along the Keystone segment. Passenger vehicles travel just above the speed limit in the 65 mph section. Truck speeds are slightly slower than the passenger vehicle speeds.	
Tulsa	The Tulsa segment extends from I-244 to I-44 / Highway 364 (Creek Turnpike). Eastbound and westbound travel speeds for passenger vehicles and trucks are generally slower than the posted speed limits of 55 and 65 mph along the Tulsa Segment. Eastbound AM travel speeds decrease to around 55 mph at the Memorial Dr Exit Ramp to Highway 11 entrance ramp and gradually recover, but remain below 65 mph until rebounding to the posted speed limit at Highway 167 exit ramp. In the PM peak, speeds again drop to near 30 mph around the I-44 exit. In the AM, westbound speeds decrease to approximately 20 mph below the posted speed limit at Highway 167 and again to about 50 mph at Highway 169. PM speeds decline to between 50 and 55 mph at the Highway 66 entrance ramp and Memorial Dr Exit Ramp to Highway 11 entrance ramp. Each of these speed drops are likely due to urban traffic congestion that exists within the Tulsa area.	
Inola	The Inola segment extends from I-44 / Highway 364 (Creek Turnpike) to U.S. 412 Alt near the Neosho River. Eastbound and westbound travel speeds for passenger vehicles and trucks follow the posted speed of 65 mph until U.S. 412 crosses Highway 88, where the posted speed limit increases to 70 mph for the remainder of the segment. At that point, speeds remain below the posted speed limit and generally fluctuate between 62 to 67 mph. Truck speeds are	

Planning Segment	Travel Speed Summary	>20% below Posted Sped Limit
	slightly slower than passenger vehicles in both direction during the PM peak period.	
Cherokee Turnpike	The Cherokee segment extends from U.S. 412 Alt near the Neosho River to U.S. 59 near Flint Creek. Eastbound and westbound travel speeds for passenger vehicles are approximately 5-10 mph below the posted speed limit of 75 mph, with slight fluctuations throughout. Truck speeds are consistently slower than passenger vehicles by 1 to 3 mph consistently in both directions and during both peaks.	
Siloam Springs	The Siloam Springs segment extends from U.S. 59 near Flint Creek to Highway 59. Eastbound and westbound posted speed limits vary from 45 mph, 50 mph, 70 mph, and 75 mph. Both passenger vehicles and truck speeds are approximately 10 to 20 mph lower than the posted speeds through most of the segment, likely due to the effects of signals.	
Springdale	NPMRDS data for this segment was incomplete	NA

Source: NPMRDS (National Performance Management Research Data Set), Jan. 1, 2019 to Dec. 31, 2019.

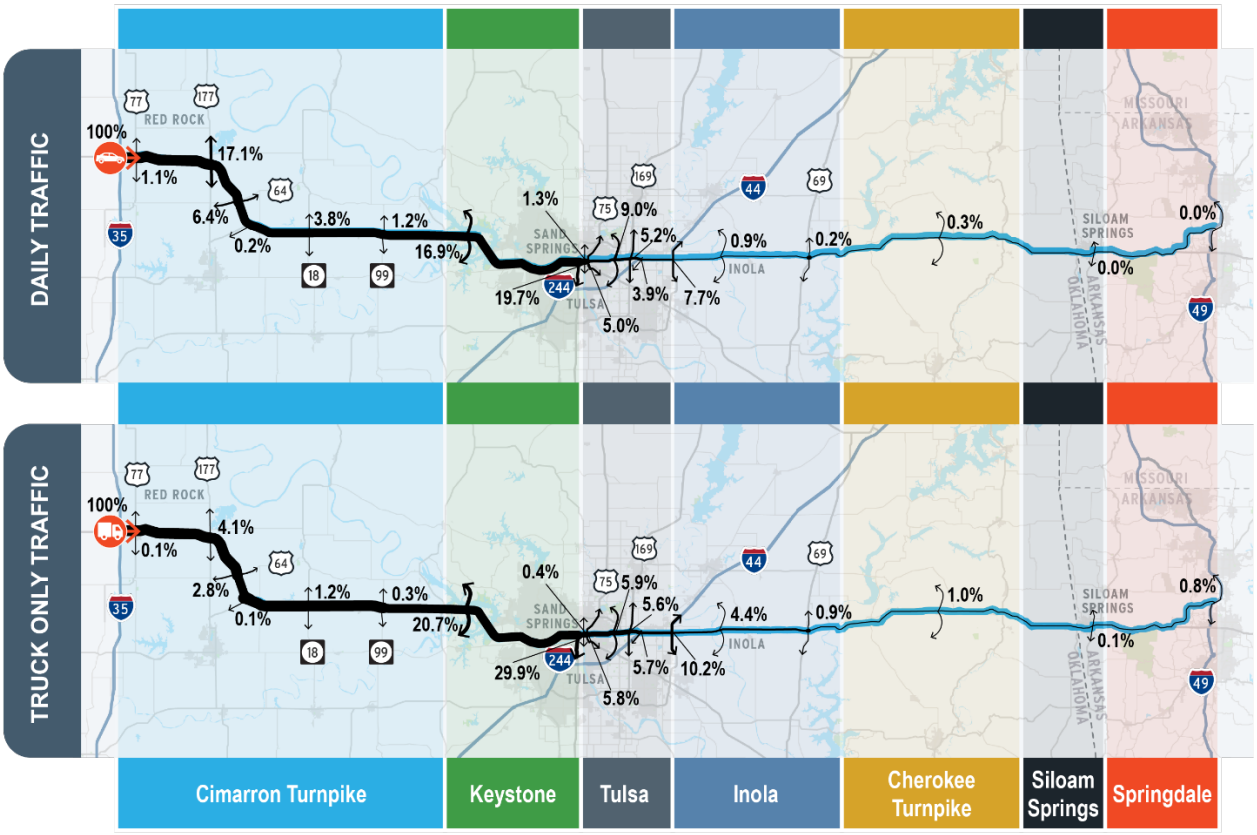
Origins and Destinations

Origin and destination (OD) data was gathered and analyzed for the U.S. 412 corridor to understand daily traffic flow patterns – where traffic is coming and going. The project team identified various pass-through locations along each planning segment to count number of vehicles, using StreetLight Insight, an online mobility platform that can analyze traffic between multiple geographic areas. The data included covered a 24 hour span over a typical weekday (Tuesday through Thursday). The data shows that less than 1% of trucks starting at one end of the corridor travel all the way to the other end of the corridor. A smaller percentage of general-purpose vehicles make the trip all the way across the corridor. Generally, the trips originating along the corridor west of the Cherokee Turnpike have destinations in the Tulsa area (including I-44) compared to other locations. Vehicle trips originating east of the Cherokee Turnpike mostly have destinations in eastern Oklahoma and the Siloam Springs and Springdale areas. The data also shows that trucks are generally traveling farther distances than general purpose vehicles.

2.2.1 Cimarron Turnpike at I-35

Based on the OD data, drivers entering the U.S. 412 corridor from the western limit and I-35 exit at three main locations, as shown in Figure 4. 19.7% of drivers exit at I-244, south of U.S. 412, 17.1% of exit at U.S. 177, and 16.9% exit at Highway 99 and I-244.

Figure 4: Cimarron Turnpike Eastbound U.S. 412 at I-35

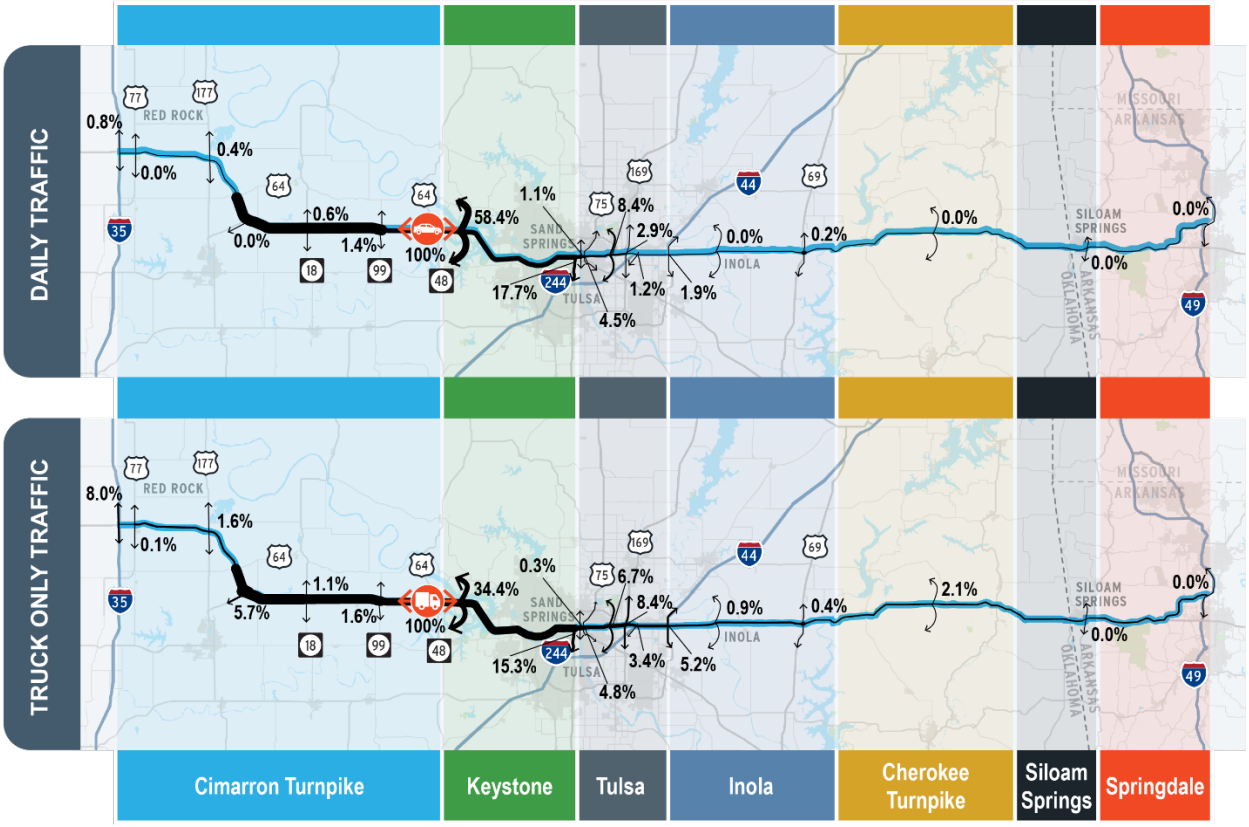


Source: StreetLight Insight, 2019 Traffic Volumes

2.2.2 Cimarron Turnpike at U.S. 64/Highway 48

Based on the OD data, 58% of all drivers entering the U.S. 412 corridor at U.S. 64 and Highway 48 exit between Highway 99 and I-244, as shown in **Figure 5**. 17.7% of drivers exit at I-244, just south of U.S. 412.

Figure 5: Cimarron Turnpike Eastbound and Westbound U.S. 412 at U.S. 64/Highway 48

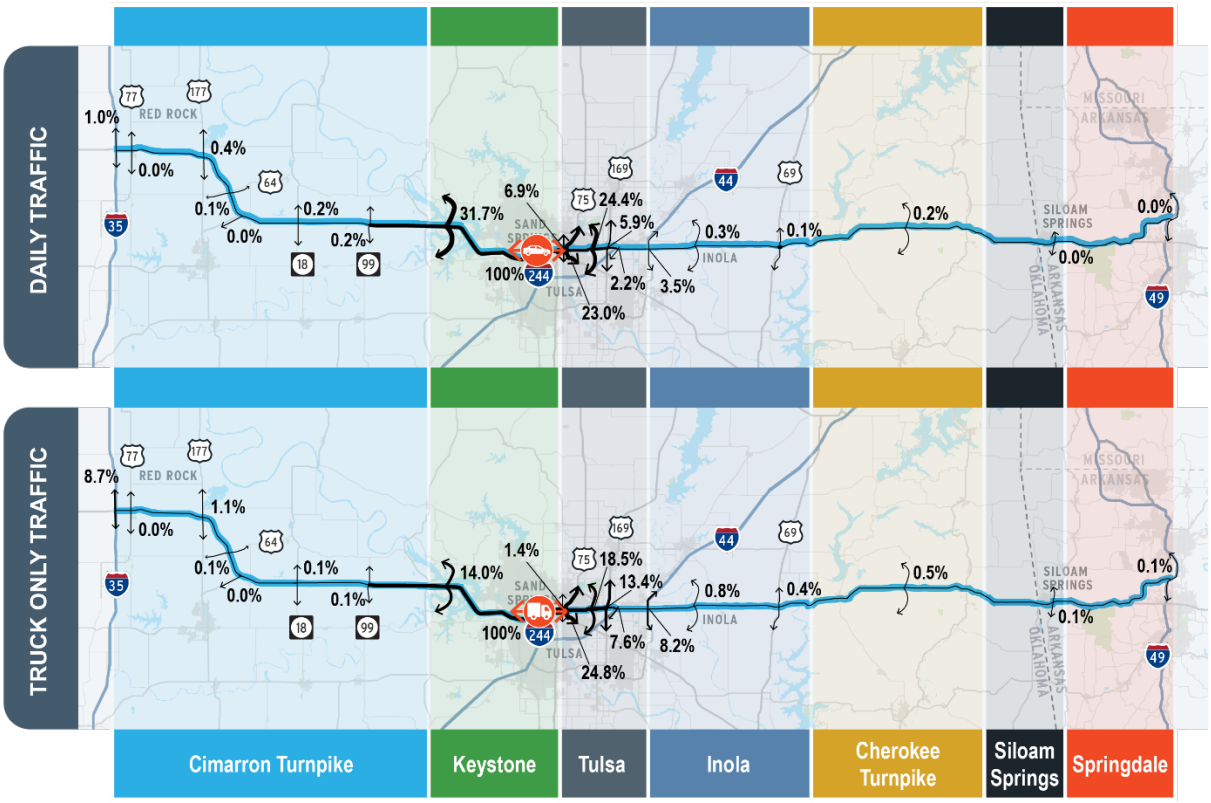


Source: StreetLight Insight, 2019 Traffic Volumes

2.2.3 Keystone

Based on the OD data, drivers entering the U.S. 412 corridor exit at three main locations, as shown in **Figure 6**. 31.7% of drivers exit between Highway 99 and I-244, 24.4% exit between U.S. 75 and U.S. 169, and 23.0% exit at U.S. 75.

Figure 6: Keystone Eastbound and Westbound U.S. 412 at I-244

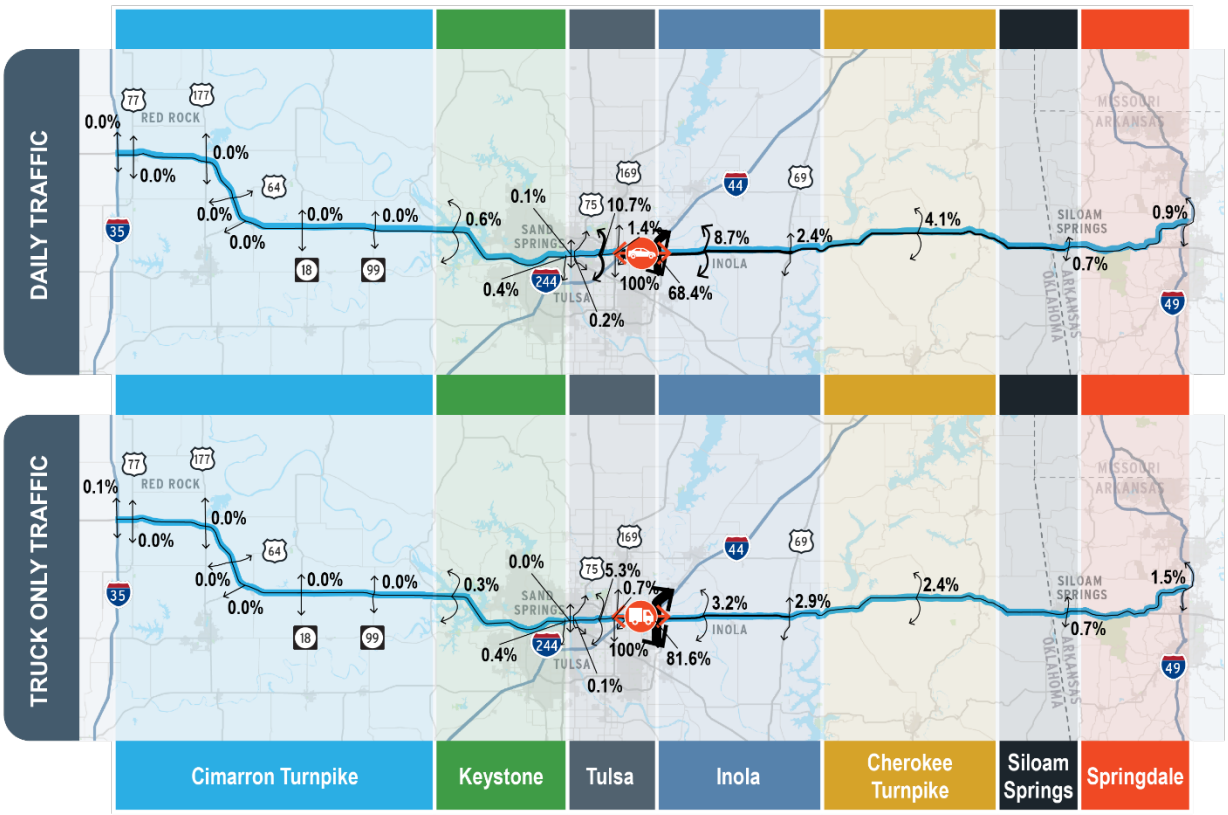


Source: StreetLight Insight, 2019 Traffic Volumes

2.2.4 Tulsa at I-44 South

Based on the OD data, over 68% of all drivers entering the U.S. 412 corridor at the I-44 exit, south of U.S. 412, as shown in **Figure 7**. Another 11% exit between U.S. 75 and U.S. 169.

Figure 7: Tulsa Eastbound and Westbound U.S. 412 at I-44 South

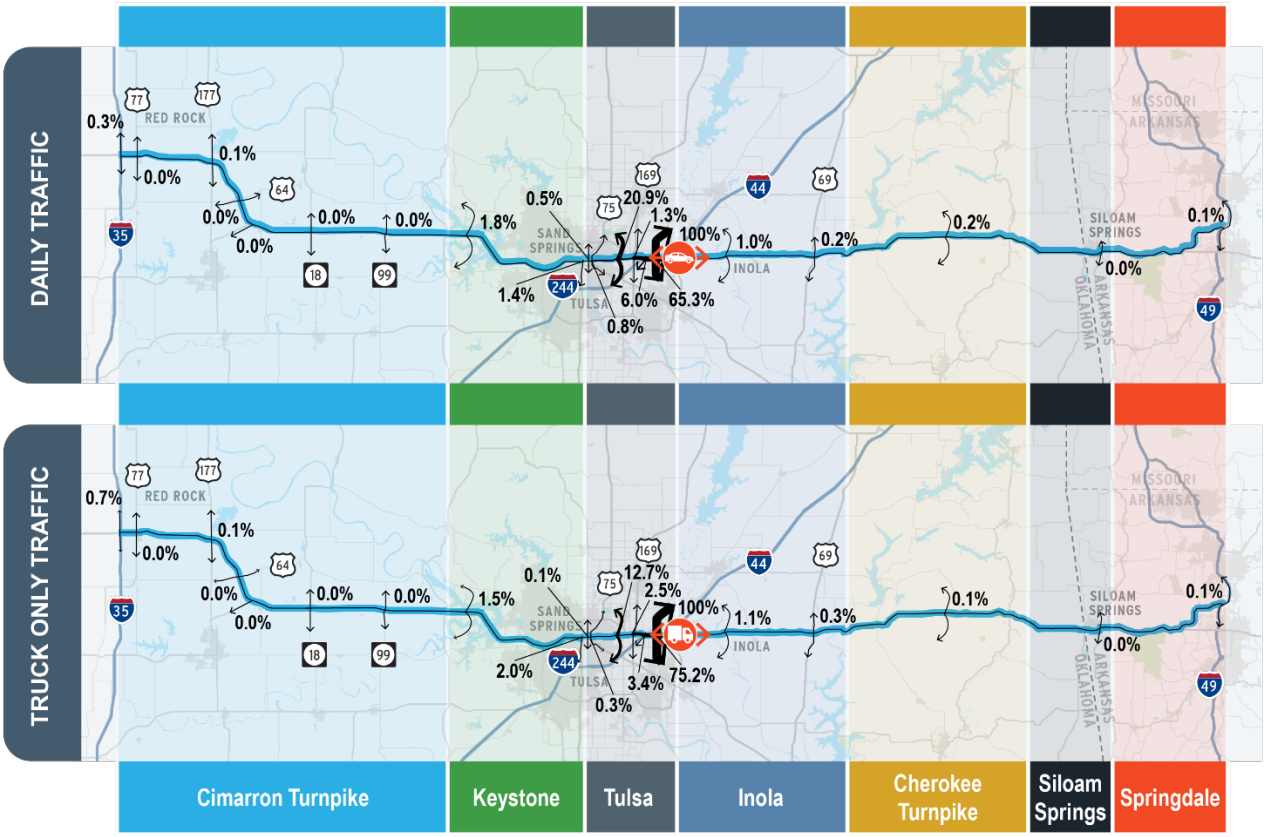


Source: StreetLight Insight, 2019 Traffic Volumes

2.2.5 Tulsa at I-44 North

Based on the OD data, over 65% of all drivers entering the U.S. 412 corridor at the I-44 exit, north of U.S. 412, as shown in **Figure 8**. Another 21% exit between U.S. 75 and U.S. 169.

Figure 8: Tulsa Eastbound and Westbound U.S. 412 at I-44 North

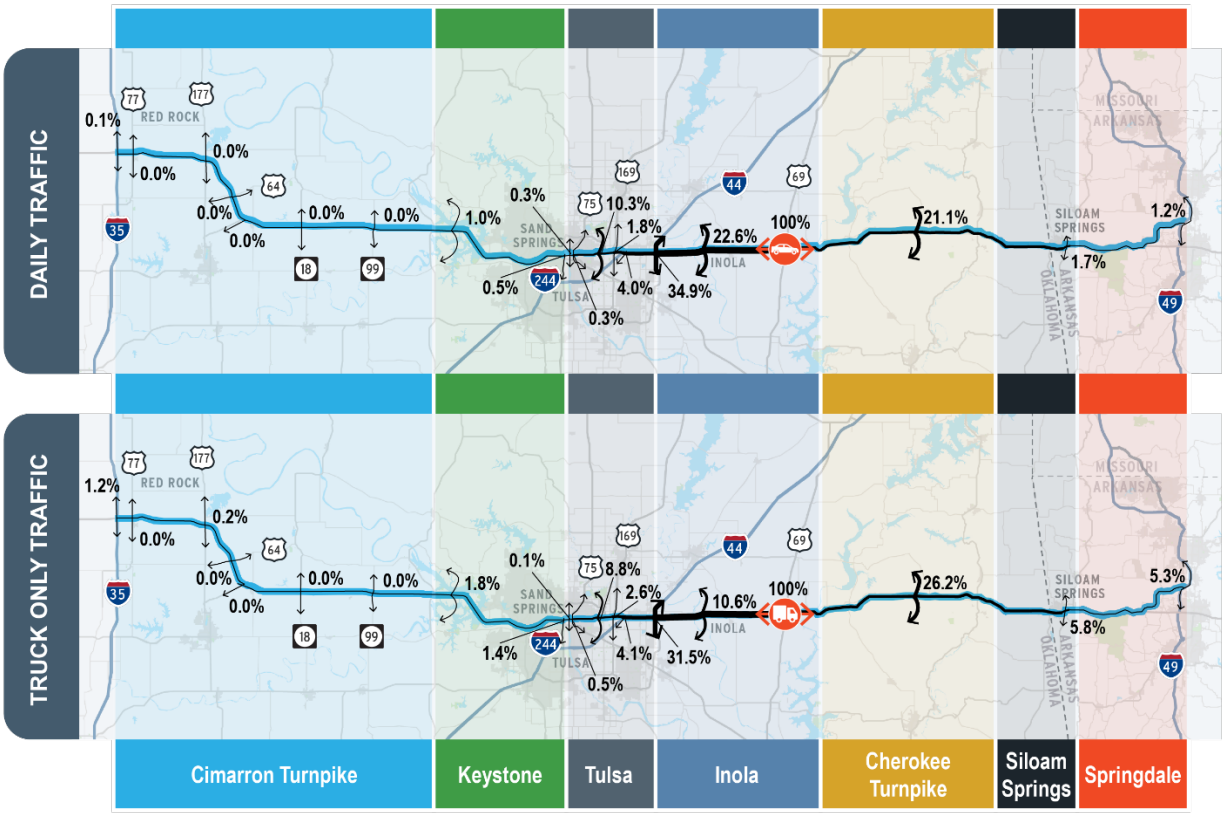


Source: StreetLight Insight, 2019 Traffic Volumes

2.2.5 Inola

Based on the OD data, drivers entering the U.S. 412 corridor at U.S. 69 exit three clear locations, as shown in **Figure 9**. 34.9% of drivers exit at I-44/Skelly Bypass and I-44/Creek Turnpike, 22.6% exit between I-44/Creek Turnpike and U.S. 69, and 21% exit between U.S. 69 and Siloam Springs.

Figure 9: Inola Eastbound and Westbound U.S. 412 at U.S. 69

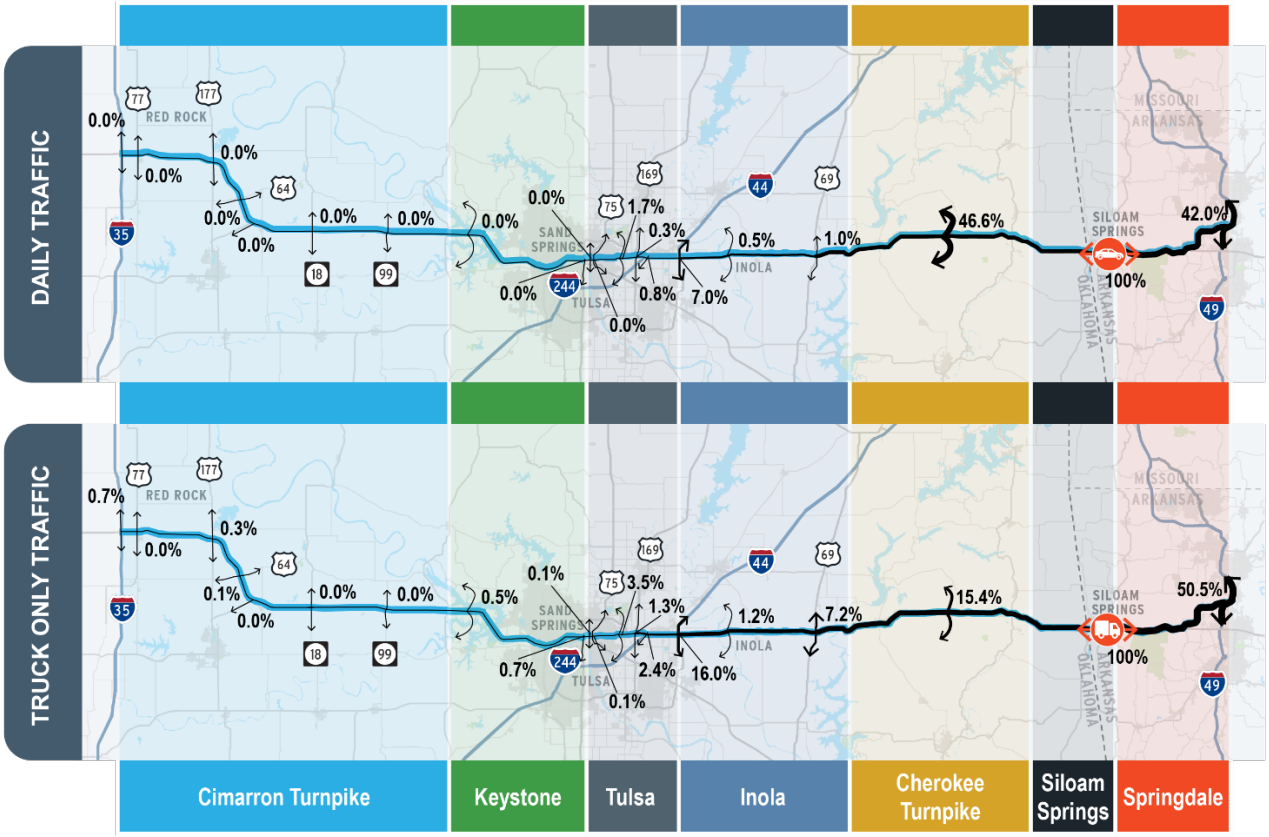


Source: StreetLight Insight, 2019 Traffic Volumes

2.2.6 Siloam Springs

Based on the OD data, 46% of all drivers entering the U.S. 412 corridor at Siloam Springs exit between U.S. 69 and Siloam Springs, as shown in **Figure 10**.

Figure 10: Siloam Springs Eastbound and Westbound U.S. 412 at Highway 59

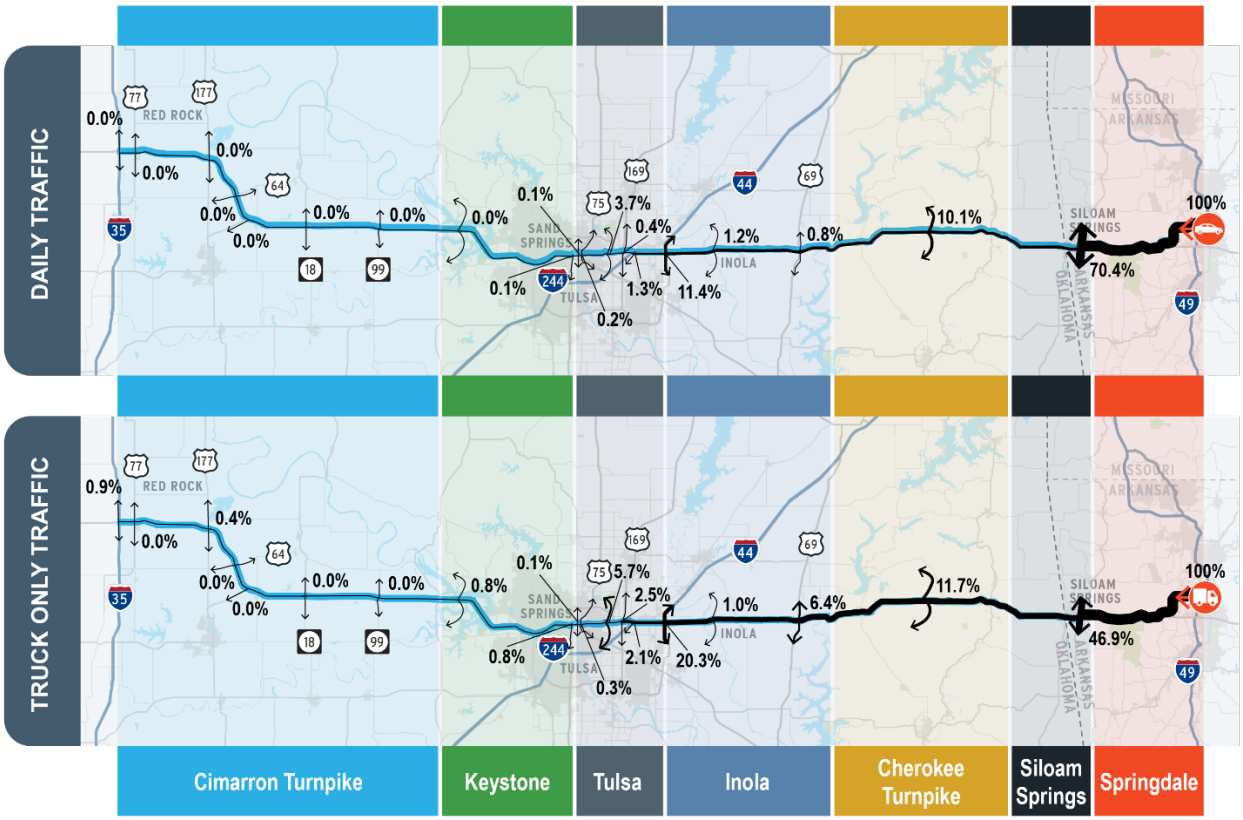


Source: StreetLight Insight, 2019 Traffic Volumes

2.2.7 Springdale

Based on the OD data, 70% of all drivers entering the U.S. 412 corridor at I-49 exit at Siloam Springs, as shown in **Figure 11**.

Figure 11: Springdale Eastbound and Westbound U.S. 412 at I-49

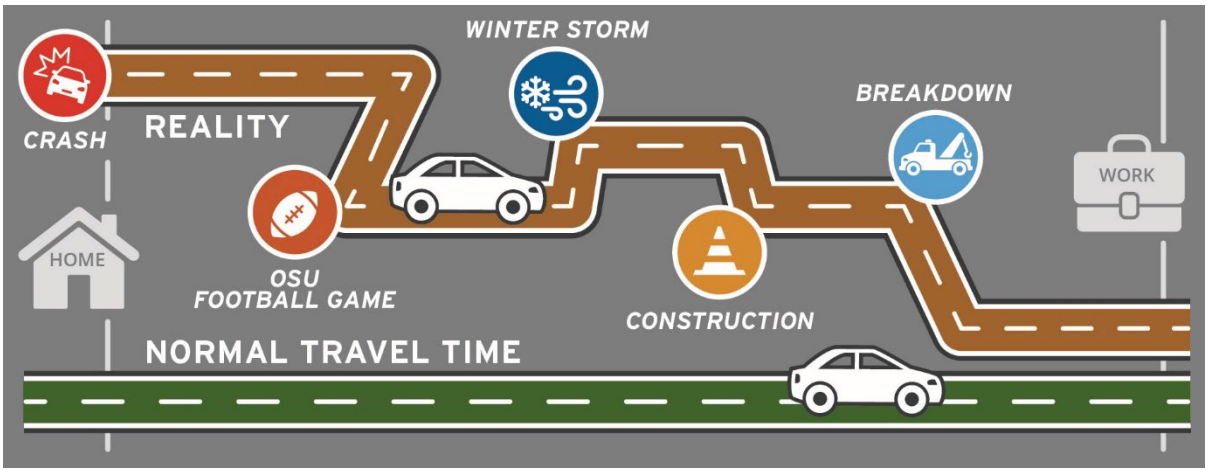


Source: StreetLight Insight, 2019 Traffic Volumes

Travel Reliability

Travel reliability describes the variability of travel time drivers experience from day-to-day. Crashes, weather, special events, construction, and traffic are just a few factors that can negatively affect the reliability of a trip, as illustrated in **Figure 12**. Travelers often remember the worst days.

Figure 12: What is Travel Time Reliability?

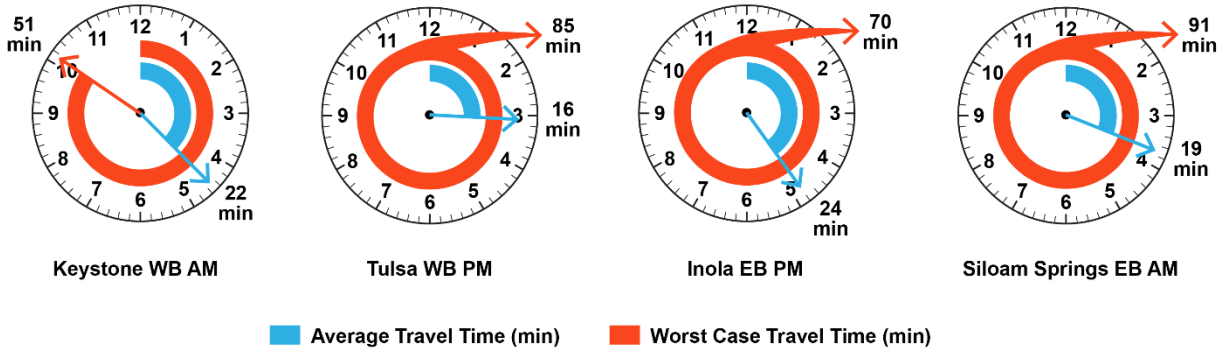


Source: Study Team, 2023.

Travel time and speed data was collected for U.S. 412 in 2019. It included data for average travel days, but also for days with incidents or other non-recurring congestion events which allowed the opportunity to look at the reliability (or variability) of travel times in the corridor. Travel times and speeds through the corridor were analyzed for the AM and PM peak periods in the eastbound (EB) and westbound (WB) directions for six of the seven segments (travel time data for the Springdale segment was incomplete

Figure 13 shows a sample of the average and worst-case travel time results from four of the segments. During periods of non-recurring congestion, speeds can fall well below posted speeds and travel times increase substantially in each of the segments. This can be due to crashes, weather events, construction, or special events and indicates a lack of resiliency in the network to adapt to these types of events. The worst-case travel times on U.S. 412, from days with incidents or other non-recurring congestion events, can be two to five times longer than average travel times. This demonstrates an opportunity and a need to improve mobility in the corridor.

Figure 13: Travel Time Reliability on U.S. 412



Source: National Performance Management Research Data Set (NPMRDS), January 1, 2019 to December 31, 2019.

3.0 Safety

3.1 Existing Safety

The following section provides a summary of the existing traffic safety analysis. The full analysis can be found in **Appendix B**.

In conjunction with the U.S. 412 traffic analysis, an existing crash analysis was performed along the U.S. 412 mainline within the project study limits. The existing safety analysis was conducted using crash data, obtained from ODOT and ARDOT, for the most current complete five-year period (2017-2021). The crash analysis provided a summary of various existing crash characteristics including crash types, crash severities, roadway conditions, and lighting conditions.

A total of 4,863 crashes occurred along the U.S. 412 corridor within the project limits, resulting in 47 fatalities over the 5-year analysis period. That represents an average of 2.7 crashes per day. Among the planning segments, the Tulsa planning segment experienced the highest percentage of crashes (1853 crashes, 38.3% of total crashes) resulting in 19 fatalities and 61 incapacitating injury crashes. Fixed object collisions were the predominant crash types in Cimarron Turnpike, Keystone, Cherokee Turnpike, and Springdale #1 planning segments. In contrast, rear-end collisions were the predominant crash types in Tulsa and Siloam Springs planning segments. In the Inola planning segment, which has many at-grade crossings, angle collisions resulted higher percentage of fatalities and incapacitating injuries. As the planning segments transition between rural and urban areas, the shift in crash types from fixed object collisions to rear-end collisions and angle collisions indicates a change in both traffic patterns and roadway elements. Table 2 provides the crash attributes for all six planning segments. It is noteworthy that the Springdale #1 planning segment begins from Airport Road and ends at Old Highway 68 whereas the Springdale #2 planning segment refers to the approximately 3-mile stretch of the AR–612 from AR-112 to I-49.

Table 2: Crash Attributes of the Planning Segments

Planning Segment	No of Crashes (% of heavy vehicle crashes)	Crash /Per day	Crash Severity -Number (%)	Crash Types -Number (%)
Cimarron Turnpike	447 (~17%)	0.2	• Fatality -3 (0.7%) • Incapacitating Injury – 14 (3.1%) • Non-incapacitating Injury- 34 (7.6%) • Possible Injury – 56 (12.6%) • Property Damage Only – 340 (76.1%)	• Fixed objects -300 (67.1%) • Sideswipe same directions- 36 (8.1%) • Others – 111 (24.8%)
Keystone	904 (~6%)	0.5	• Fatality -8 (0.9%) • Incapacitating Injury – 20 (2.2%) • Non-incapacitating Injury- 120 (13.3%)	• Fixed objects -431 (47.7%) • Rear-end – 185 (20.5%) • Sideswipe same - directions- 131 (14.5%)

Planning Segment	No of Crashes (% of heavy vehicle crashes)	Crash /Per day	Crash Severity -Number (%)	Crash Types -Number (%)
			• Possible Injury – 137 (15.2%) • Property Damage Only – 619 (68.5%)	• Others – 157 (17.4%)
Tulsa	1853 (~7%)	1.0	• Fatality -19 (1.0%) • Incapacitating Injury – 61 (3.3%) • Non-incapacitating Injury- 322 (17.3%) • Possible Injury – 497 (26.8%) • Property Damage Only – 954 (51.5%)	• Rear-end – 544 (29.4%) • Fixed objects -466 (25.1%) • Sideswipe same-directions- 388 (20.9%) • Angle Collisions-306 (16.5%) • Others – 149 (8.0%)
Inola	351 (~10%)	0.2	• Fatality -9 (2.6%) • Incapacitating Injury – 25 (7.2%) • Non-incapacitating Injury- 89 (25.4%) • Possible Injury – 58 (16.5%) • Property Damage Only – 170 (48.4%)	• Rear-end – 102 (29.1%) • Angle Collisions - 100 (28.5%) • Fixed objects -63 (17.9%) • Sideswipe same-directions- 36 (10.3%) • Others – 50 (14.2%)
Cherokee Turnpike	187 (~10%)	0.1	• Fatality -3 (1.6%) • Incapacitating Injury – 1 (0.5%) • Non-incapacitating Injury- 37 (19.8%) • Possible Injury – 23 (12.3%) • Property Damage Only – 123 (65.8%)	• Fixed objects -88 (54.7%) • Rollover/Overturn – 20 (12.4%) • Animal -19 (11.8%) • Rear-end- 10 (6.2%) • Others – 24 (14.9%)
Siloam Springs	817 (~6%)	0.5	• Fatality -3 (0.4%) • Incapacitating Injury – 16 (2.0%) • Non-incapacitating Injury- 66 (8.1%) • Possible Injury – 124 (15.2%) • Property Damage Only – 608 (74.4%)	• Rear-end – 365 (42.3%) • Angle Collisions -195 (22.6%) • Sideswipe same-directions- 156 (18.1%) • Fixed Objects-66 (7.6%) • Others – 81 (9.4%)
Springdale #1	284 (~5%)	0.1	• Fatality -2 (0.7%) • Incapacitating Injury – 9 (3.2%) • Non-incapacitating Injury- 39 (13.7%) • Possible Injury – 31 (10.9%) • Property Damage Only – 203 (71.5%)	• Fixed objects -149 (58.9%) • Rear-end – 29 (11.5%) • Animal Collisions- 22 (8.7%) • Sideswipe same-directions- 16 (6.3%) • Others – 21 (8.3%)
Springdale #2	20 (0%)	0.0	• Fatality -0 (0.0%) • Incapacitating Injury – 1 (5.0%) • Non-incapacitating Injury- 1 (5.0%) • Possible Injury – 3 (15.0%) • Property Damage Only – 15(75.0%)	• Animal Collisions- 9 (45%) • Fixed Objects - 6 (30%) • Sideswipe same-directions- 3 (15%) • Others - 2 (10%)

Source: ODOT & ARDOT Crash Data 2017-2021

Crash rates were calculated for total crashes and fatal and incapacitating injury (KA) crashes for all the roadway segments and were compared to the statewide average crash rates for similar facilities. When compared with the statewide average, 58% of Cimarron Turnpike mileage, 47% of Keystone mileage, 63% of Tulsa mileage, 21% of Inola mileage, 13% of Cherokee Turnpike mileage, 18% of Siloam Springs mileage, 13% of Springdale #1 mileage, surpassed statewide average crash rates for total crashes. However, it is important to note that shorter segment lengths have the potential to skew the crash rate. Crash density maps and the locations of the KA crashes along the corridor are presented in **Appendix D**. For a high-level

crash density summary along the entire corridor, please refer to Figure 5 located in **Appendix A** of the safety memo. Tulsa and east portions of Keystone, and all of Siloam Springs in Arkansas experienced the highest concentration of crashes. KA crashes also mostly were concentrated in these same segments. Along with other segments, several segments experienced a substantial number of severe crashes within the project study limits. Table 3 provides the list of high-crash risk locations with potential safety issues.

Table 3: Locations with Potential Safety Issues

Planning Segments	Locations	Potential Safety Issues
Cimarron Turnpike	I-35 to N 3260 Road	• The design of the roadway with center barriers • Inadequate lighting facilities
	Cimarron Turnpike Spur to N 3430 Road	
	OK-18 to N 3550 Road segments	
	N 3570 Road to OK-48	
Keystone	N 129th W Avenue to Wilson Avenue	• The design of the roadway with center barriers • Inadequate lighting facilities • Closely spaced merging and diverging ramps • High Traffic
	N 49th W Avenue to N 33rd W Avenue	
	N Gilcrease Museum Road to N Quanah Avenue	
Tulsa	I-244 to Utica Avenue	• Closely spaced merging and diverging ramps • Inadequate lighting facilities • High traffic volume
	Sheridan Road to N 129th E Avenue	
	OK-66 to 165th Avenue	
	U.S. 169 to N 129th Road	
	County Line Road to the OK-66	
Inola	265th E Avenue to N 289th E Ave	• At-grade intersections • Inadequate lighting facilities
	N 305th E Ave to S 4160 Road	
	NS-4195 road to 4200 Road	
	S 432 Road to Old Highway 33	
Cherokee Turnpike	Cherokee Turnpike west limit to S 437 Road	• The design of the roadway with center barriers • Inadequate lighting facilities
	S 437 Road to OK-82	

Planning Segments	Locations	Potential Safety Issues
	N 4540 Road to 4580 Road	
	S 444 Road to S 447	
	ALT U.S. 412 to N 4540 Road	
	U.S. 59 interchange	
Siloam Springs	S Lincoln Street to Airport Road	• Undivided Highways with no access control
Springdale	Fairmount Road to Chamber Springs	• At-grade intersections in west side • Inadequate lighting facilities
	County Road 102 to WC Road 851	

Source: ODOT & ARDOT Crash Data 2017-2021

Rear-end collisions in the Tulsa and Siloam Springs can be attributed to high traffic volume, as rear-end collisions are usually indicative of highly congested areas and are typically attributed to lower-speed crashes. Furthermore, angle collisions are mostly attributable to the conflict points at intersections and ramp terminals. Attention to geometrics at ramp merge and diverge as well as converting at grade intersections into grade separated interchanges ought to be considered to avoid such collisions.

3.2 Future No-Build Safety

In the future no-build, traffic volumes are expected to increase across the U.S. 412 corridor. Current crash trends point to congestion related crashes such as rear-end collisions, specifically along the Tulsa and Siloam Springs segment. Increases in traffic volumes will only increase this corridor congestion, likely leading to an increase in rear-end crashes. Angle collisions that are attributed to the at-grade intersections in Inola and Siloam Springs are also expected to increase.

4.0 Existing Engineering Conditions and Deficiencies

The following section provides a summary of the existing engineering conditions and evaluation against interstate standard criteria for identification of deficiencies along the U.S. 412 corridor between I-35 and I-49.

4.1 Methodology

In order to identify the engineering deficiencies associated with the study area, information was collected through on-line database searches, imagery analyses, Google Maps, as-built plan review, a site visit of the entire corridor, and desktop geographic information system (GIS) analyses. Where applicable, the deficiencies identified throughout this document are shown graphically in their respective planning sections. To correlate identified interstate deficiencies to the map graphics, a mile-marker reference line was established along U.S. 412, numbered from the west to the east, starting at I-35/U.S. 412, and numbering restarting from zero at the Arkansas-Oklahoma state line. The Mile Markers illustrated or noted here do not align with Arkansas log miles, Oklahoma mile markers (where they exist), or turnpike mile markers and are purely for reference purposes between map graphics and tabular data.

The 2016 A Policy on Design Standards – Interstate System (2016 Interstate Policy) and the 2018 A Policy on Geometric Design of Highways and Streets (2018 Greenbook), were used to establish criteria for identifying engineering deficiencies in the corridor. Where posted speeds exceed the minimum required by the 2016 Interstate Policy, the posted speed was used as the criteria. The Table 4 contains the criteria used for U.S. 412 corridor design deficiency identification. After the table, a summary of each of the seven planning segments is provided.

Table 4: Interstate Design Deficiency Identification Criteria

Design Criteria for design deficiency identification*								
Controlling Criteria								
1. Design Speed (mph)		50	55	60	65	70[1]	75[2]	80[2]
2. Lane Width		12'-0"						
3. Shoulder Width[3]	inside (2 lanes)	4'-0"						
	inside (3+ lanes)	10'-0"						
	outside (level/rolling)	10'-0"						
	outside (mountainous)	8'-0"						
4. Minimum Curve Radius	e_{max} = 6% (feet)	833	1060	1330	1660	2040	2500	3050
	e_{max} = 8% (feet)	758	960	1200	1480	1810	2210	2670
5. Superelevation		e_{max} = 8%						
6. Stopping Sight Distance[4]	distance (feet)	425	495	570	645	730	820	910
	crest K	84	114	151	193	247	312	384
	<non-controlling> sag K	96	115	136	157	181	206	231
7. Maximum grade[5]		4%	4%	3%	3%	3%	3%	3%
8. Cross Slope (lanes, on tangent)		1.5% (min)						
9. Vertical Clearance	non-inter-x road over hwy	16'-0"						
	hwy over non-inter-x road	14'-0"						
	interchange bridges	16'-0"						
	sign truss or ped overpass[6]	17'-0"						
10. Design Loading Structural Capacity		*presence of posted load limit signs*						
Additional Criteria								
11. Number of lanes	Two through traffic lanes for each direction of travel							
12. Median type	Medians should not drain across travel lanes							
13. Median width	50'-0" (min, rural); left shoulder width + barrier width (urban, mountainous)							
14. Curbs	4 inch height (max), sloped face, on outer edge of shoulder							
15. Access control	Fully controlled, including ramps							
16. Ramp spacing	See Figure 10-70, 2018 Greenbook							

* Sources: 2016 *A Policy on Design Standards – Interstate System* (2016 Interstate Policy)
2018 *A Policy on Geometric Design of Highways and Streets* (2018 Greenbook)

[1] 70mph minimum design speed for rural, non-mountainous interstate. 50mph min. in urban or mountainous terrain

[2] Not allowed in mountainous terrain

[3] Assumes portions of corridor in mountainous terrain are divided 2-lane sections

[4] Values for passenger cars on level roadway.

[5] Add 1% for rolling terrain. Add 2% for mountainous terrain. An additional 1% may be added in urban areas.

[6] On urban interstate routes with less than 16' clearance, min. clear to sign trusses shall be 1'-0" greater than the minimum vertical clearance of other structures

4.2 Cimarron Turnpike

This segment begins at I-35 (Mile Marker 0.0) and includes the ramps connecting to I-35. The segment ends at U.S. 64 (Mile Marker 59.0). The segment is functionally classified as a Principal Arterial-Other, operates as a turnpike, and is fully access controlled to non-authorized vehicles (law enforcement and maintenance are authorized). The posted speed is 75 mph along the segment, except for the location at

an existing toll plaza where all traffic is stopped or slowed to 30 mph. The entire segment is considered rural, and its location is considered to be rolling terrain. The entire segment was evaluated for interstate deficiencies, noting that the existing toll plaza at U.S. 177 and SH-99 is under construction for removal as part of an All-Electronic Tolling Conversion (AETC) project and is expected to be completed in 2023. **Tables 6 and 7** in **Appendix C** and baseline conditions exhibits in **Appendix D** show the identified deficiencies, which can be summarized as:

- Access Control – 3 locations for maintenance and emergency access (gated) and two identified to be addressed at U.S. 177 and SH-99
- Median Type – predominately flush median that drains across travel lanes with cable barrier down centerline. 11 locations with raised curb medians (bridges)
- Number of Interchange Ramp Lanes – 4 locations at the I-35 interchange which are single-lane ramps
- Stopping Sight Distance (Crest curve) – 1 location at the I-35 interchange
- Stopping Sight Distance (Sag curve) – 12 locations along the unlit corridor
- Superelevation Rate – 26 locations where the curve radius and superelevation combination do not meet the criteria for the posted speed
- Vertical Clearance – 3 overpass locations, two of which are assumed to be addressed with the OTA AET/Cashless Conversion projects

4.3 Keystone

This segment begins at U.S. 64 (Mile Marker 59.0), ends at I-244 (Mile Marker 83.7), and includes the I-244/U.S. 412 interchange on the west side of downtown Tulsa. The segment is functionally classified as a *Principal Arterial – Other* west of Sand Springs, Oklahoma (Mile Marker 74.2) and a *Principal Arterial – Other Freeways or Expressways* to the east, where it is also known as the Sand Springs Expressway. It is access-controlled with a singular exception at Diamond Head Drive. The posted speed is 75 mph for 2.5 miles east of U.S. 64, 65 mph through the Sand Springs Expressway portion, and 70 mph between the 65 mph and 75 mph portions. The segment is considered rural west of the N. 161st W. Avenue overpass (Mile Marker 73.1) and urban to the east. East of Mile Marker 75.0 the segment location is considered to be level terrain, while west is considered as rolling terrain. The entire segment was evaluated for interstate deficiencies. **Tables 8 and 9** in **Appendix C** and baseline conditions exhibits in **Appendix D** show the identified deficiencies, which can be summarized as such:

- Access Control – 1 location with an at-grade intersection (Diamond Head Drive)
- Curb – 1 location with outside shoulder curb height exceeding 4 inches
- Minimum Curve Radius – 2 locations with horizontal curve radii smaller than required at a maximum 8% superelevation
- Maximum Grade – 1 location that slightly exceeds the 4% maximum
- Median Type – 1 portion with a raised curb median which drains across travel lanes
- Ramp Spacing – 1 location with insufficient spacing between an exit and entrance
- Shoulder Width – 3 portions with insufficient, or no, shoulder width

- Stopping Sight Distance (Crest curve) – 10 locations along the expressway portion
- Stopping Sight Distance (Sag curve) – 1 location in the I-244 interchange
- Stopping Sight Distance (Horizontal curve) – 6 locations at bridges or within the I-244 interchange
- Superelevation Rate – 18 locations where the curve radius and superelevation do not meet the criteria for the posted speed
- Vertical Clearance – 12 underpass or overpass locations

4.4 Tulsa

This segment begins east of the I-244 interchange (Mile Marker 83.7) and ends just west of the I-44/Creek Turnpike interchange (Mile Marker 98.4). This segment is functionally classified as *Interstate* and is also designated as I-244 and I-44. It is fully access-controlled, has posted speeds that vary from 55 mph near downtown Tulsa and along westbound at the I-44 interchange to 65 mph, is entirely located in what is considered level terrain, and within an urban area. Due to the existing interstate designation, the segment, as described, was not evaluated for interstate deficiencies.

4.5 Inola

This segment begins at the west side of the I-44/Creek Turnpike interchange (Mile Marker 98.4) and includes the I-44 interchange. The segment ends at the U.S. 412 Alt/Cherokee Turnpike interchange (Mile Marker 125.0). This segment is functionally classified as *Principal Arterial – Other* and is not access-controlled. The existing posted speed is 65 mph from I-44 to SH-88, and 70 mph from SH-88 to the Cherokee Turnpike. The segment is considered to be located in level terrain west of the Cherokee Turnpike interchange (Mile Marker 125.1) and rolling terrain from the west side of the interchange to the east. The segment is located within an urban zone west of the N 225th overpass (Mile Marker 99.1) and rural to the east. The entire segment was evaluated for interstate deficiencies. **Tables 10 and 11** in **Appendix C** and baseline conditions exhibits in **Appendix D** show the identified deficiencies, which can be summarized as such:

- Access Control – 24 locations with at-grade intersections
- Maximum Grade – 6 locations with profile grades exceeding the 3% maximum
- Median Width – 1 portion through the I-44 interchange with a 40'-0" median with cable barrier
- Number of Lanes – 1 location eastbound at the Cherokee Turnpike with a single through lane
- Stopping Sight Distance (Crest Curve) – 1 location near the SH-88 interchange
- Stopping Sight Distance (Sag Curve) – 1 unlit location within the I-44 interchange
- Superelevation Rate – 12 locations where the curve radius and superelevation do not meet the criteria for an interstate

4.6 Cherokee Turnpike

This segment begins at the U.S. 412 Alt. interchange (Mile Marker 125.0) and ends at the U.S. 59/412 Alt. interchange (Mile Marker 158.1). The segment is functionally classified as a *Principal Arterial – Other*, operates as a turnpike, and is fully access controlled within the turnpike limits. The existing posted speed varies from 75 mph to 80 mph through most of the corridor and is posted 65 mph westbound near the end of the turnpike. Westbound through the U.S. 412 Alt. interchange is posted 35 mph at a result of the transition to the turnpike and eastbound is posted 55 mph. The entire segment is rural and located in what is considered rolling terrain. The entire segment was evaluated for interstate deficiencies. **Tables 12, 13, and 14** in **Appendix C** and baseline conditions exhibits in **Appendix D** show the identified deficiencies, which can be summarized as such:

- Maximum Grade – 1 location in the U.S. 59/412 Alt interchange along westbound with grades exceeding the 4% maximum
- Minimum Curve Radius – 10 locations with horizontal curve radii smaller than required at a maximum 8% superelevation
- Median Width – The entire segment has a 40'-0" median with no cable barrier present
- Number of Lanes – 3 locations where the U.S. 412 through movement is a single lane, at interchange ramp locations on either end of the segment
- Shoulder Width – 3 locations at the U.S. 412 Alt interchange bridge (Rose/Leach access point)
- Stopping Sight Distance (Crest Curve) – 13 locations
- Stopping Sight Distance (Sag Curve) – 12 locations
- Stopping Sight Distance (Horizontal) – 8 locations, 2 related to vegetation and 6 at bridges, 4 of which are mitigated by vertical profile
- Superelevation Rate – 37 locations where the curve radius and superelevation do not meet the criteria for the posted speed.

4.7 Siloam Springs

This segment begins at the U.S. 59/412 Alt. interchange (Mile Marker 158.1), crosses the Arkansas state line (Mile Marker 166.6/Arkansas Mile Marker 0.0) and ends at Airport Road in East Siloam Springs. The segment is functionally classified as a *Principal Arterial – Other*, and is not access controlled. The existing posted speed varies along the segment from 45 mph in West Siloam Springs to 70 mph. Speed limits near the U.S. 412 Alt. interchange drop to 55 mph. West of N. 4700 Rd (Mile Marker 162.5), the segment is considered rural, and to the east is considered an urban zone of West Siloam Springs. The entire segment is in rolling terrain. The portion of the segment evaluated for interstate deficiencies is the divided highway portion, which ends within West Siloam Springs (Mile Marker 165.7). The undivided portion of highway to the east was not evaluated for interstate deficiencies due to the high density of driveways, at-grade intersections, lower design speeds, and proximity of developed properties which would, qualitatively, have a significant impactful to the surrounding community to bring the existing facility to interstate

standards. **Tables 15 and 16** in **Appendix C** and baseline conditions exhibits in **Appendix D** show the identified deficiencies, which can be summarized as such:

- Access Control – 25 locations of at-grade intersections and 26 locations of at-grade driveways
- Minimum Curve Radius – 1 location with a horizontal curve radius smaller than required at a maximum 8% superelevation
- Maximum Grade – 6 locations with profile grades exceeding the 4% maximum
- Median Type – 1 portion with no shoulder and raised curb median in the transition from divided highway to 4-lane through West Siloam Springs.
- Median Width – 1 portion with 40'-0" median width and no cable barrier near the U.S. 412 Alt interchange
- Shoulder Width – 1 portion along eastbound west of West Siloam Springs with insufficient inside shoulder width
- Stopping Sight Distance (Crest Curve) – 2 locations
- Stopping Sight Distance (Sag Curve) – 4 locations
- Superelevation Rate – 5 locations where the curve radius and superelevation do not meet the criteria for the posted speed

4.8 Springdale #1 & #2

The Springdale #1 segment begins at Airport Road in East Siloam Springs (beginning of divided section) and ends at the Old Highway 68 intersection in Tontitown where the divided highway ends. The segment is functionally classified as a *Principal Arterial – Other*, and is not access controlled. The existing posted speed varies from 45 mph within Siloam Springs to 65 mph in the divided highway section east of Airport Road. The divided highway section between Airport Road (Mile Marker 5.2) and Wildcat Creek Road just west of Tontitown (Mile Marker 14.8) is considered rural, the rest of the segment is considered urban, with Siloam Springs on the west end and Tontitown on the east end. The entire segment is assumed to be located within rolling terrain. The divided highway portion between Airport Road (Mile Marker 5.2) and Old Highway 68 (Mile Marker 16.2) was evaluated for interstate deficiencies.

The Springdale #2 segment contains the Springdale Northern Bypass, which re-routes U.S. 412 from Old Highway 68 (Mile Marker 16.2) to I-49 on the west side of Springdale Arkansas. It is assumed that the future Springdale Northern Bypass (Arkansas State Highway 612/Future U.S. 412) will be designed and constructed to interstate standards and was thus not evaluated for interstate deficiencies. Tables 17 and 18 in **Appendix C** and baseline conditions exhibits in **Appendix D** show the identified deficiencies for the Springdale #1 segment, which can be summarized as such:

- Access Control – 22 locations of at-grade intersections
- Minimum Curve Radius – 1 location with a horizontal curve radius smaller than required at a maximum 8% superelevation
- Maximum Grade – 4 locations with profile grades exceeding the 4% maximum
- Stopping Sight Distance (Crest Curve) – 3 locations

- Stopping Sight Distance (Sag Curve) – 2 locations
- Stopping Sight Distance (Horizontal) – 4 locations at bridges, 2 of which are mitigated by vertical profile
- Superelevation Rate – 11 locations where the curve radius and superelevation do not meet the criteria for the posted speed.

5.0 Planned Projects

5.1 Methodology and Project Information

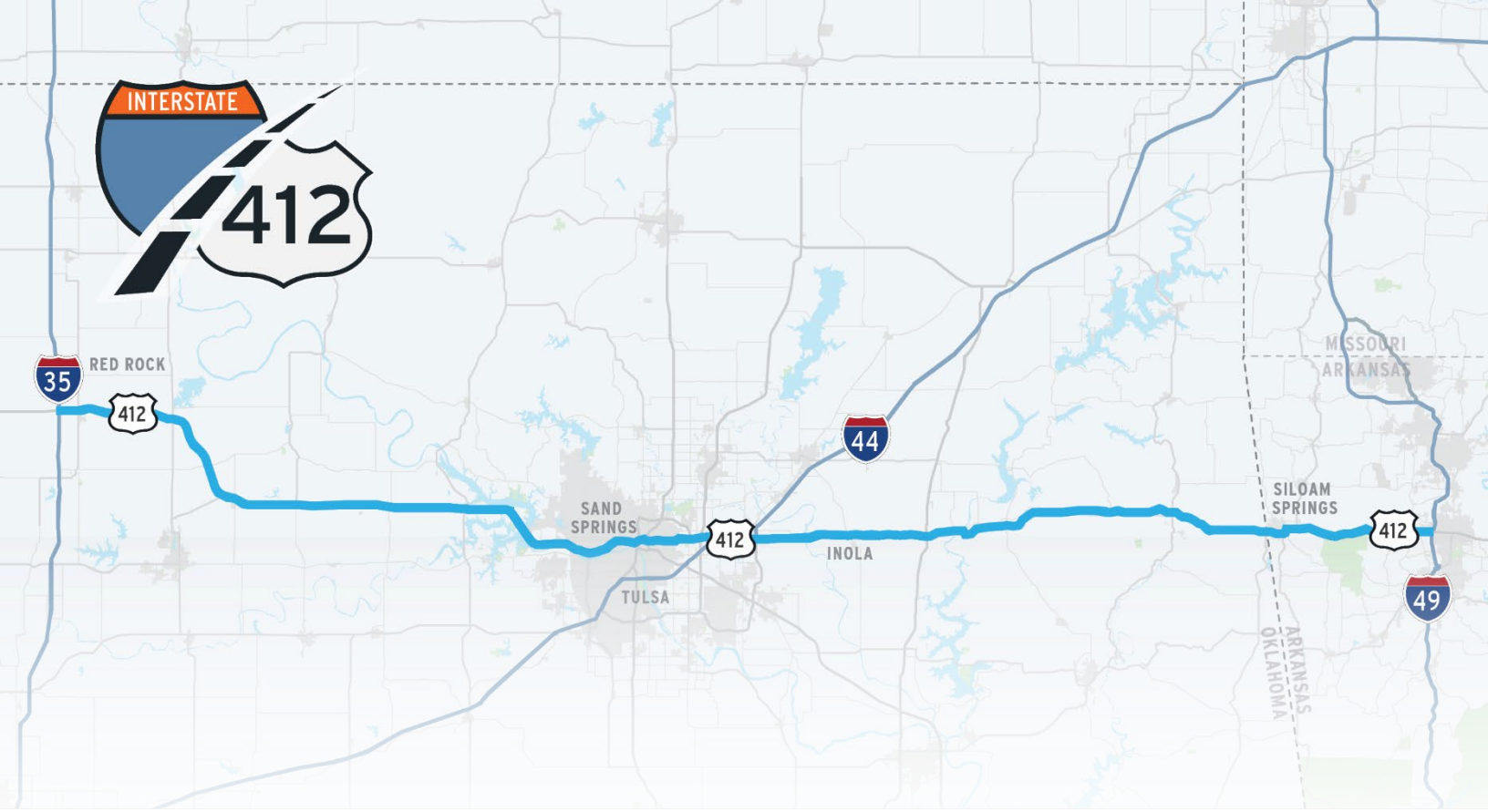
The corridor was evaluated for current and future planned projects that impact the conversion of existing U.S. 412 to a future interstate. ODOT's 8-year construction workplan, ARDOT's 2023-2026 Statewide Transportation Improvement Program (STIP) and OTA's ACCESS Program and Capital Plan Program (2023-2027) were reviewed for projects in the U.S. 412 corridor. Projects from these sources that address design deficiencies such as replacing at-grade intersections with grade separated and access-controlled facilities, cable median barrier addressing cross over collisions and safety, and new interchanges/by-pass routes were identified and noted in **Table 5** below, and can be seen in **Appendix E**. Preservation projects like pavement rehabilitation, bridge repair, or intersection improvement projects were excluded. The Springdale Northern Bypass (Highway 412-Highway 112) is the only project that is identified at this time to be outside the existing U.S. 412 alignment. One new access point has been identified as part of the OTA ACCESS Program on the Cimarron Turnpike at SH-108 near Glencoe.

Table 5: Planned Corridor Projects

Ref. Point	Project #	Work Category	SEGMENT	Project Description	Planned Year	Agency
1	C-MC-27	AET CONVERSION	CIMARRON	US-412/US-177 & US-412/SH-99 TOLL PLAZA CASHLESS TOLLING CONVERSION	2023	OTA
2	CIM-33001	ACCESS PROGRAM	CIMARRON	NEW INTERCHANGE AT SH-108 NEAR GLENCOE	TBD	OTA
3	3640804	GRADE, DRAIN & SURFACE	KEYSTONE	US-64: FROM ~0. 5 MILES EAST OF SH-48, EXTEND EAST ~ 2 MILES TO ARKANSAS RIVER	2029	ODOT
4	3635304	INTERCHANGE	KEYSTONE	US-64: AT DIAMOND HEAD RD APPROX. 0.5 MILES WEST OF SH-151	2026	ODOT
5	3511104	INTERCHANGE	KEYSTONE	US-64: AT 65TH W. AVE, APPROX. 4 MILES WEST OF I-244	TBD	ODOT
6	3549304	INTERCHANGE	INOLA	SH-66/I-44/US-412: (OPERATIONAL IMPROVEMENTS)	2024	ODOT
7	3109305	INTERCHANGE	INOLA	US-412: AT 265TH E AVE, APPROX. 2.8 MILES EAST OF I-44 JCT	2025	ODOT
8	3636904	BRIDGE & APPROACHES	INOLA	US-412: AT 289TH E AVE. APPROX. 4.3 MILES EAST OF I-44 JCT	2025	ODOT
9	1998311	INTERCHANGE	INOLA	SH-412P: INTERCHANGE AT US-412, 5.37 MI EAST OF I-44	2025	ODOT
10	3551007	INTERCHANGE	INOLA	US-412: AT 4170 RD	2024	ODOT
11	3640904	INTERCHANGE	INOLA	US-412: AT 4190 RD APPROX. 1.50 MILES WEST OF SH-88	2029	ODOT
12	3641004	INTERCHANGE	INOLA	US-412: AT 4240RD APPROX. 16.8 EAST OF I-44	2029	ODOT
13	3109104	GRADE,DRAIN,BRIDGE & SURFACE	INOLA	US 69: BEGIN AT MAYES/WAGONER CL AND EXTEND NORTH APPROX 6.7 MI SB	2024	ODOT
14	3505004	INTERCHANGE	INOLA	SH-412B: AT US-412 JUNCTION	2024	ODOT
15	3551005/06	RIGHT OF WAY /UTILITIES	INOLA	US-412: VERDIGRIS RIVER NAVIGATION CHANNEL EXTEND EAST 6.0 MILES TO SH-88	2028	ODOT
16	3632805/06	RIGHT OF WAY /UTILITIES	INOLA	US-412: FROM SH-88 EXTEND EAST APPROX 14 MILES TO CHEROKEE TURNPIKE	2029	ODOT
17	CHT-MC-11	POSITIVE BARRIER	CHEROKEE	CHEROKEE TURNPIKE: POSITIVE BARRIER MP 0-32	2023	OTA
18	090250	MAJOR WIDENING	SILOAM SPRINGS	WASHINGTON ST - EAST (HWY. 412) (SILOAM SPRINGS) (PROJECT DEVELOPMENT ONLY)	2025	ARDOT
19	012326	NEW LOCATION	SPRINGDALE	HWY. 412- HWY. 112 (SPRINGDALE BYPASS)	2025	ARDOT
**NOTE: ONLY PLANNED PROJECTS ARE SHOWN THAT IMPACT CONVERSION OF US 412 TO INTERSTATE STANDARDS ARE LISTED						

Source: ODOT's 8-year construction workplan, ARDOT's 2023-2026 Statewide Transportation Improvement Program (STIP) and OTA's ACCESS Program and Capital Plan Program (2023-2027) were reviewed for projects in the U.S. 412 corridor

**Note: Project Ref. Point 18 (Job 090250) only provides funding for Project Development.*



OKLAHOMA Transportation

ARDOT ARKANSAS DEPARTMENT OF TRANSPORTATION

OKLAHOMA Turnpike Authority

U.S. Department of Transportation Federal Highway Administration

U.S. 412: from I-35 in Noble County, Oklahoma
to I-49 in Benton County, Arkansas

PEL Study

Traffic, Safety and Engineering Constraints Existing Conditions Report

Appendix A – Travel Speed Analysis by Segment

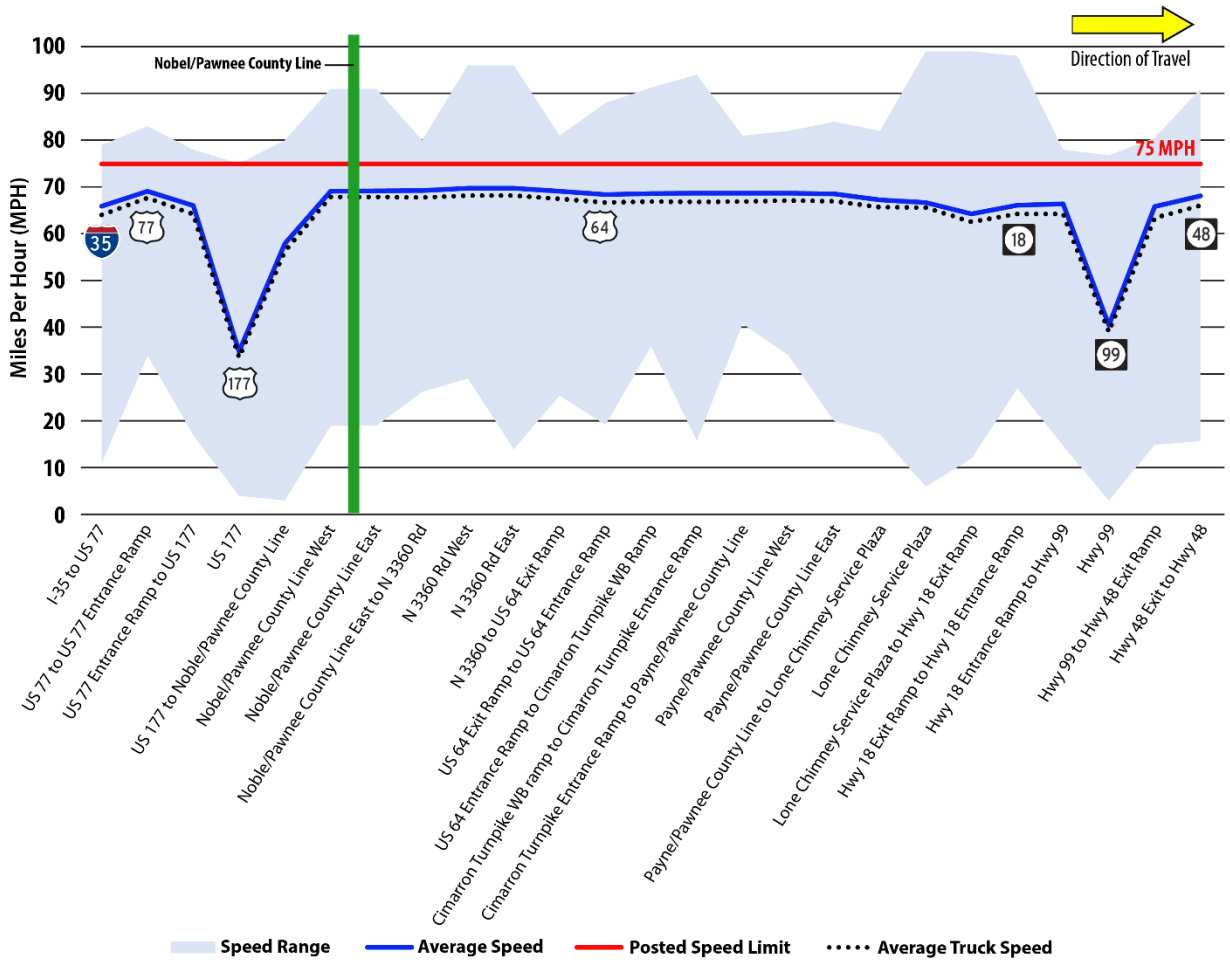
The following appendix provides existing travel speed by planning segment for the U.S. 412 corridor.

Cimarron Turnpike

Eastbound AM Passenger and Truck Travel Speeds

Eastbound morning peak period traffic between the hours of 7 AM and 9 AM. Speeds for both passenger vehicles and trucks consistently stay 5-10 mph below the posted speed limit of 75 mph and closely mirror one another across the full length of the segment, with significant drops in speed at U.S. 177 and State Highway 99 due to toll plazas.

Figure A- 1: Cimarron EB AM Travel Speeds



Source: NPMRDS (National Performance Management Research Data Set), Jan. 1, 2019 to Dec. 31, 2019.

The average passenger car and truck speed along the Cimarron Turnpike in the eastbound direction during the AM peak hour is between 33 and 64 mph from the U.S. 77 entrance ramp to U.S. 177 to Noble/Pawnee County line west. Average speeds recover to 67 mph, 8 mph below the posted speed of 75 mph, between

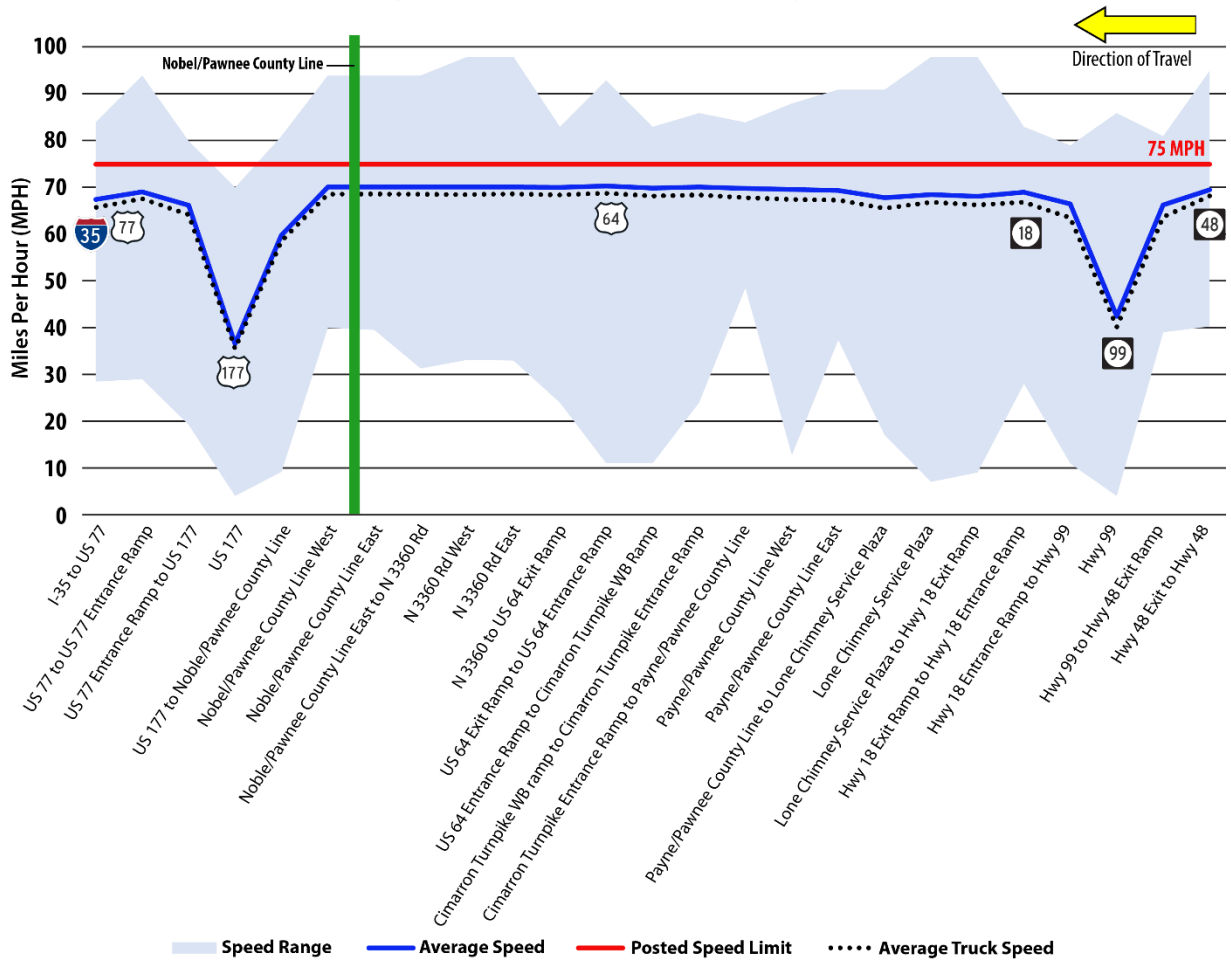
the Noble/Pawnee County line west and Highway 18 exit ramp. Average speeds range from 39 to 64 mph between the Highway 18 exit ramp and the Highway 48 Exit ramp. The data shows that eastbound speeds range from 5 to 95 mph for the entire segment.

A large range of speed could be attributed to a crash, construction, hazardous weather, or other incident that may have occurred at one time in the corridor when the data was pulled but is also representative of the lack of reliability in the corridor. This is true with many of the other planning segments also so this text will not be repeated.

Westbound AM Passenger and Truck Travel Speeds

Westbound morning peak period traffic between the hours of 7 AM and 9 AM. Speeds for both passenger vehicles and trucks consistently stay 5-10 mph below the posted speed limit of 75 mph and closely mirror one another across the segment, with significant drops in speed at Highway 99 and U.S. 177 due to toll plazas.

Figure A- 2: Cimarron WB AM Travel Speeds



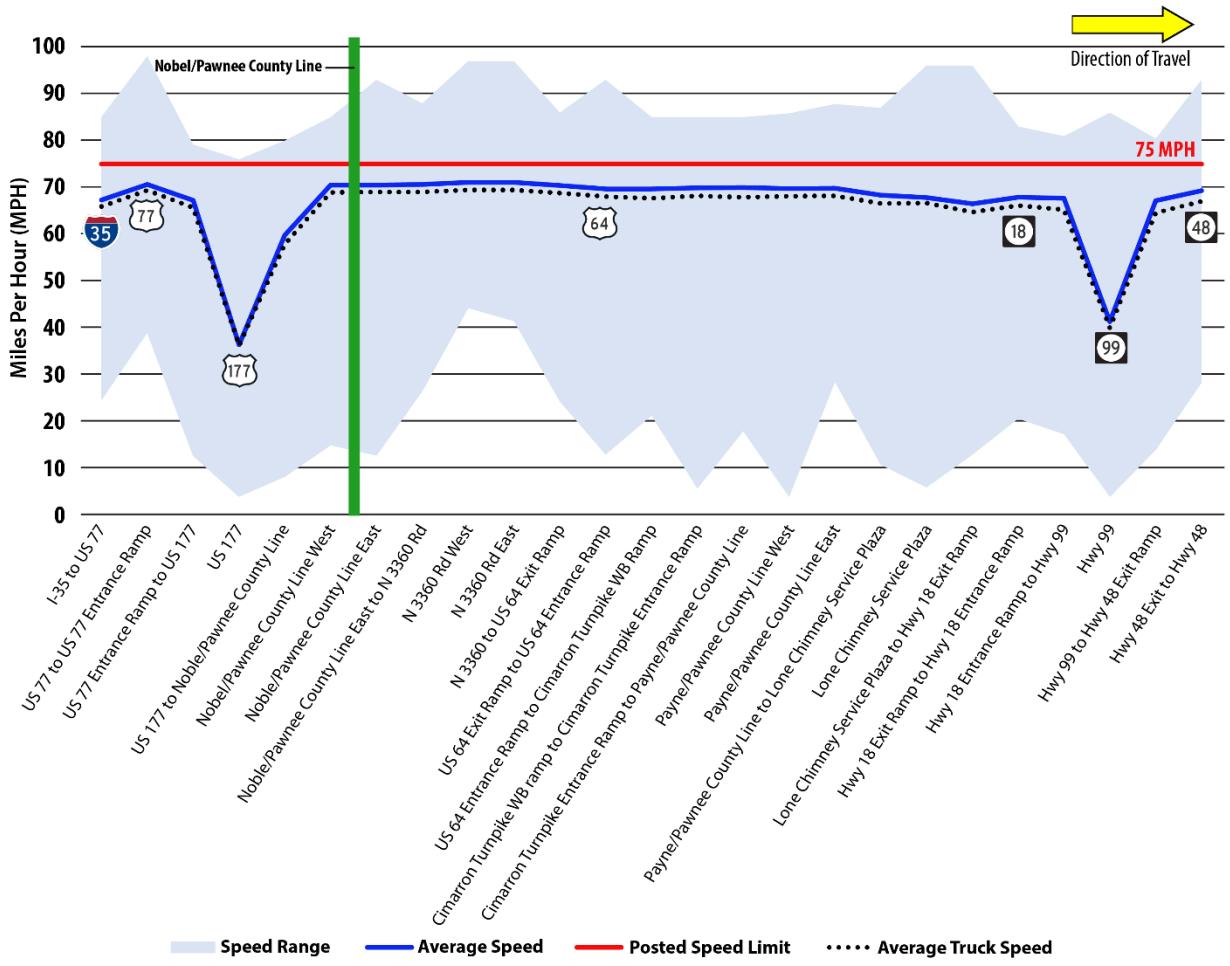
Source: NPMRDS (National Performance Management Research Data Set), Jan. 1, 2019 to Dec. 31, 2019.

The average passenger car and truck speed along the Cimarron Turnpike in the westbound direction during the AM peak hour is between 40 and 65 mph from Highway 48 entrance ramps to Highway 99 to Highway 18 exit ramp. Speeds recover to an average of 70 mph, 5 mph below the posted speed of 75 mph, between Highway 18 exit ramp and the Noble/Pawnee County Line West. Speeds range from 40 to 70 mph between the Noble/Pawnee County line west to the Highway 177 to U.S. 77 Exit ramp. The data shows that westbound speeds range from 5 to 95 mph for the entire segment.

Eastbound PM Passenger and Truck Travel Speeds

Eastbound evening peak period traffic between the hours of 4 PM and 6 PM is shown below. Speeds for both passenger vehicles and trucks consistently stay 5-10 mph below the posted speed limit of 75 mph and closely mirror one another across the full length of the segment, with significant drops in speed at U.S. 177 and Highway 99 due to toll plazas.

Figure A- 3: Cimarron EB PM Travel Speeds



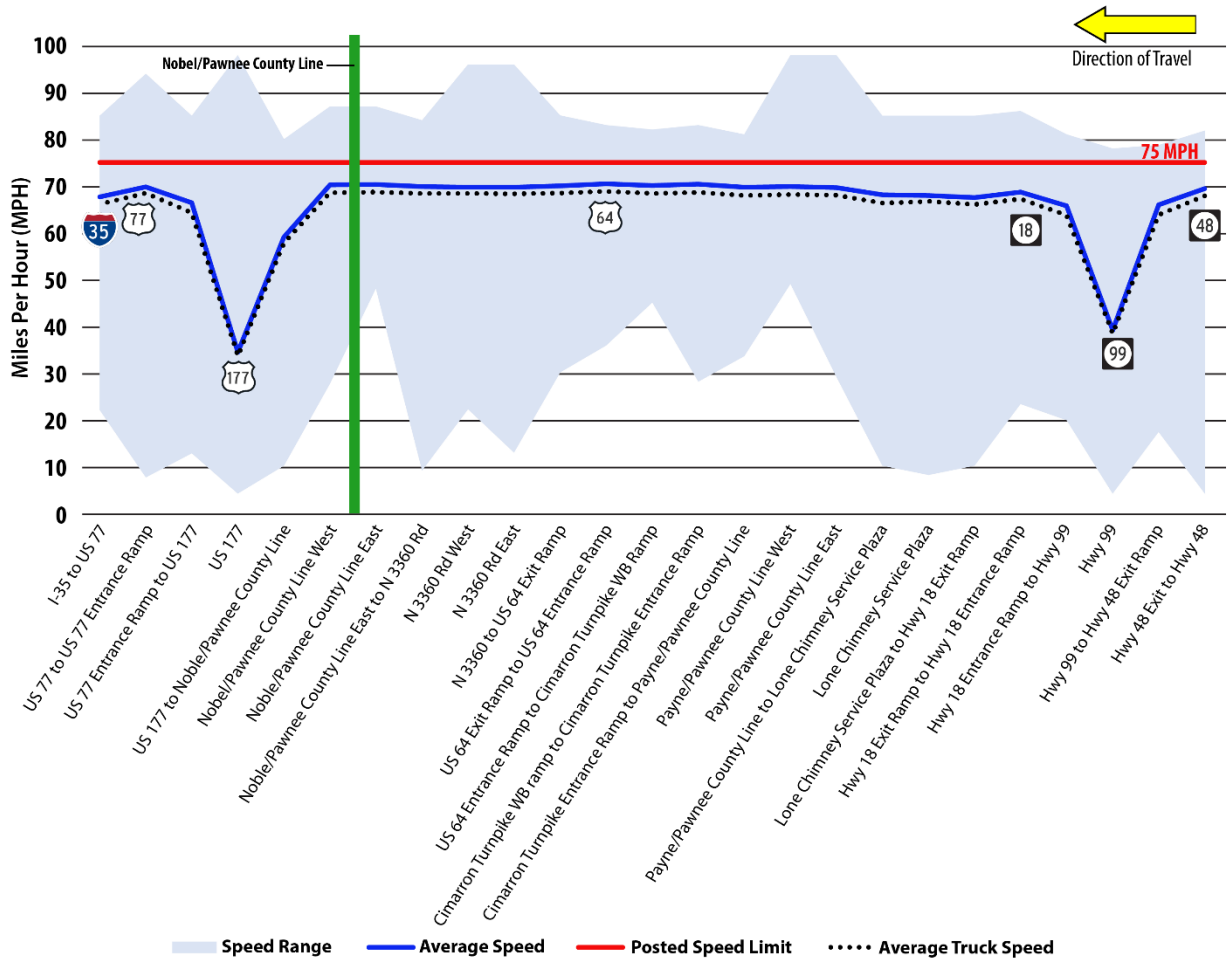
Source: NPMRDS (National Performance Management Research Data Set), Jan. 1, 2019 to Dec. 31, 2019.

The average passenger car and truck speed along the Cimarron Turnpike in the eastbound direction during the PM peak hour is between 66 and 69 mph and 36 mph from the U.S. 77 entrance ramp to Noble/Pawnee County Line East. Speeds recover to 65 to 69 mph, 6 to 10 mph below the posted speed of 75 mph, between Noble/Pawnee County Line East to Highway 18 entrance ramp/Highway 99. Speeds range from 34 to 69 mph between Highway 18 entrance ramp/Highway 99 and the Highway 99/Highway 48 exit ramp. The data shows that eastbound speeds range from 5 to 95 mph for the entire segment.

Westbound PM Passenger Car and Truck Travel Speeds

Westbound evening peak period traffic between the hours of 4 PM and 6 PM is shown below. Speeds for both passenger vehicles and trucks consistently stay 5-10 mph below the posted speed limit of 75 mph and closely mirror one another across the full length of the segment, with significant drops in speed at Highway 99 and U.S. 177 due to toll plazas.

Figure A- 4: Cimarron WB PM Travel Speeds



Source: NPMRDS (National Performance Management Research Data Set), Jan. 1, 2019 to Dec. 31, 2019.

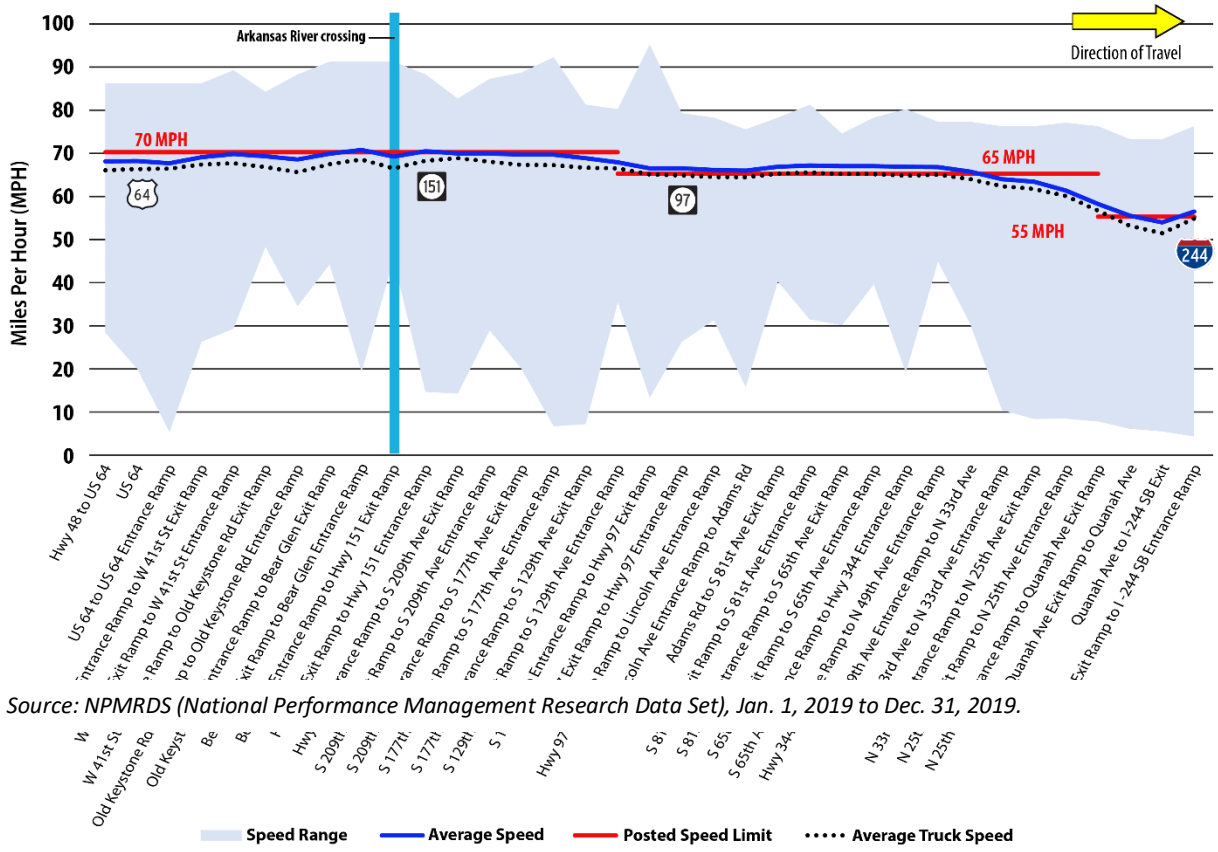
The average passenger car and truck speed along the Cimarron Turnpike in the westbound direction during the PM peak hour is between 64 and 38 mph from the Highway 48 entrance ramp/Highway 99 to Highway 99 to Highway 18 exit ramp. Speeds recover to 68 mph, 7 mph below the posted speed of 75 mph, between the Highway 99 to Highway 18 exit ramp to Noble/Pawnee County Line West. Speeds range from 69 to 34 mph between Noble/Pawnee County Line West and the U.S. 77 exit ramp. The data shows that westbound speeds range from 5 to 95 mph for the entire segment.

Keystone

Eastbound AM Passenger and Truck Travel Speeds

Eastbound morning peak period traffic between the hours of 7 AM and 9 AM is presented in this section. Speeds limits vary from 55 mph to 65 mph to 70 mph. Passenger vehicles travel just above the speed limit in the 65 mph section. Truck speeds are slightly slower than the passenger vehicle speeds but follow the similar speed patterns.

Figure A- 5: Keystone EB AM Travel Speeds



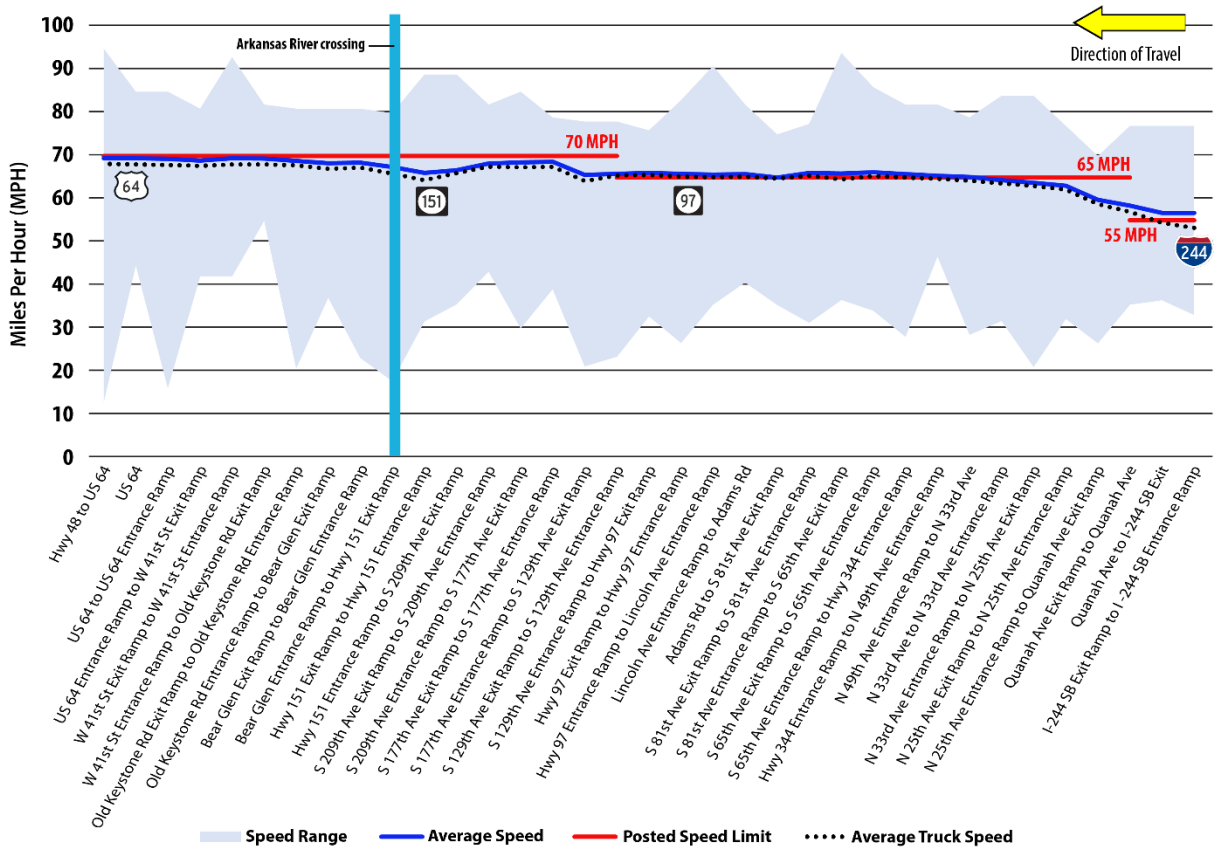
Source: NPMRDS (National Performance Management Research Data Set), Jan. 1, 2019 to Dec. 31, 2019.

The average passenger car and truck speed along the Keystone segment in the eastbound direction during the AM peak hour remain steady at around the 65 mph posted speed limit until the speed limit lowers to 55 mph at N 25th Ave entrance ramp/Quanah Ave exit ramp. From I-244 SB exit ramp/I-244 NB entrance ramp to N 25th Ave exit ramp/N 25th Ave entrance ramp where speeds lower to the posted limit. The data shows that westbound speeds range from 5 to 95 mph for this segment.

Westbound AM Passenger and Truck Travel Speeds

Westbound morning peak period traffic between the hours of 7 AM and 9 AM is presented in this section. Speeds limits vary from 55 mph to 65 mph to 70 mph. Both average passenger vehicles and trucks generally maintain the posted speeds of 55 and 65 mph in this planning segment.

Figure A- 6: Keystone WB AM Travel Speeds



Source: NPMRDS (National Performance Management Research Data Set), Jan. 1, 2019 to Dec. 31, 2019.

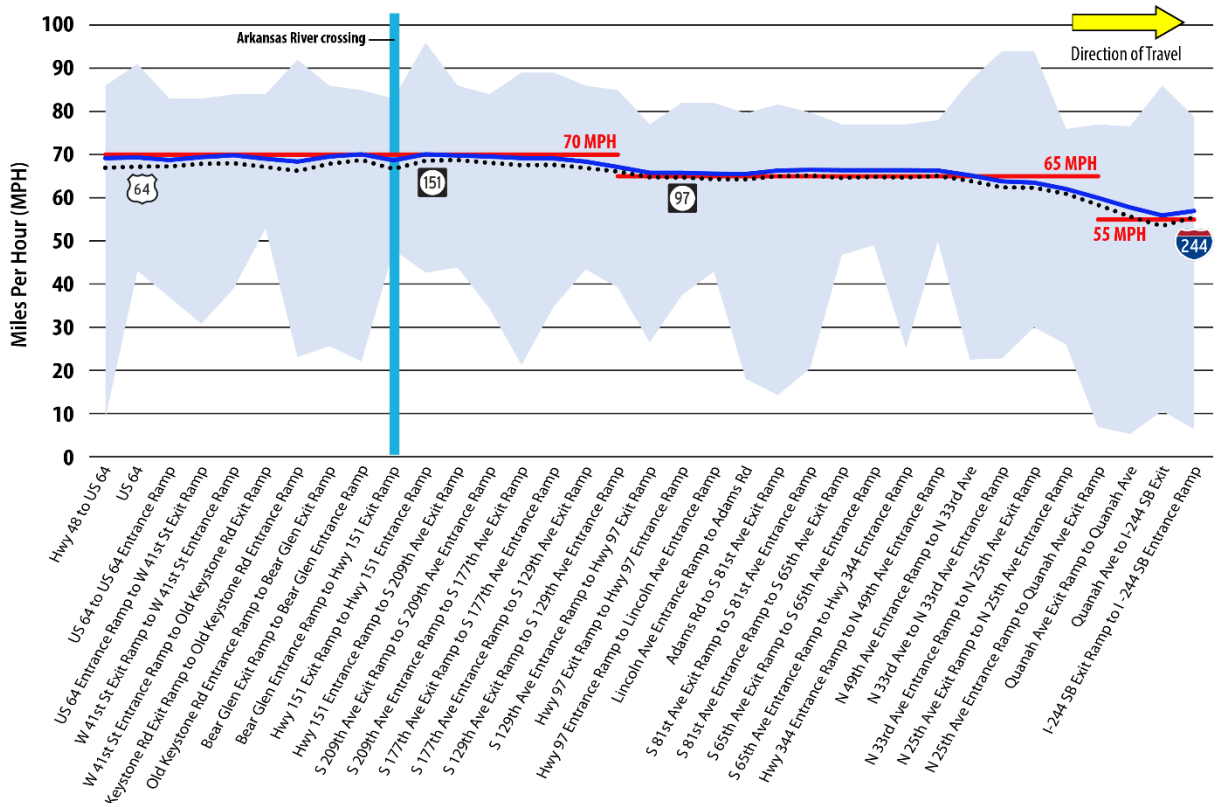
The average passenger car and truck speeds along the Keystone segment in the westbound direction during the AM peak hour is between 55 and 62 mph from I-244 SB exit ramp/I-244 NB entrance ramp to N 25th Ave exit ramp/N 25th Ave entrance ramp. Speeds recover to 65 mph, which is also the posted speed

until around S 177th Ave exit ramp/S 177th Ave entrance ramp. The data shows that westbound speeds range from 25 to 93 mph in this planning segment.

Eastbound PM Passenger and Truck Travel Speeds

Eastbound evening peak period traffic between the hours of 4 PM and 6 PM is presented in this section. Speeds limits vary from 55 mph to 65 mph to 70 mph. Passenger vehicles travel just above the speed limit in the 65 mph segment. Truck speeds are slightly slower than the passenger vehicle speeds but follow the similar speed patterns.

Figure A- 7: Keystone EB PM Travel Speeds



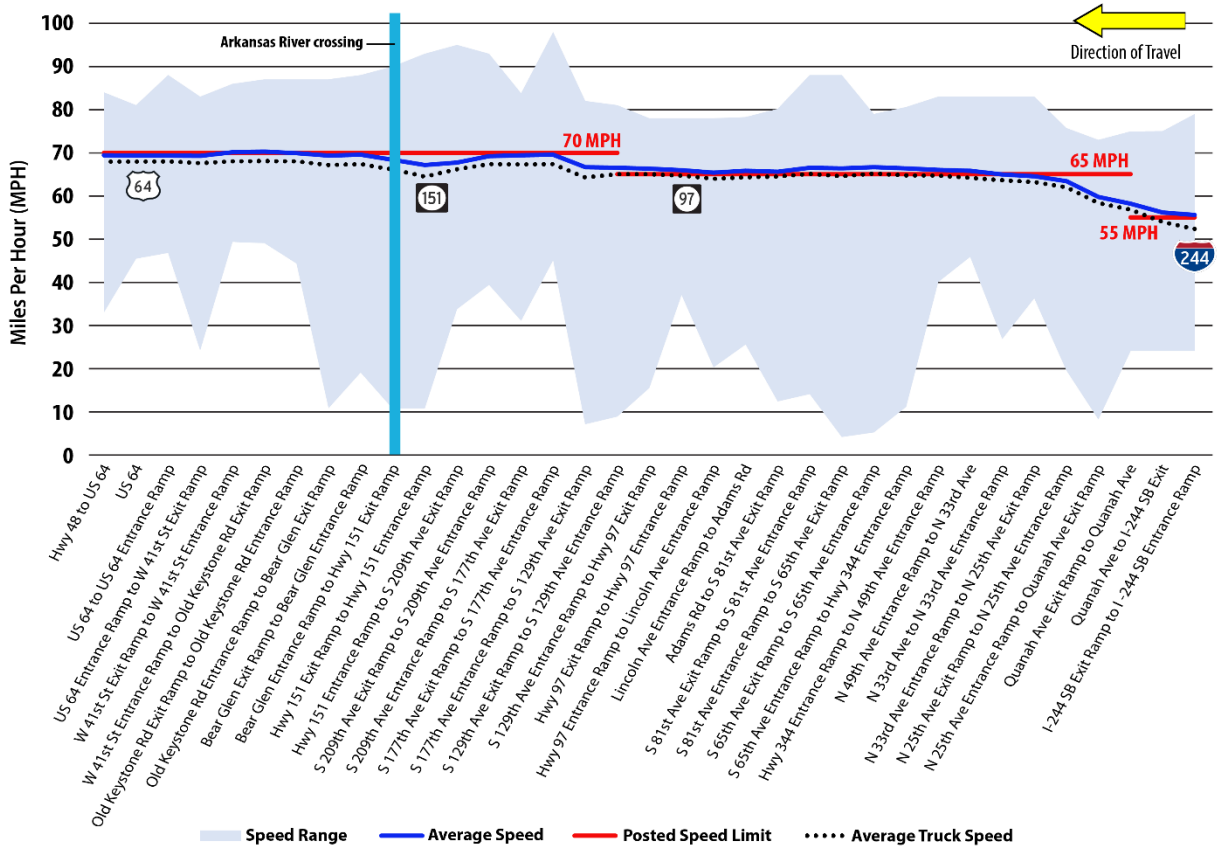
Source: NPMRDS (National Performance Management Research Data Set), Jan. 1, 2019 to Dec. 31, 2019.

The average passenger car and truck speed along the Keystone segment in the eastbound direction during the PM peak hour remain steady at around the 65 mph posted speed limit until the speed limit lowers to 55 mph at N 25th Ave entrance ramp/Quanah Ave exit ramp. From I-244 SB exit ramp/I-244 NB entrance ramp to N 25th Ave Exit Ramp/N 25th Ave entrance ramp where speeds lower to the posted limit. The data shows that eastbound speeds range from 5 to 93 mph in this planning segment.

Westbound PM Passenger and Truck Travel Speeds

Westbound evening peak period traffic between the hours of 4 PM and 6 PM is presented in this section. Speeds limits vary from 55 mph to 65 mph to 70 mph. Both passenger vehicles and trucks generally maintain the posted speeds of 55 and 65 mph. Truck speeds during the evening peak periods are slightly slower than passenger vehicles.

Figure A- 8: Keystone WB PM Travel Speeds



Source: NPMRDS (National Performance Management Research Data Set), Jan. 1, 2019 to Dec. 31, 2019.

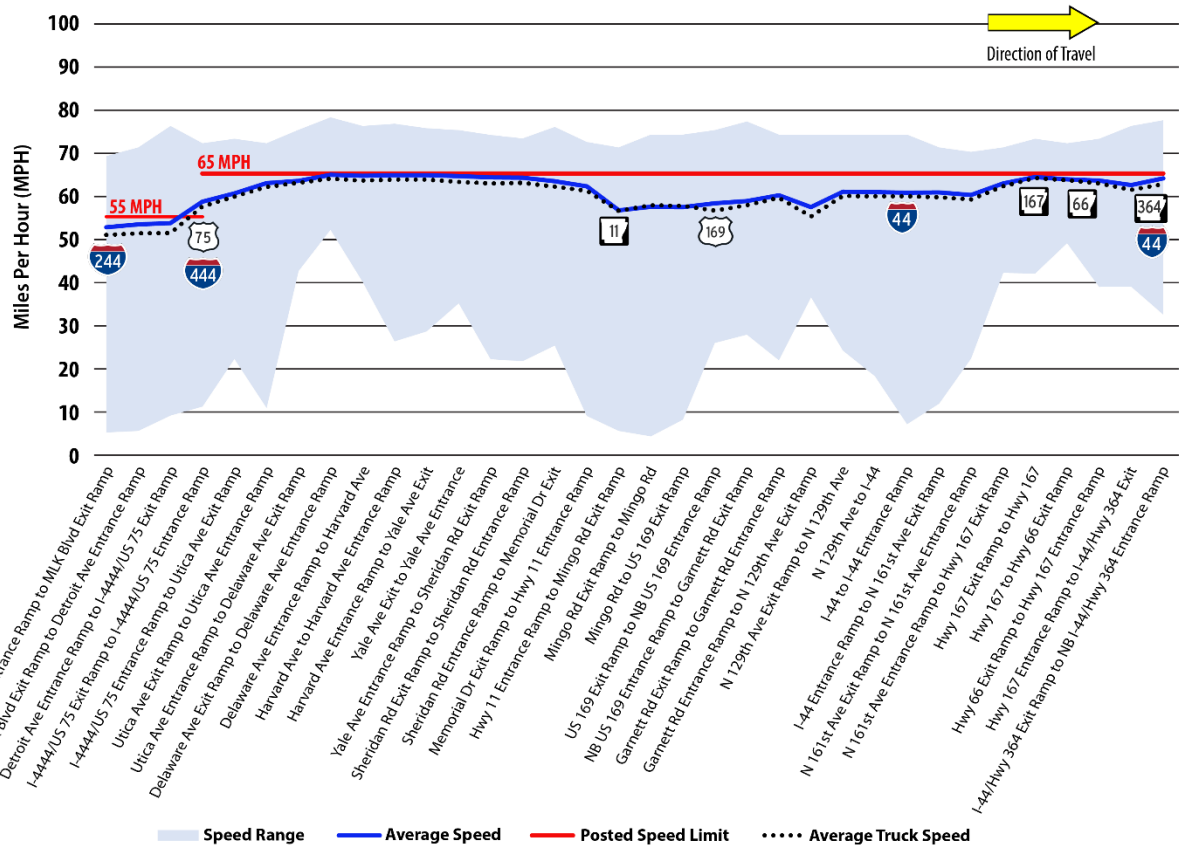
The average passenger car and truck speed along the Keystone segment in the westbound direction during the PM peak hour is between 55 and 62 mph from I-244 SB exit ramp/I-I-244 NB entrance ramp to N 25th Ave exit ramp/N 25th Ave entrance ramp. Speeds maintain 65 mph, which is also the posted speed, for the remainder of the segment. The data shows that westbound speeds range from 9 to 95 mph for this planning segment.

Tulsa

Eastbound AM Passenger and Truck Travel Speeds

Eastbound morning peak period traffic between the hours of 7 AM and 9 AM is presented in this section. Posted speed limits vary from 55 mph to 65 mph. Both passenger vehicles and trucks speeds decrease to about 10 mph below the posted 65 mph speed limit at Highway 11 and slowly increase back to 65 mph at Highway 167.

Figure A- 9: Tulsa EB AM Travel Speeds



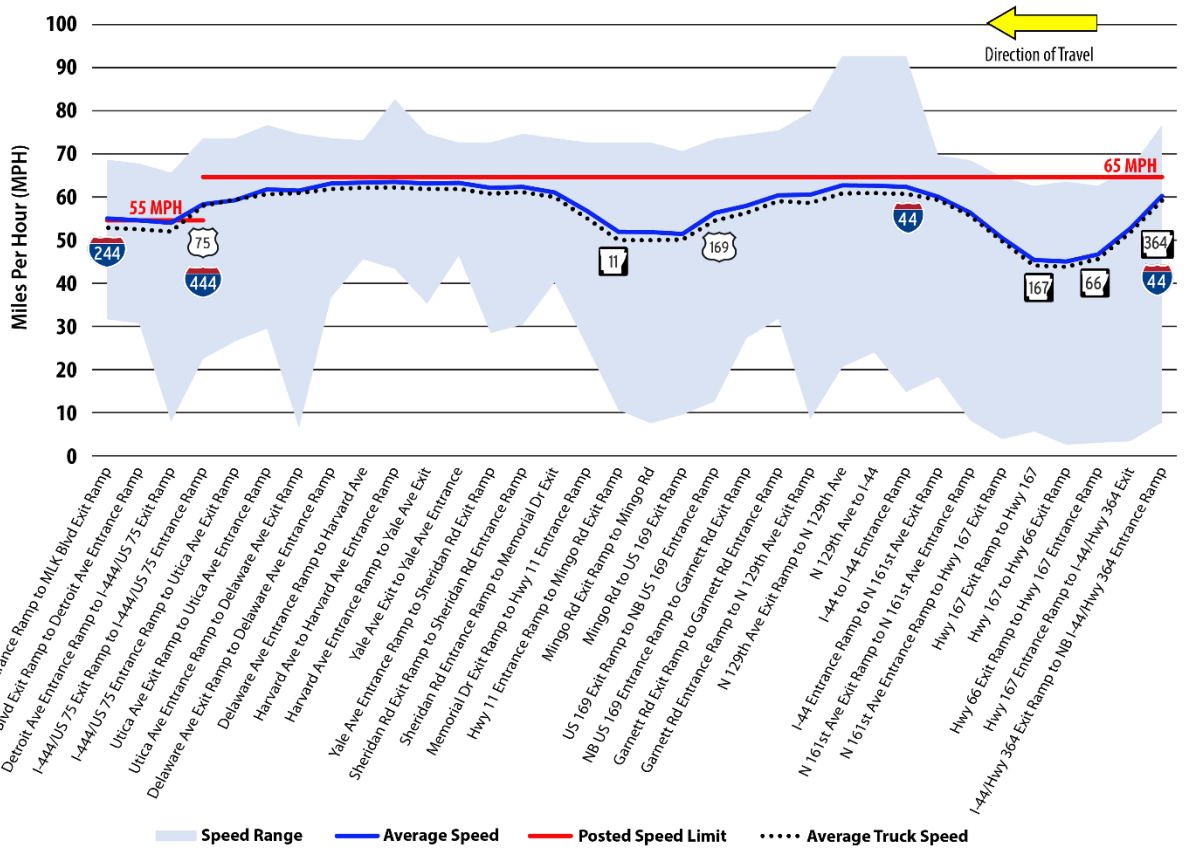
Source: NPMRDS (National Performance Management Research Data Set), Jan. 1, 2019 to Dec. 31, 2019.

The average passenger car and truck speeds along the Tulsa segment in the eastbound direction during the AM peak hour is between 51 mph and slowly increases near the posted speed of 65 mph at Delaware Ave exit ramp/Delaware Ave entrance ramp. Speeds slowly decrease to 56 mph at Highway 11 entrance ramp/Mingo exit ramp and remain below the posted speed limit for the remainder of the segment. The data shows that eastbound speeds range from 5 to 78 mph in this planning segment.

Westbound AM Passenger and Truck Travel Speeds

Westbound morning peak period traffic between the hours of 7 AM and 9 AM is presented in this section. Posted speed limits vary from 55 mph to 65 mph. Both passenger vehicles and trucks speeds decrease to about 20 mph below the posted 65 mph speed limit at Highway 167, slowly increase back to approximately 63 mph at I-44 and decrease again to around 50 mph at U.S. 169.

Figure A- 10: Tulsa WB AM Travel Speeds



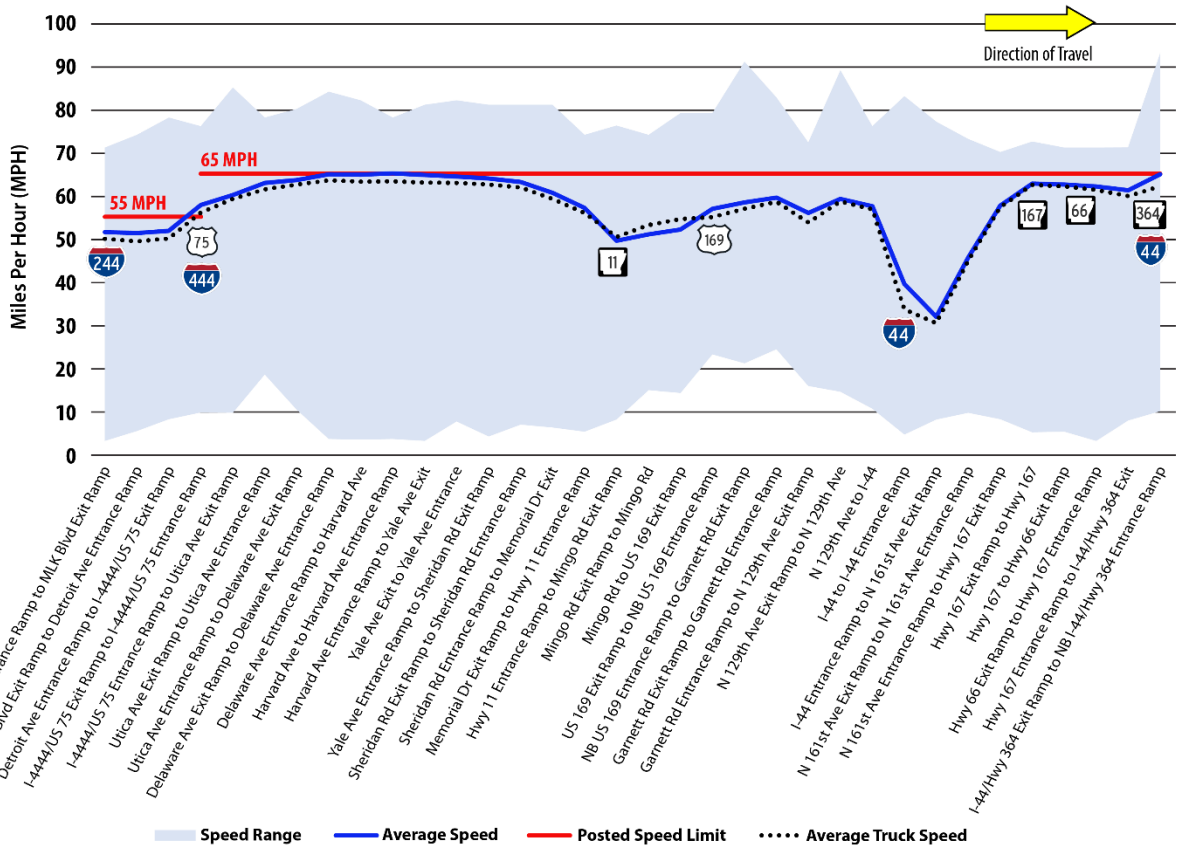
Source: NPMRDS (National Performance Management Research Data Set), Jan. 1, 2019 to Dec. 31, 2019.

The average passenger car and truck speeds along the Tulsa segment in the westbound direction during the AM peak hour is between 44 mph and 59 mph from NB Highway 364 exit ramp/SB Highway 364 entrance ramp to Hwy 167 Exit Ramp/Hwy 167 entrance ramp. Speeds slowly recover to 61 mph, 4 mph below the posted speed of 65 mph until N 129th Ave entrance ramp/Garnett Rd exit ramp where speeds gradually reduce to 50 mph until Highway 11 exit ramp/Highway 11 entrance ramp where they slowly recover to the posted speed limit of 65 mph. The data shows that westbound speeds range from 5 to 93 mph in this planning segment.

Eastbound PM Passenger and Truck Travel Speeds

Eastbound evening peak period traffic between the hours of 4 PM and 6 PM is presented in this section. Posted speed limits vary from 55 mph to 65 mph. Both passenger vehicles and trucks speeds decrease to about 10 mph below the posted 65 mph speed limit at Highway 11 and decrease to around 30 mph at I-44.

Figure A- 11: Tulsa EB PM Travel Speeds



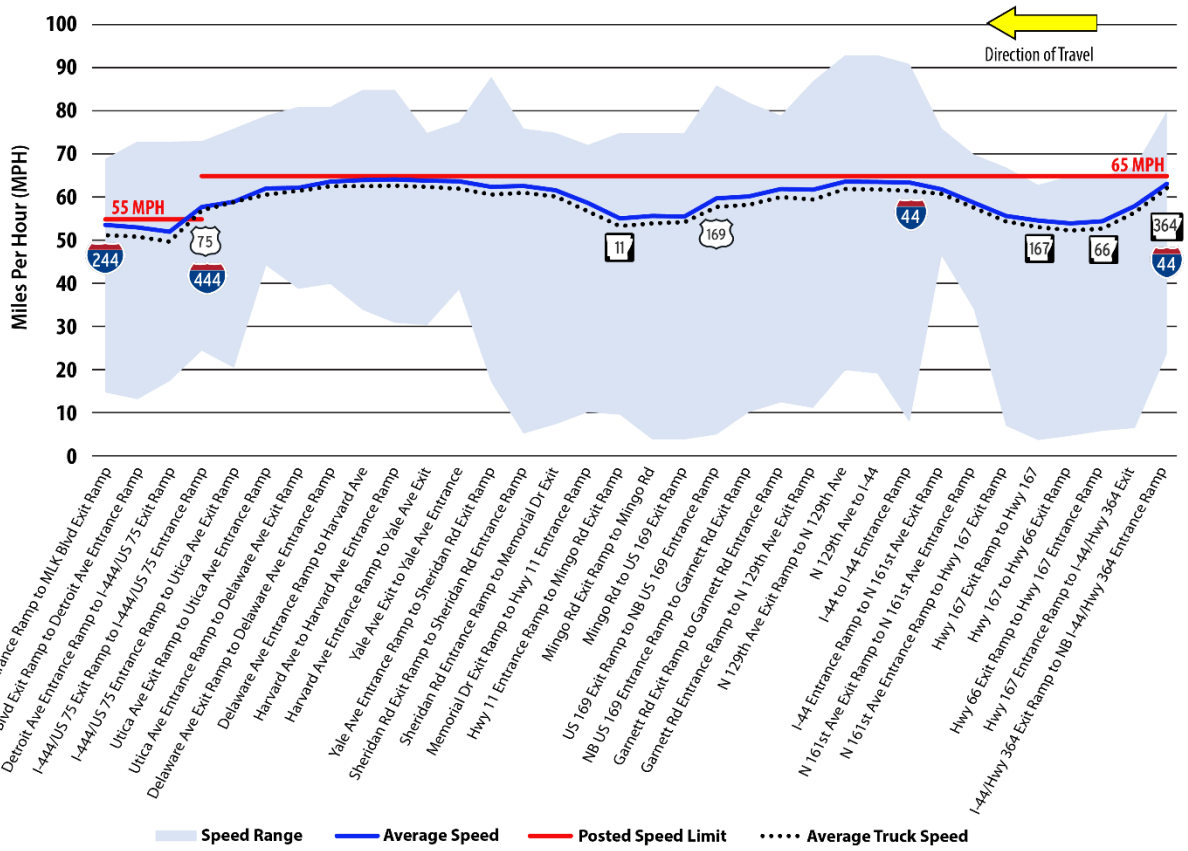
Source: NPMRDS (National Performance Management Research Data Set), Jan. 1, 2019 to Dec. 31, 2019.

The average passenger car and truck speeds along the Tulsa segment in the eastbound direction during the PM peak hour to be 49 mph at I-244 NB entrance ramp/MLK Blvd and slowly increasing to near the posted speed of 65 mph at Delaware Ave exit ramp/Delaware Ave entrance ramp. Speeds slowly decrease to 50 mph at Highway 11 entrance ramp/Mingo exit ramp and remain below the posted speed limit for the remainder of the segment. A sharp decrease in speed occurred at N 195th Ave/I-44, lowering speeds to 30 mph at I-44 entrance ramp/N 161st Ave exit ramp. Speeds gradually rebound near but below the posted speed limit. The data shows that eastbound speeds range from 5 to 91 mph in this planning segment.

Westbound PM Passenger and Truck Travel Speeds

Westbound evening peak period traffic between the hours of 4 PM and 6 PM is presented in this section. Posted speed limits vary from 55 mph to 65 mph. Both passenger vehicles and truck speeds decrease to about 10 mph below the posted 65 mph speed limit at Highway 11 and slowly increase back to 65 mph at Highway 167.

Figure A- 12: Tulsa WB PM Travel Speeds



Source: NPMRDS (National Performance Management Research Data Set), Jan. 1, 2019 to Dec. 31, 2019.

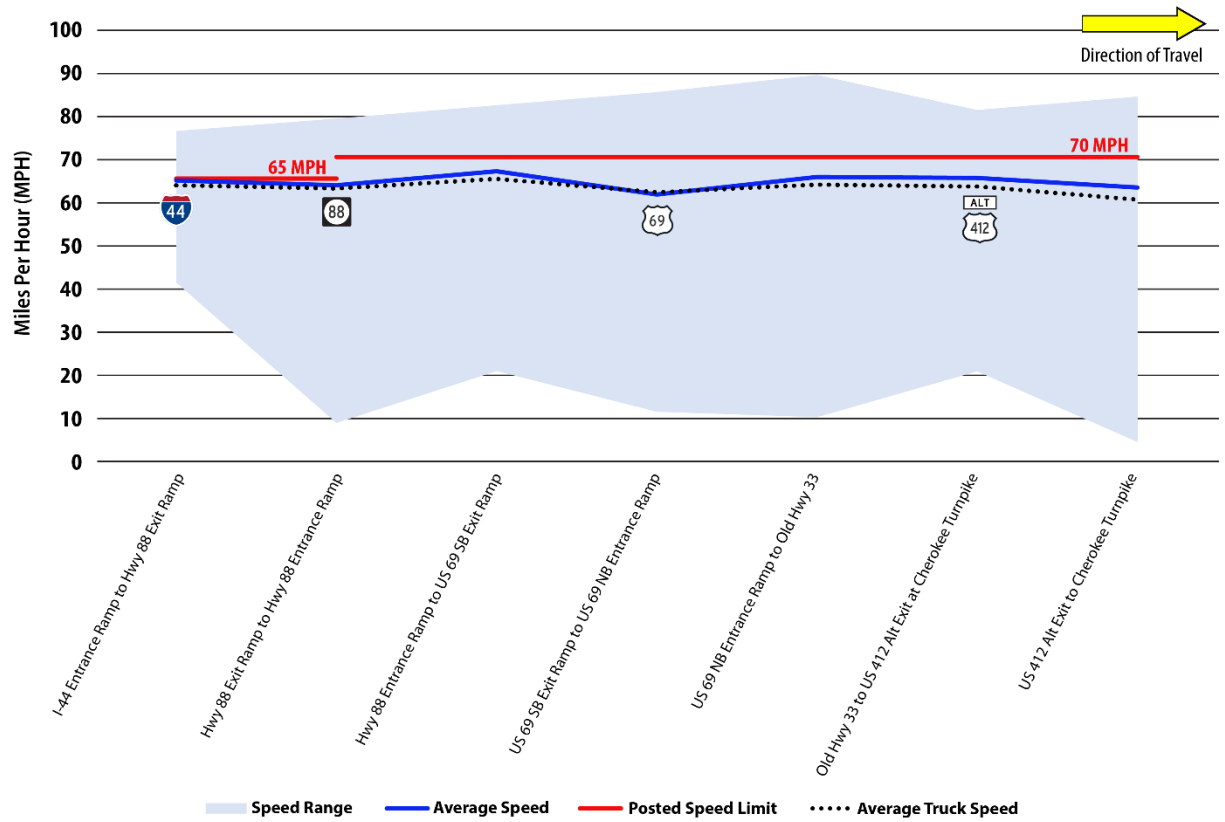
The average passenger car and truck speeds along the Tulsa segment in the westbound direction during the PM peak hour is between 52 mph and 62 mph from NB Highway 364 exit ramp/SB Highway 364 entrance ramp to Highway 167 Exit Ramp/Highway 167 entrance ramp. Speeds slowly recover to 61 mph, 4 mph below the posted speed of 65 mph until N 129th Ave entrance ramp/Garnett Rd exit ramp where speeds gradually reduce to 53 mph until Highway 11 exit ramp/Highway 11 entrance ramp where they slowly recover to the posted speed limit of 65 mph, until speed limits reduce at Delaware Ave entrance/Utica Ave exit. The data shows that westbound speeds range from 5 to 93 mph in this segment.

Inola

Eastbound AM Passenger and Truck Travel Speeds

Eastbound morning peak period traffic between the hours of 7 AM and 9 AM is presented in this section. Posted speed limits vary from 65 mph to 70 mph. Both passenger vehicles and truck speeds hover around 5 to 10 mph below the posted speed limit of 70 mph throughout most of the corridor.

Figure A- 13: Inola EB AM Travel Speeds



Source: NPMRDS (National Performance Management Research Data Set), Jan. 1, 2019 to Dec. 31, 2019.

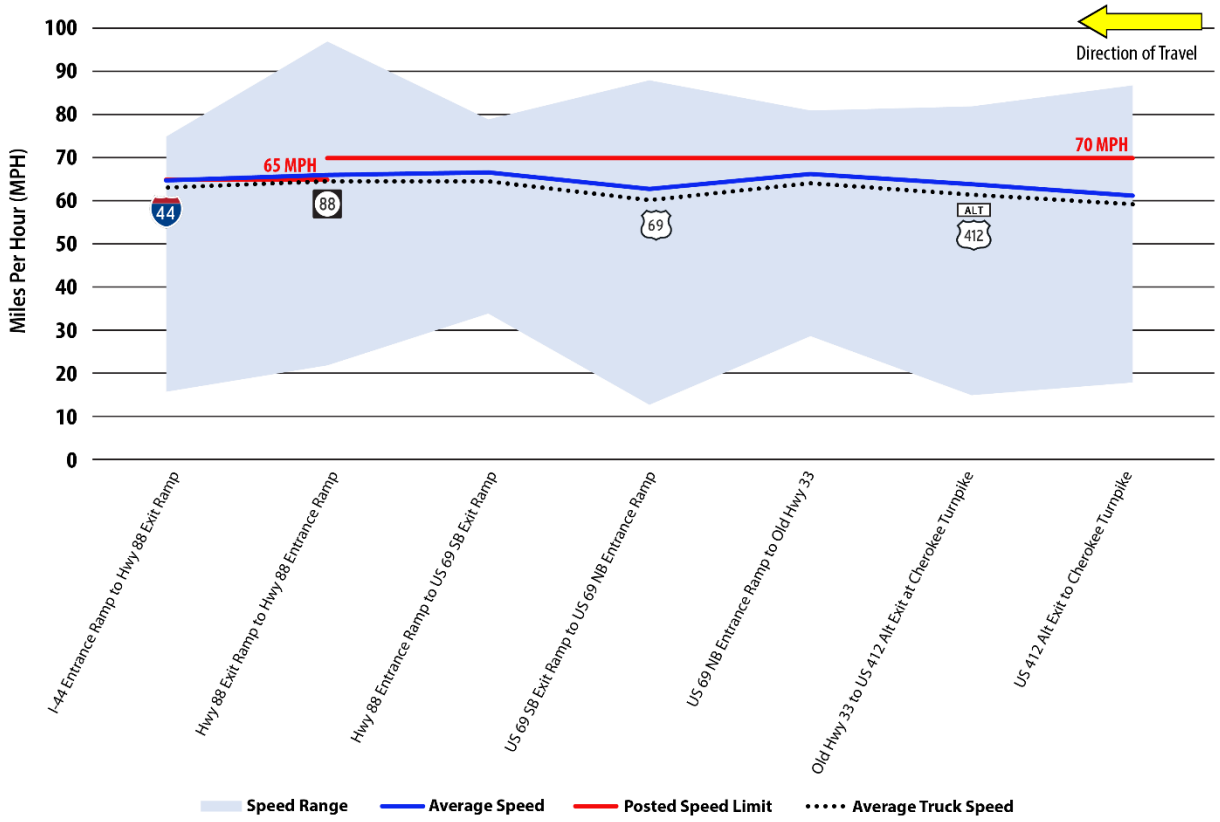
The average passenger car and truck speeds along the Inola segment in the eastbound direction during the AM peak hour is between 60 mph and 65 mph for the full length of the segment, from Highway 88 entrance ramp/I-44 NB Exit ramp to Cherokee Turnpike/U.S. 412 entrance ramp. The data shows that eastbound speeds range from 6 to 89 mph in this planning segment.

Westbound AM Passenger and Truck Travel Speeds

Westbound morning peak period traffic between the hours of 7 AM and 9 AM is presented in this section. Posted speed limits vary from 65 mph to 70 mph. Both passenger vehicles and truck speeds hover around

5 to 10 mph below the posted speed limit of 70 mph throughout most of the corridor. Truck speeds are a 2 to 3 mph slower than passenger vehicles, across the entire segment.

Figure A- 14: Inola WB AM Travel Speeds



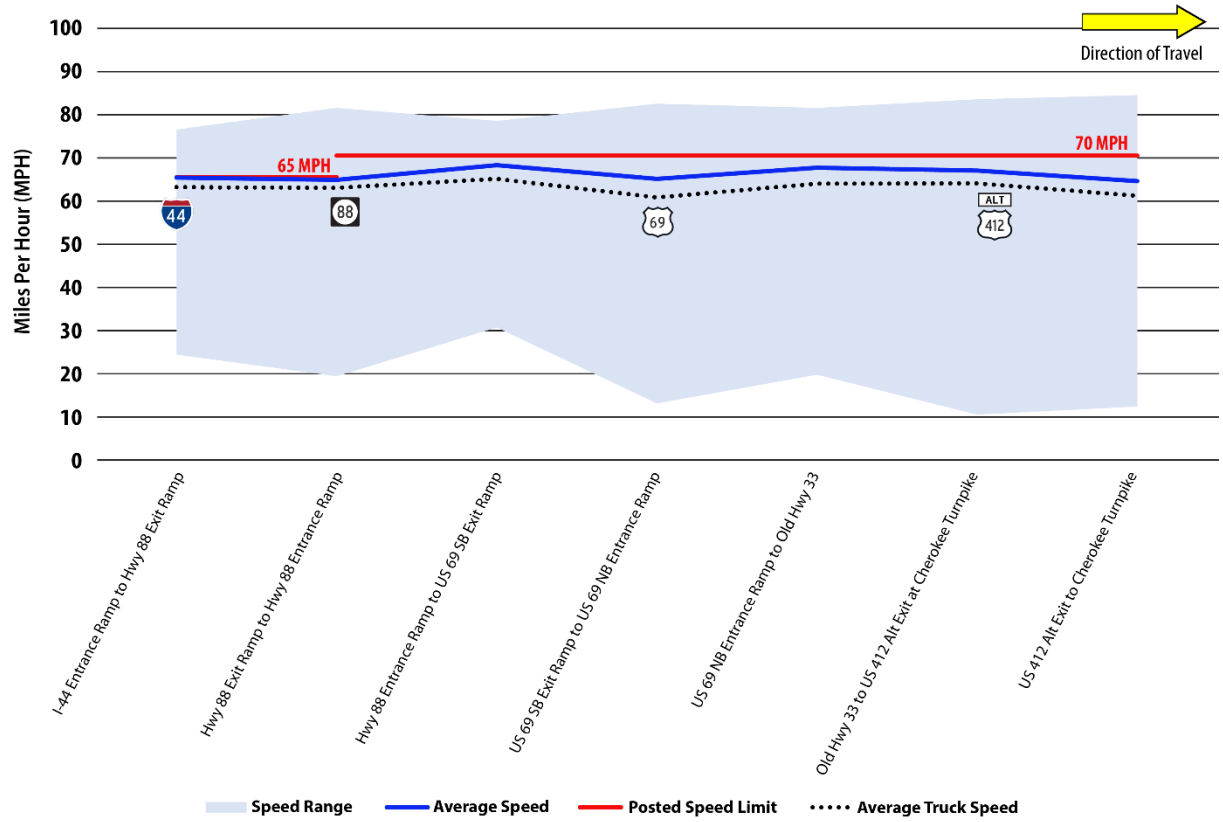
Source: NPMRDS (National Performance Management Research Data Set), Jan. 1, 2019 to Dec. 31, 2019.

The average passenger car and truck speeds along the Inola segment in the westbound direction during the AM peak hour is between 59 mph and 65 mph from Cherokee Turnpike/U.S. 412 entrance ramp to Highway 88 entrance ramp to I-44 NB exit ramp. The data shows that westbound speeds range from 12 to 95 mph in this planning segment.

Eastbound PM Passenger and Truck Travel Speeds

Eastbound evening peak period traffic between the hours of 4 PM and 6 PM is presented in this section. Posted speed limits vary from 65 mph to 70 mph. Passenger vehicle speeds are around 3 mph higher during PM travel compared to AM travel. Truck speeds, however, remain about the same as AM travel, at around 5 to 10 mph slower across the segment.

Figure A- 15: Inola EB PM Travel Speeds



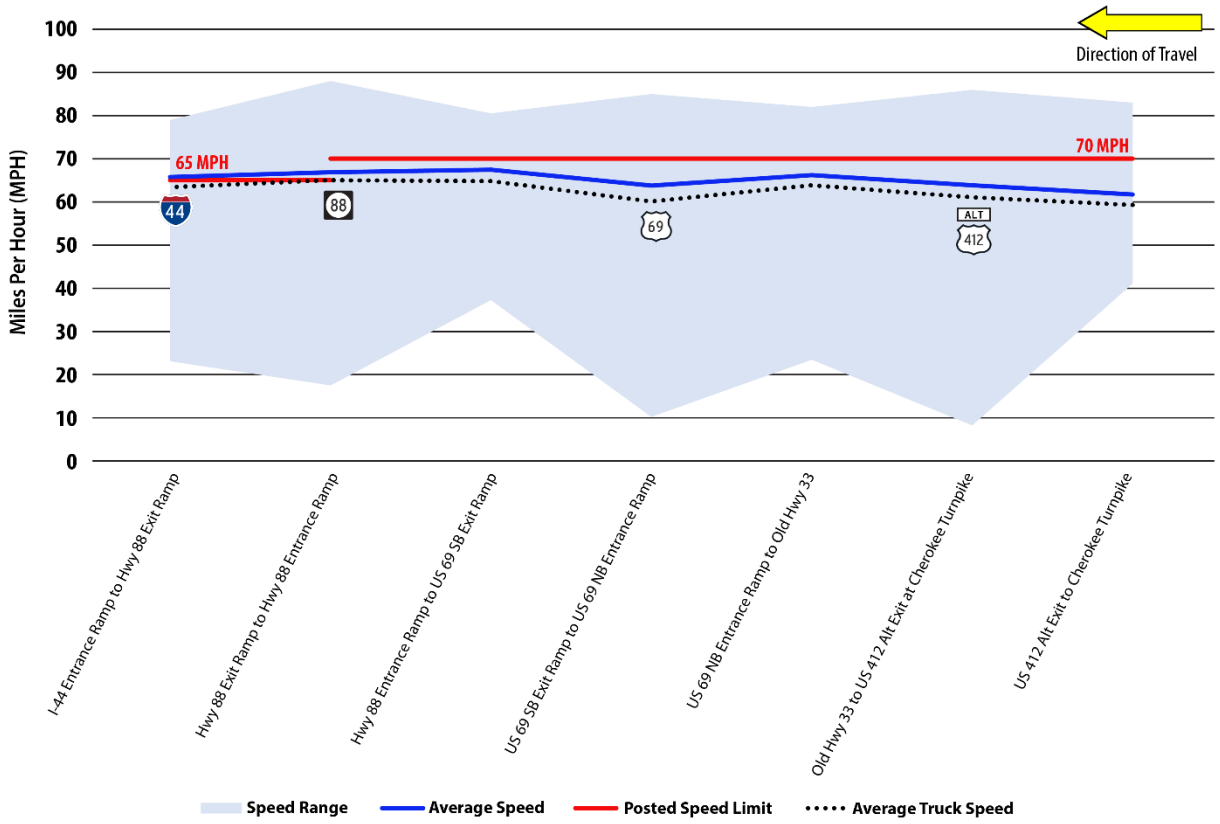
Source: NPMRDS (National Performance Management Research Data Set), Jan. 1, 2019 to Dec. 31, 2019.

The average passenger car and truck speeds along the Inola segment in the eastbound direction during the PM peak hour is between 59 mph and 67 mph from I-44 NB exit ramp to Cherokee Turnpike entrance. The data shows that westbound speeds range from 11 to 83 mph.

Westbound PM Passenger and Truck Travel Speeds

Westbound evening peak period traffic between the hours of 4 PM and 6 PM is presented in this section. Posted speed limits vary from 65 mph to 70 mph. Passenger vehicle speeds are slightly higher during PM travel compared to AM travel. PM truck speeds remain the same as AM across the segment.

Figure A- 16: Inola WB PM Travel Speeds



Source: NPMRDS (National Performance Management Research Data Set), Jan. 1, 2019 to Dec. 31, 2019.

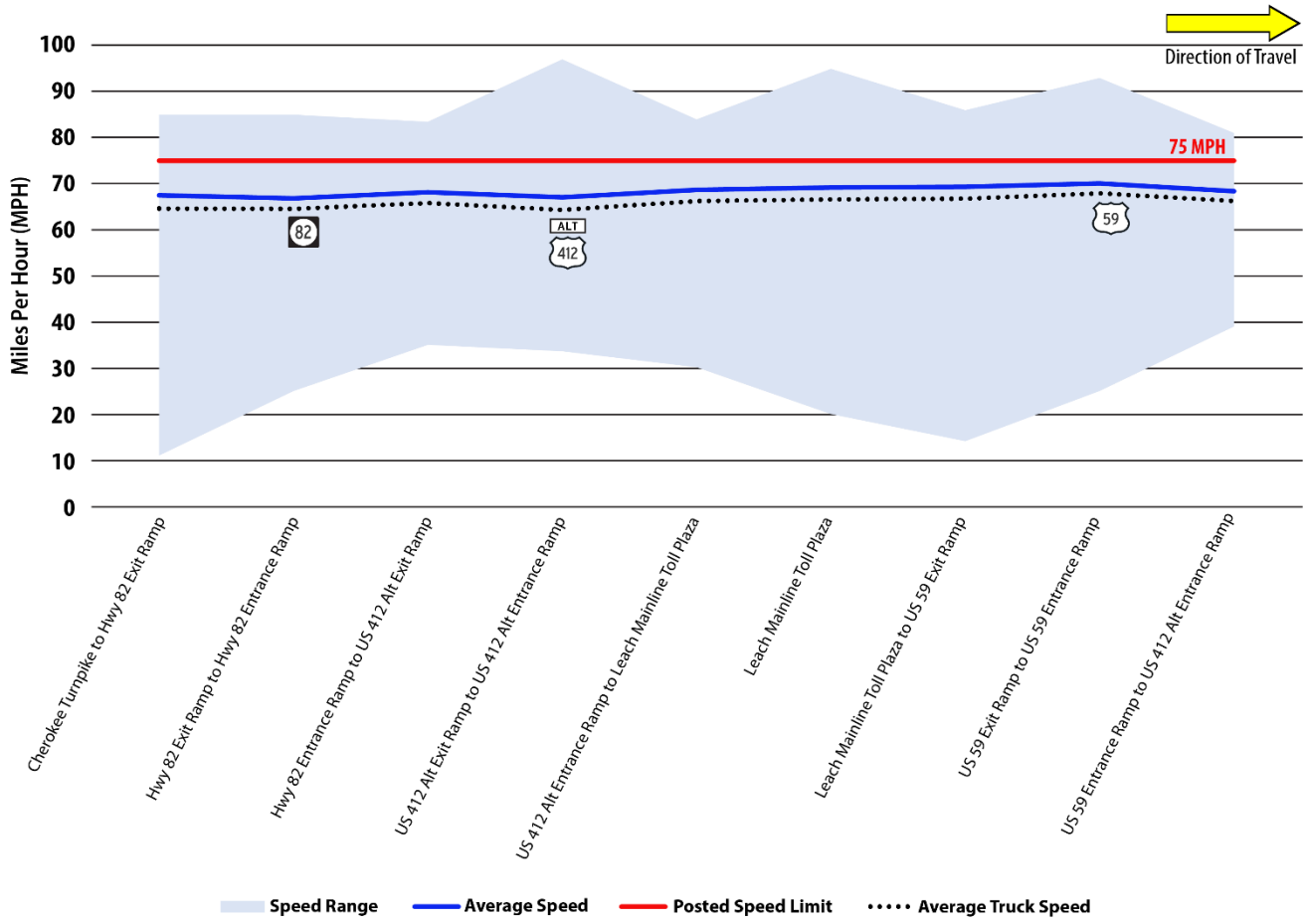
The average passenger car and truck speeds along the Inola segment in the westbound direction during the PM peak hour is between 64 mph and 70 mph for the full length of the segment, from Cherokee Turnpike/U.S. 412 entrance ramp to the Highway 88 entrance ramp. The data shows that westbound speeds range from 9 to 87 mph in the planning segment.

Cherokee Turnpike

Eastbound AM Passenger and Truck Travel Speeds

Eastbound morning peak period traffic between the hours of 7 AM and 9 AM is presented in this section. The posted speed limit in the Cherokee segment is 75 mph. Passenger vehicle and truck speeds remain steady at around 70 mph along the entire segment. Truck speeds are roughly 2 mph slower but follow the same increase or decrease in speed as passenger vehicles.

Figure A- 17: Cherokee EB AM Travel Speeds



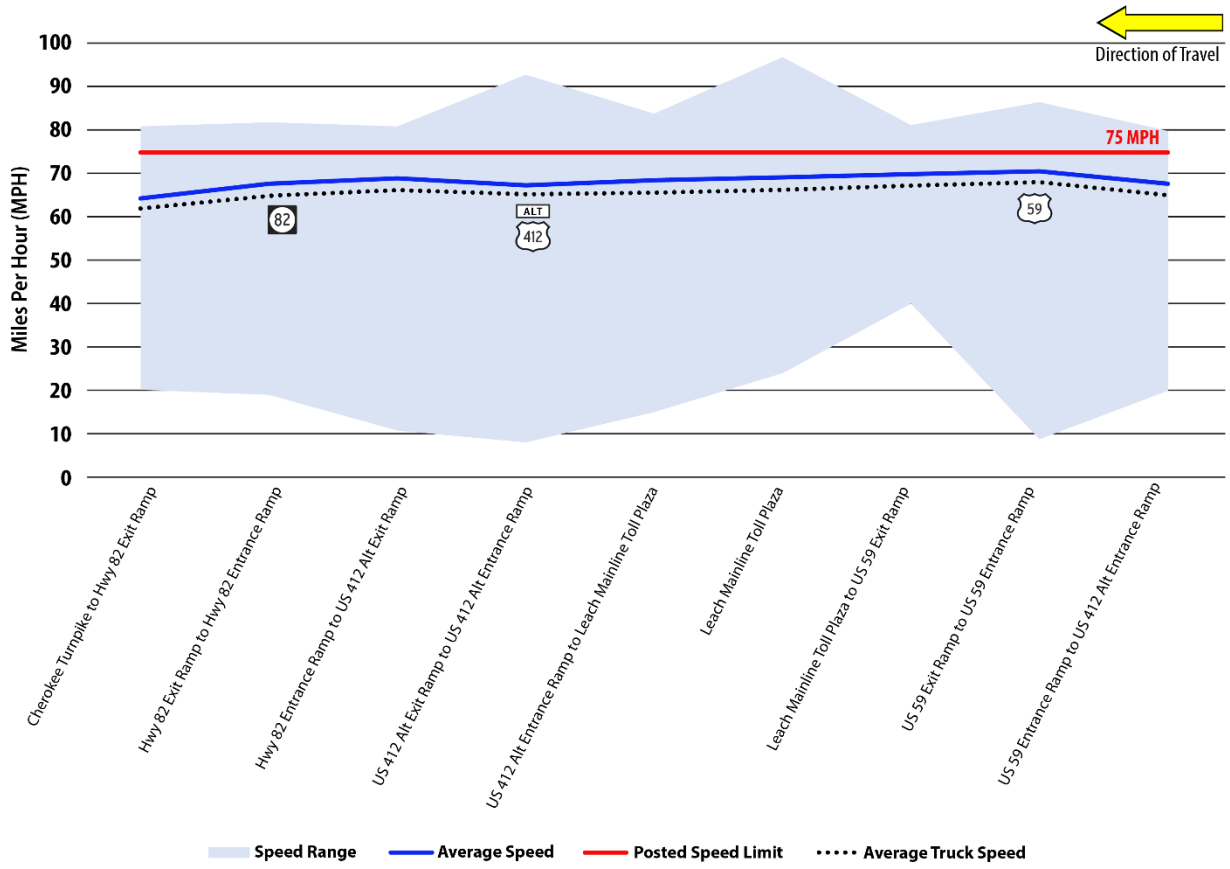
Source: NPMRDS (National Performance Management Research Data Set), Jan. 1, 2019 to Dec. 31, 2019.

The average passenger car and truck speeds along the Cherokee Turnpike in the eastbound direction during the PM peak hour is between 68 and 70 mph from Cherokee Turnpike/Highway 82 Exit to U.S. 59 entrance ramp/U.S. 412 Alt entrance ramp. The posted speed limit is 75 mph. The data shows that eastbound speeds range from 11 to 95 mph in this planning segment.

Westbound AM Passenger and Truck Travel Speeds

Westbound morning peak period traffic between the hours of 7 AM and 9 AM is presented in this section. The posted speed limit in the Cherokee segment is 75 mph. Passenger vehicle and truck speeds remain steady at around 70 mph along the entire segment. Truck speeds are roughly 2 mph slower but follow the same increase or decrease in speed as passenger vehicles.

Figure A- 18: Cherokee WB AM Travel Speeds



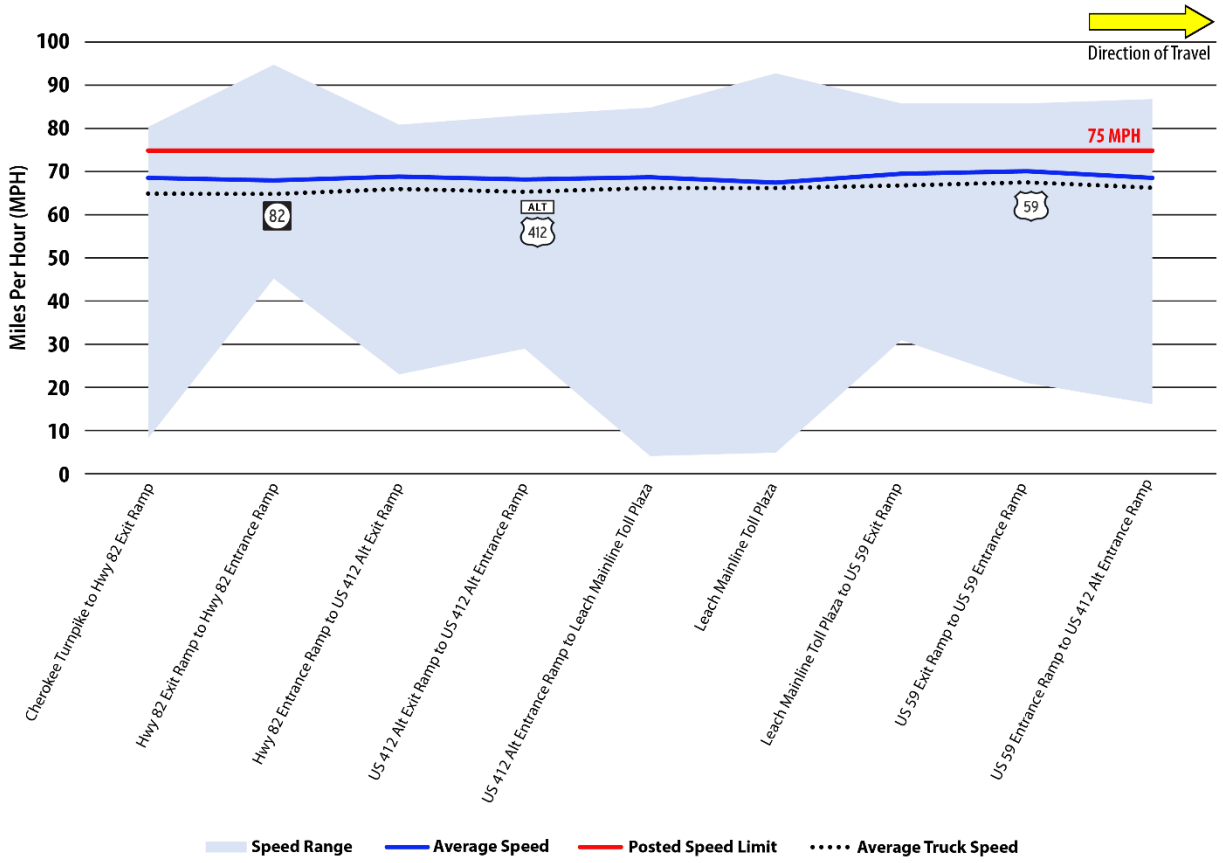
Source: NPMRDS (National Performance Management Research Data Set), Jan. 1, 2019 to Dec. 31, 2019.

The average passenger car and truck speeds along the Cherokee Turnpike in the westbound direction during the AM peak hour is between 63 and 71 mph from U.S. 412 Alt/U.S. 59 exit ramp to Highway 82 entrance ramp/U.S. 412. The data shows that westbound speeds range from 9 to 89 mph in this planning segment.

Eastbound PM Passenger and Truck Travel Speeds

Eastbound evening peak period traffic between the hours of 4 PM and 6 PM is presented in this section. The posted speed limit in the Cherokee segment is 75 mph. Passenger vehicle and truck speeds remain steady at around 70 mph along the entire segment. Truck speeds at the west end of the segment are approximately 66 mph and slightly increase to approximately 68 mph toward the east end of the segment.

Figure A- 19: Cherokee EB PM Travel Speeds



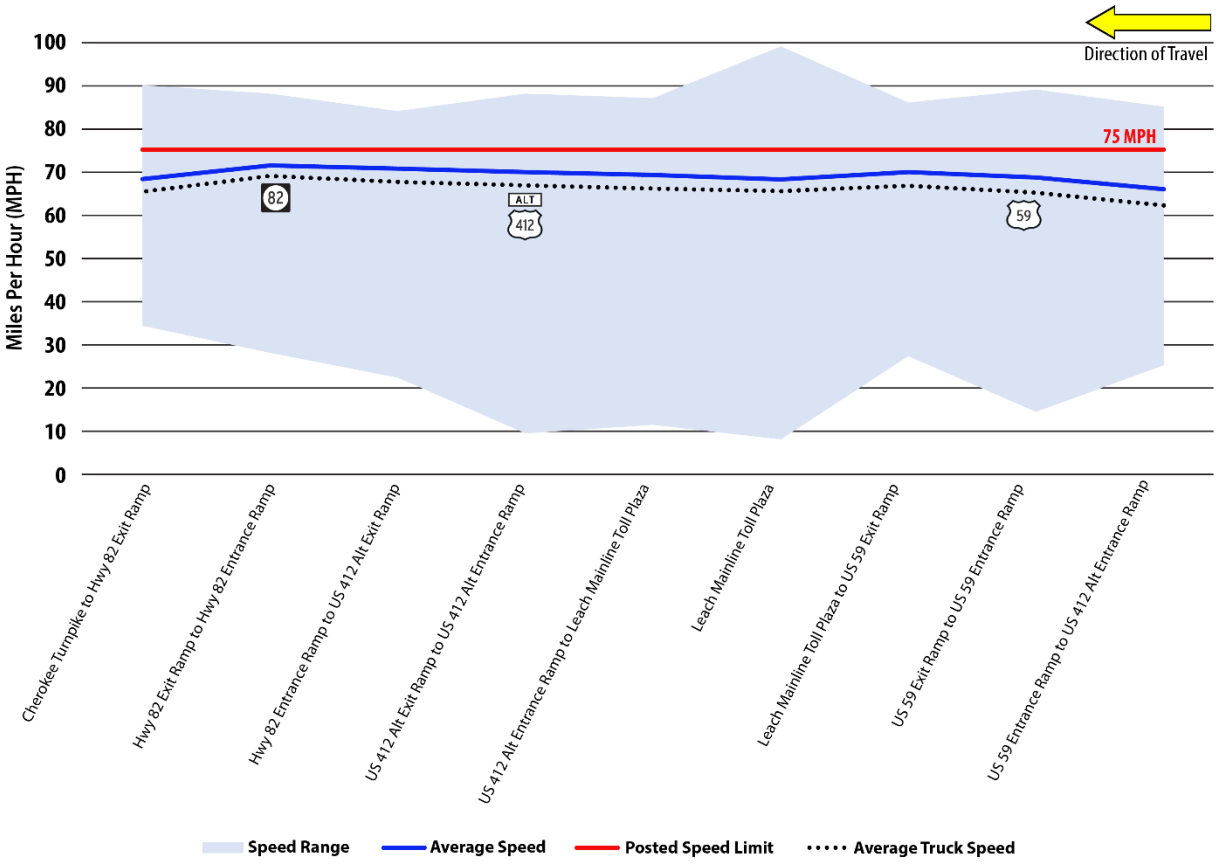
Source: NPMRDS (National Performance Management Research Data Set), Jan. 1, 2019 to Dec. 31, 2019.

The average passenger car and truck speeds along the Cherokee Turnpike in the eastbound direction during the PM peak hour is between 68 and 71 mph from Cherokee Turnpike/Highway 82 Exit to U.S. 59 entrance ramp/U.S. 412 alt entrance ramp. The posted speed limit is 75 mph. The data shows that eastbound speeds range from 9 to 95 mph.

Westbound PM Passenger and Truck Travel Speeds

Westbound evening peak period traffic between the hours of 4 PM to 6 PM is presented in this section. The posted speed limit in the Cherokee segment is 75 mph. Passenger vehicle and truck speeds remain steady at around 70 mph along the entire segment. Truck speeds are 2 to 3 mph lower across the segment but increase and decrease at the same rate as passenger vehicles.

Figure A- 20: Cherokee WB PM Travel Speeds



Source: NPMRDS (National Performance Management Research Data Set), Jan. 1, 2019 to Dec. 31, 2019.

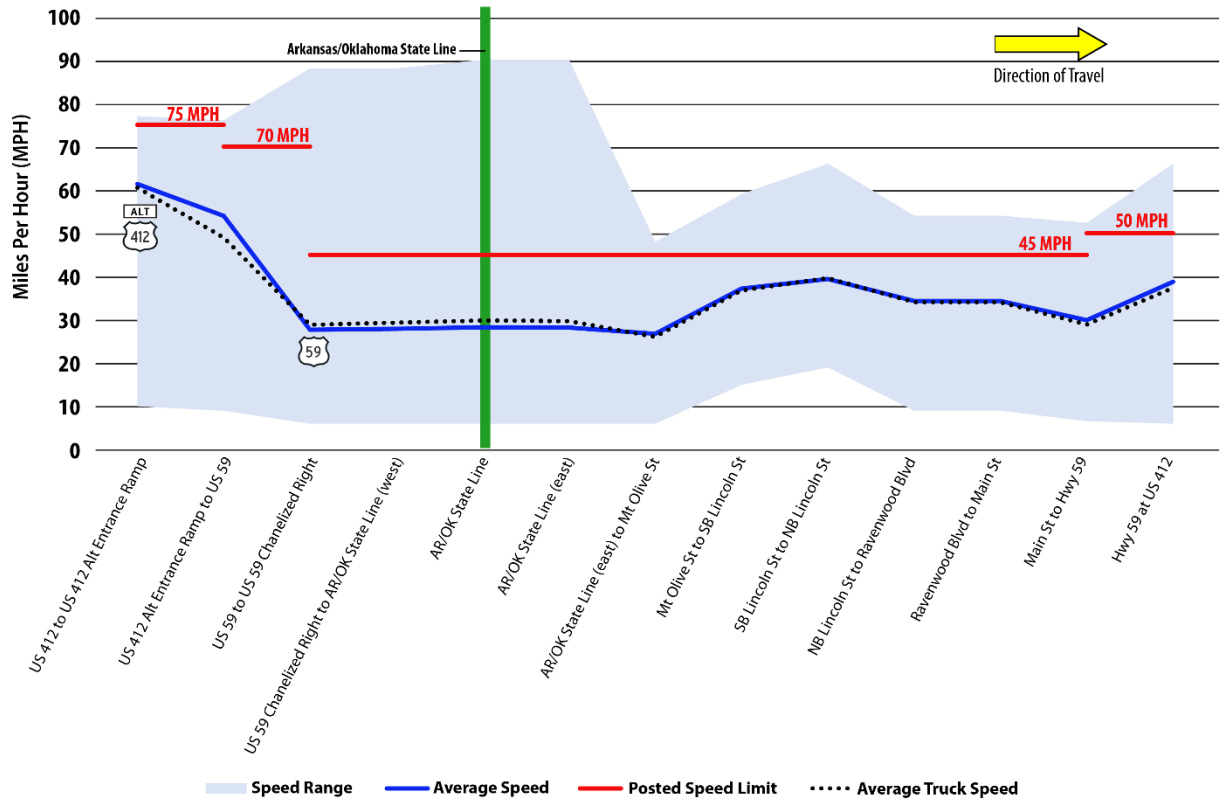
The average passenger car and truck speeds along the Cherokee Turnpike in the westbound direction during the PM peak hour is between 67 and 71 mph from U.S. 412 Alt/U.S. 59 exit ramp to Highway 82 entrance ramp/U.S. 412. The data shows that westbound speeds range from 9 to 97 mph in this planning segment.

Siloam Springs

Eastbound AM Passenger and Truck Travel Speeds

Eastbound morning peak period traffic between the hours of 7 AM and 9 AM is presented in this section. Posted speed limits vary from 45 mph, 50 mph, 70 mph, and 75 mph. Both passenger vehicles and truck speeds are approximately 10 to 15 mph lower than the posted speeds through most of the segment.

Figure A- 21: Siloam Springs EB AM Travel Speeds



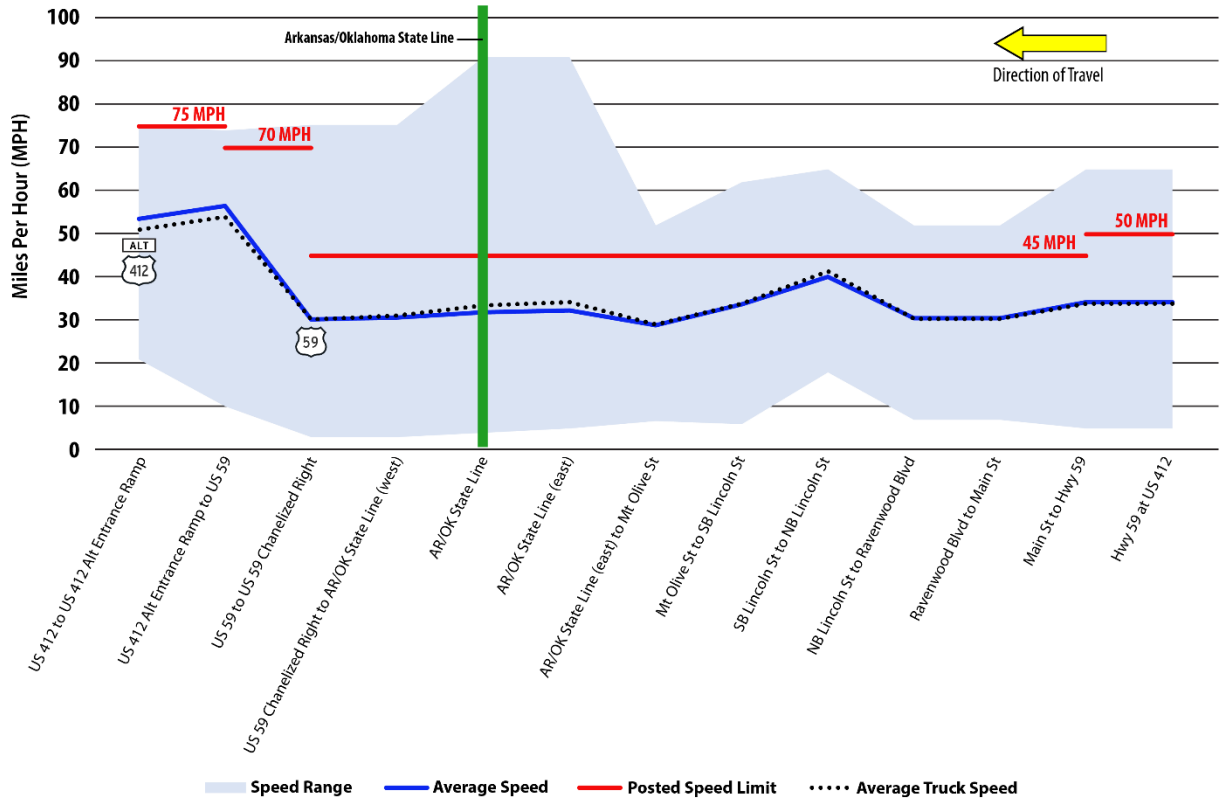
Source: NPMRDS (National Performance Management Research Data Set), Jan. 1, 2019 to Dec. 31, 2019.

The average passenger car and truck speeds along the Siloam Springs segment in the westbound direction during the AM peak hour is between 27 and 60 mph from U.S. 59/U.S. 412 to U.S. 412 Alt exit ramp/U.S. 412. Speeds start at 60 mph and slowly drop to around 27 mph at U.S. 59and maintain a low speed until the AR/OK State Line east/Mt Olive St. Speeds gradually increase back up to 40 mph, 5 to 10 mph below the posted speed limit of 45 and 50 mph. The data shows that westbound speeds range from 7 to 90 mph in this planning segment.

Westbound AM Passenger and Truck Travel Speeds

Westbound morning peak period traffic between the hours of 7 AM and 9 AM is presented in this section. Posted speed limits vary from 45 mph, 50 mph, 70 mph, and 75 mph. Both passenger vehicles and truck speeds are approximately 10 to 15 mph lower than the posted speeds through most of the segment.

Figure A- 22: Siloam Springs WB AM Travel Speeds



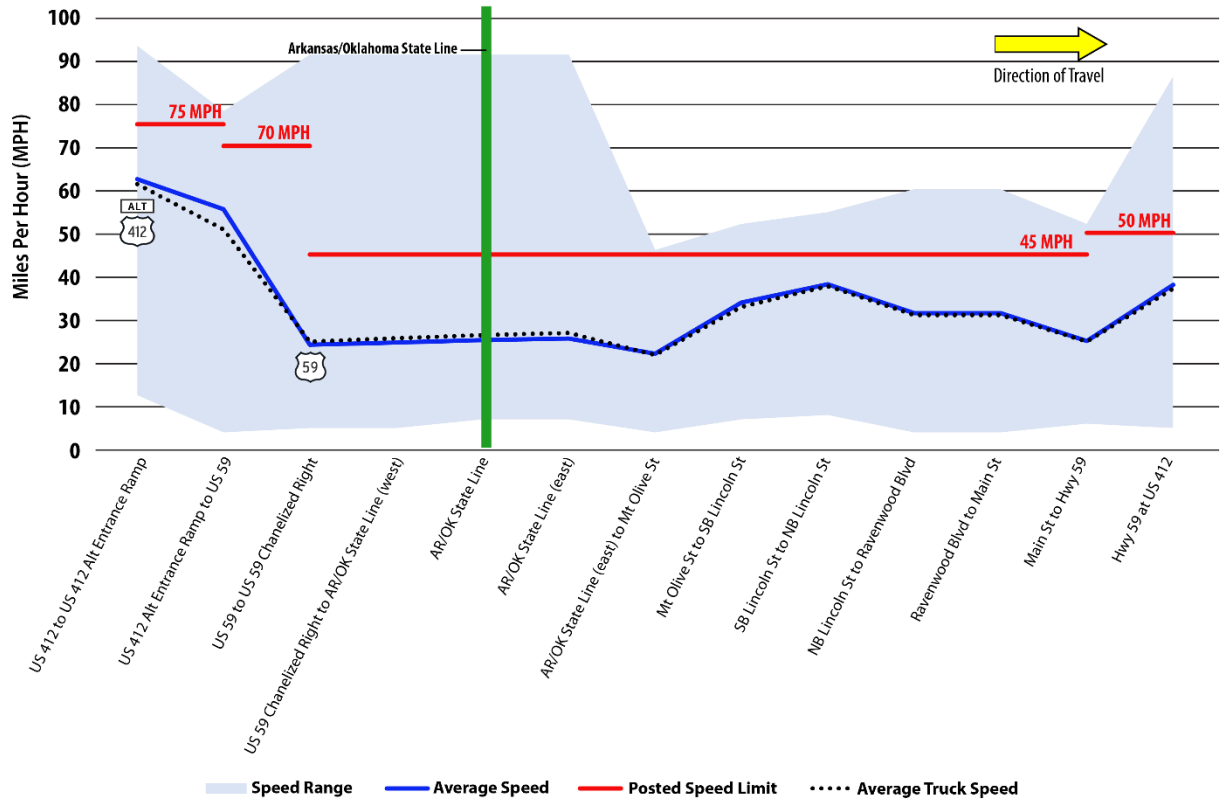
Source: NPMRDS (National Performance Management Research Data Set), Jan. 1, 2019 to Dec. 31, 2019.

The average passenger car and truck speeds along the Siloam Springs segment in the westbound direction during the AM peak hour is between 30 and 55 mph from U.S. 59 to U.S. 412 Alt exit ramp/U.S. 412. Speeds start at 35 mph and slowly drop to around 30 mph, before rebounding to 40 mph at NB Lincoln St/SB Lincoln St. Speeds gradually decrease back to around 30 mph until U.S. 59 where speeds increase to 55 mph, 15 mph below the posted speed limit. The data shows that westbound speeds range from 5 to 90 mph in this planning segment.

Eastbound PM Passenger and Truck Travel Speeds

Eastbound evening peak period traffic between the hours of 4 PM and 6 PM is presented in this section. Posted speed limits vary from 45 mph, 50 mph, 70 mph, and 75 mph. Both passenger vehicles and truck speeds are approximately 10 to 15 mph lower than the posted speeds through most of the segment.

Figure A- 23: Siloam Springs EB PM Travel Speeds



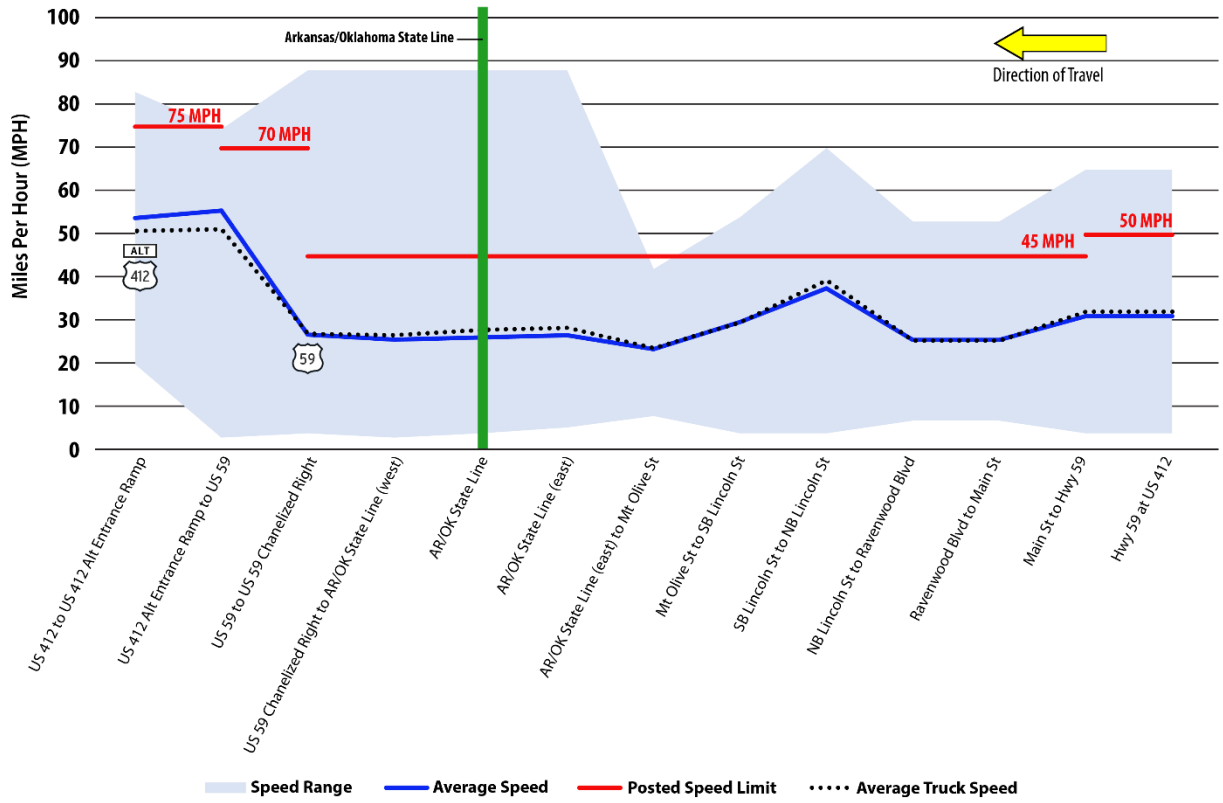
Source: NPMRDS (National Performance Management Research Data Set), Jan. 1, 2019 to Dec. 31, 2019.

The average passenger car and truck speeds along the Siloam Springs segment in the eastbound direction during the PM peak hour is between 27 and 60 mph from U.S. 59/U.S. 412 to U.S. 412 Alt exit ramp/U.S. 412. Speeds start at 60 mph and slowly drop to around 27 mph at U.S. 59and maintain a low speed until the AR/OK State Line east/Mt Olive St. Speeds gradually increase back up to 40 mph, 5 to 10 mph below the posted speed limit of 45 and 50 mph. The data shows that eastbound speeds range from 5 to 92 mph.

Westbound PM Passenger and Truck Travel Speeds

Westbound evening peak period traffic between the hours of 4 PM and 6 PM is presented in this section. Posted speed limits vary from 45 mph, 50 mph, 70 mph, and 75 mph. Both passenger vehicles and truck speeds are approximately 10 to 15 mph lower than the posted speeds through most of the segment.

Figure A- 24: Siloam Springs WB PM Travel Speeds

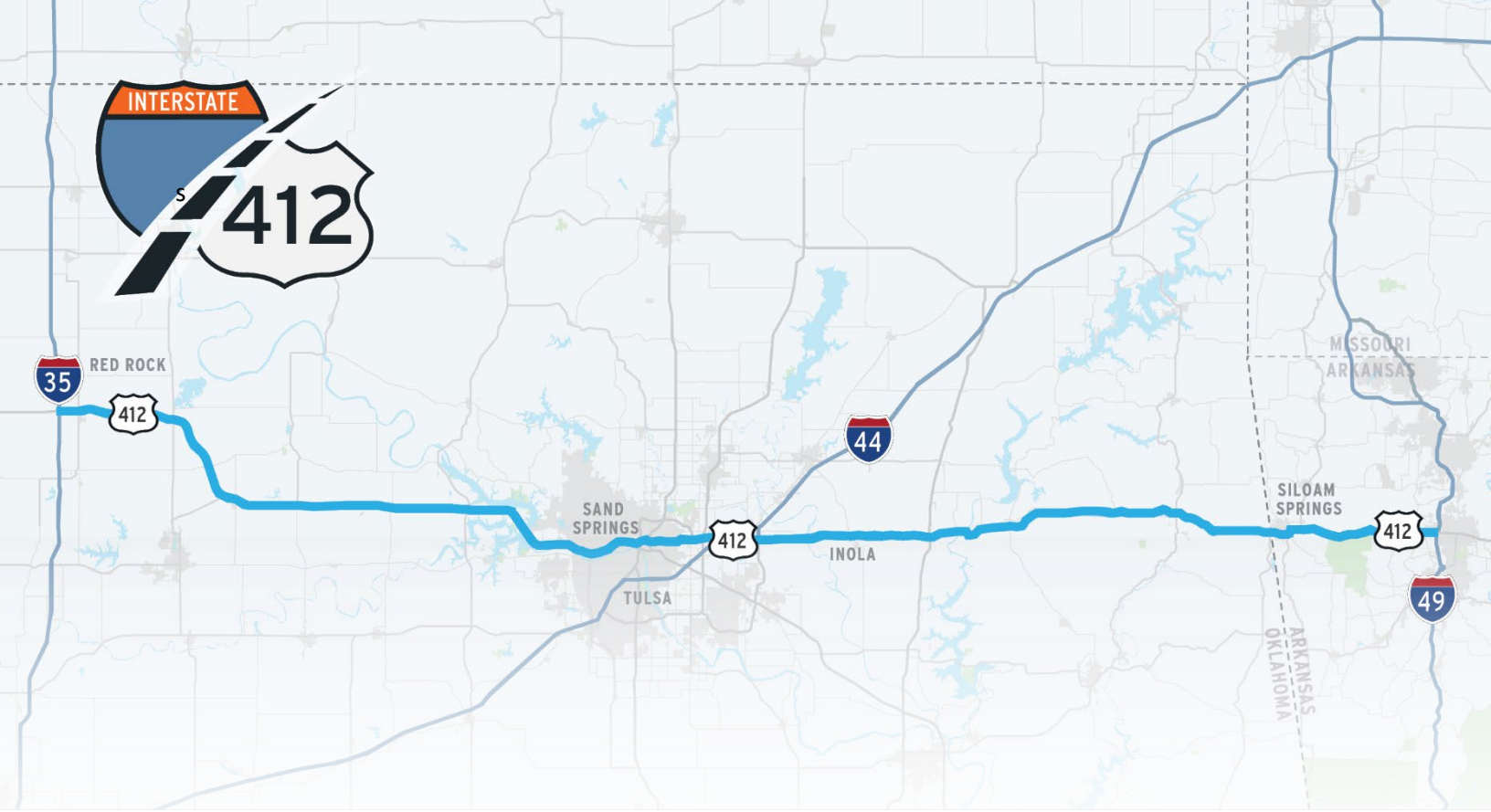


Source: NPMRDS (National Performance Management Research Data Set), Jan. 1, 2019 to Dec. 31, 2019.

The average passenger car and truck speeds along the Siloam Springs segment in the westbound direction during the PM peak hour to be between 25 and 55 mph from U.S. 59 to U.S. 412 Alt exit ramp/U.S. 412. Speeds start at 30 mph and slowly drop to around 25 mph, before rebounding to 38 mph at NB Lincoln St/SB Lincoln St. Speeds gradually decrease back to around 25 to 30 mph until U.S. 59 Channelized Right/U.S. 59 where speeds increase to 55 mph, 15 mph below the posted speed limit. The data shows that westbound speeds range from 5 to 88 mph in this planning segment.

Springdale

NPMRDS speed data was not available for the segments that make up the Springdale Segment so no analysis was performed.



OKLAHOMA Transportation

ARDOT ARKANSAS DEPARTMENT OF TRANSPORTATION

OKLAHOMA Turnpike Authority

U.S. Department of Transportation Federal Highway Administration

U.S. 412: from I-35 in Noble County, Oklahoma
to I-49 in Benton County, Arkansas

PEL Study

Traffic, Safety and Engineering Constraints Existing Conditions Report

Appendix B – Existing Safety Conditions Report

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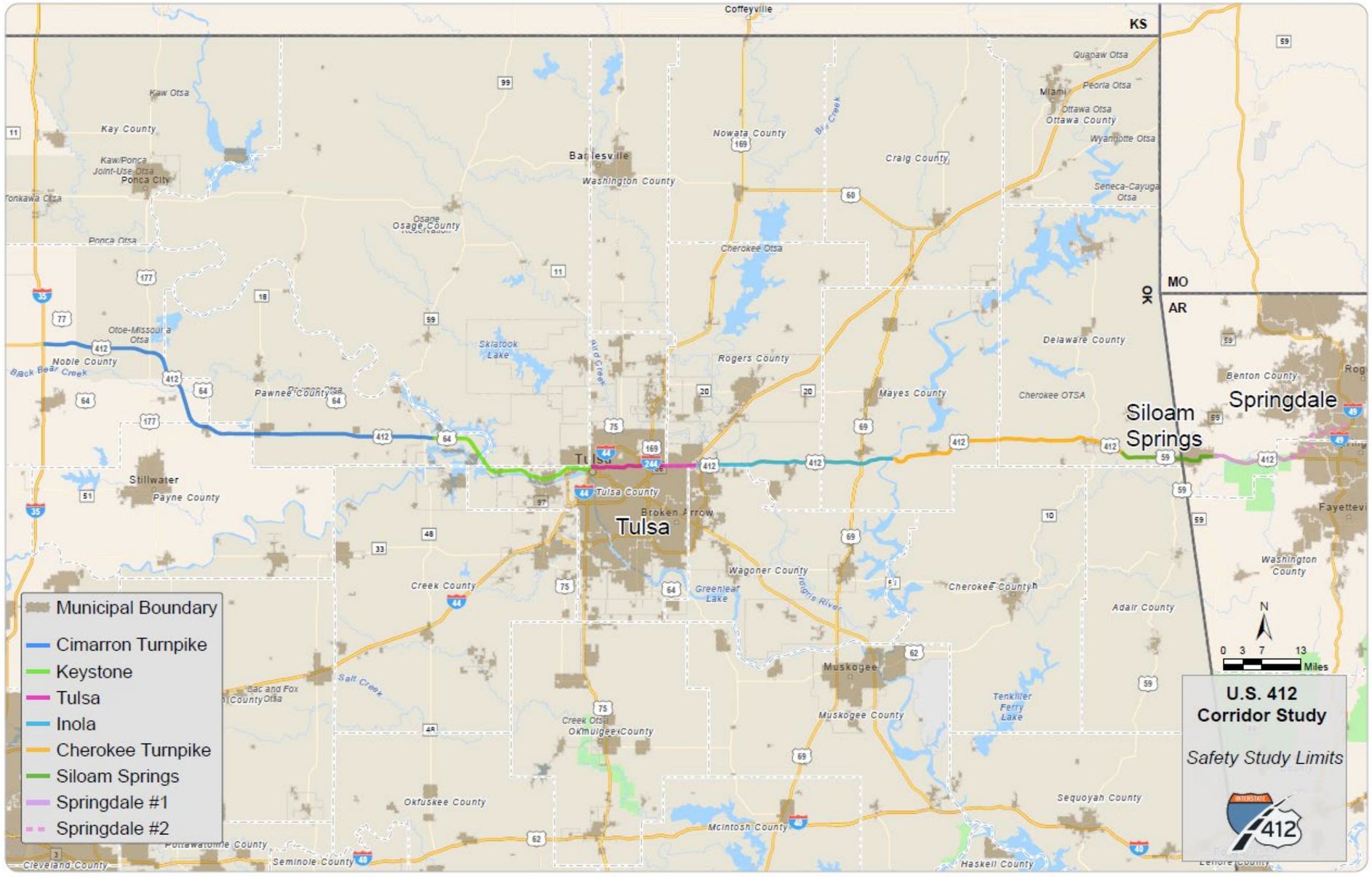
Tables

Figures

1.0 Introduction

In conjunction with the traffic analysis for the Oklahoma Department of Transportation (ODOT) and Arkansas Department of Transportation (ARDOT) U.S. 412 Planning and Environmental Linkages (PEL) study, HNTB conducted an existing crash analysis along the U.S. 412 mainline between the Interstate 35 (I-35) and Interstate 49 (I-49). The existing crash analysis aims to identify safety-related deficiencies along the study corridor by analyzing the crash data for the most current, complete 5-year period, 2017-2021. **Figure 1** illustrates the limits of the crash analysis being considered for this study.

Figure 1: Safety Study Limits



Source: Study Team, 2023.

2.0 Existing Crash Analysis Methodology

The following section serves as a discussion of the methodology utilized to complete the existing safety analysis. This is not intended to be a detailed step-by-step methodology but rather a high-level description of the approach.

The existing safety analysis was conducted using crash data, obtained from ODOT and ARDOT, for the most current complete five-year period (2017-2021). At the time of this analysis (Quarter 1 of 2023), 2022 crash data has not been fully validated for usage by ODOT and ARDOT. The crash analysis includes a summary of various existing crash characteristics including crash type, crash severity, and other prevailing conditions. The analysis also included a calculation of the crash rates and a comparison of these calculations to the Oklahoma and Arkansas statewide crash rates for similar facility types.

Segmentation Approach

Geographic Information Systems (GIS) was used to geolocate crashes within the project study limits using the crash's latitude and longitude for ODOT and route specific log mile locations for ARDOT; this information is available within the State's crash datasets. In GIS, the project corridor was segmented into reasonable areas for analysis based on the following:

- **Highway Mainline Interchange Segments:** The area between ramp gore points.
- **Highway Mainline Segments:** The remaining area of the mainline outside of the interchange or at-grade intersection. Segments in populated areas with closely spaced cross-streets were segmented at major arterials instead of every at-grade crossing.

Highway mainline segments exceeding 5-6 miles between interchanges was split to provide a smaller analysis zone. These breakpoints were done at cross streets. Smaller analysis zones are beneficial to identify specific safety issues and provide targeted safety countermeasures. In cases where interchanges are closely spaced, shorter segment lengths are expected along highway mainlines. Shorter segment lengths (under 1 mile in length) have the potential to skew crash rates, as they inaccurately depict elevated crash frequencies. In the case of an at-grade intersection, roads were segmented at the centerline of the intersection. Attention was paid to functional classification changes along the corridors and segments were split at those allowing for more accurate comparisons to statewide averages.

The study has been divided into six planning corridor segments. As necessary, highway mainline segments were broken at these corridor segments to provide consistency with the PEL analysis. The following section provides a brief description of the six segments.

- **Cimarron Turnpike** –This segment includes an approximately 59-mile stretch of U.S. 412 that will be evaluated from I-35 to the OK-48/U.S. 64 interchange.
- **Keystone** –This segment consists of an approximately 24-mile stretch of U.S. 412 corridor from OK-48/U.S. 64 to the I-244 interchange.
- **Tulsa** –This segment consists of an approximately 15-mile stretch of U.S. 412 corridor from the I-244 interchange to the I-44 interchange.

- **Inola** –This segment comprises approximately 28 miles of roadway that begins from the I-44 interchange and ends at the ALT U.S. 412 interchange.
- **Cherokee Turnpike** –This corridor segment includes approximately 29 miles from D0583 Road to the ALT U.S. 412 interchange.
- **Siloam Springs** –This segment encompasses around 14 miles of the U.S. 412 corridor that runs from U.S. 59/ ALT U.S. 412 interchange to Airport Road.
- **Springdale #1**–This segment begins at Airport Road and ends at Old Highway 68.
- **Springdale #2** –This segment includes approximately 3 miles of AR-612 corridor that runs from AR-112 to I-49.

Once the project corridor was segmented, the crash dataset was joined with the analysis segments, and the data was checked for reasonableness. Crashes along system-to-system ramps and service ramps were not evaluated. Due to the nature of GIS, sometimes polygon segments overlap, such as at grade-separated arterials over mainline interchanges or between system-to-system ramps, and interstate mainlines. At these locations, crashes were reevaluated using the On-Street clarifier data field and crashes occurring along the arterial cross street, system-to-system ramp, or mainline were manually reassigned to their proper segment. The On-Street clarifier is a data field within the Oklahoma crash dataset that describes what road the crash occurred on. Since Arkansas data was provided for the U.S. 412 only, overlapping data was not a concern. Once crashes had been evaluated in all overlapping segments, the joined crash dataset was exported to excel in conducting the quantitative assessment of the crash data.

With the crashes assigned to specific segments, GIS was used to generate a heat map to perform a crash density or "hot spot" analysis. Heat maps provide a high-level visual of locations within the study area that are experiencing the highest concentration of crashes. This allows the team to identify areas where additional information may be needed to determine the cause of crashes. The locations of fatal and incapacitating injury crashes were also mapped to identify the locations with higher numbers of such crashes. Dense clusters of Fatal and Incapacitating Injury crashes can suggest the presence of a systematic problem. Therefore, crash reports (as available from ODOT and ARDOT) of such fatal and incapacitating Injury crashes were investigated for a more in-depth analysis.

Quantitative Assessment Approach

Microsoft Excel was used to perform a quantitative analysis of crash characteristics within each segment utilizing the data derived from the GIS analysis.

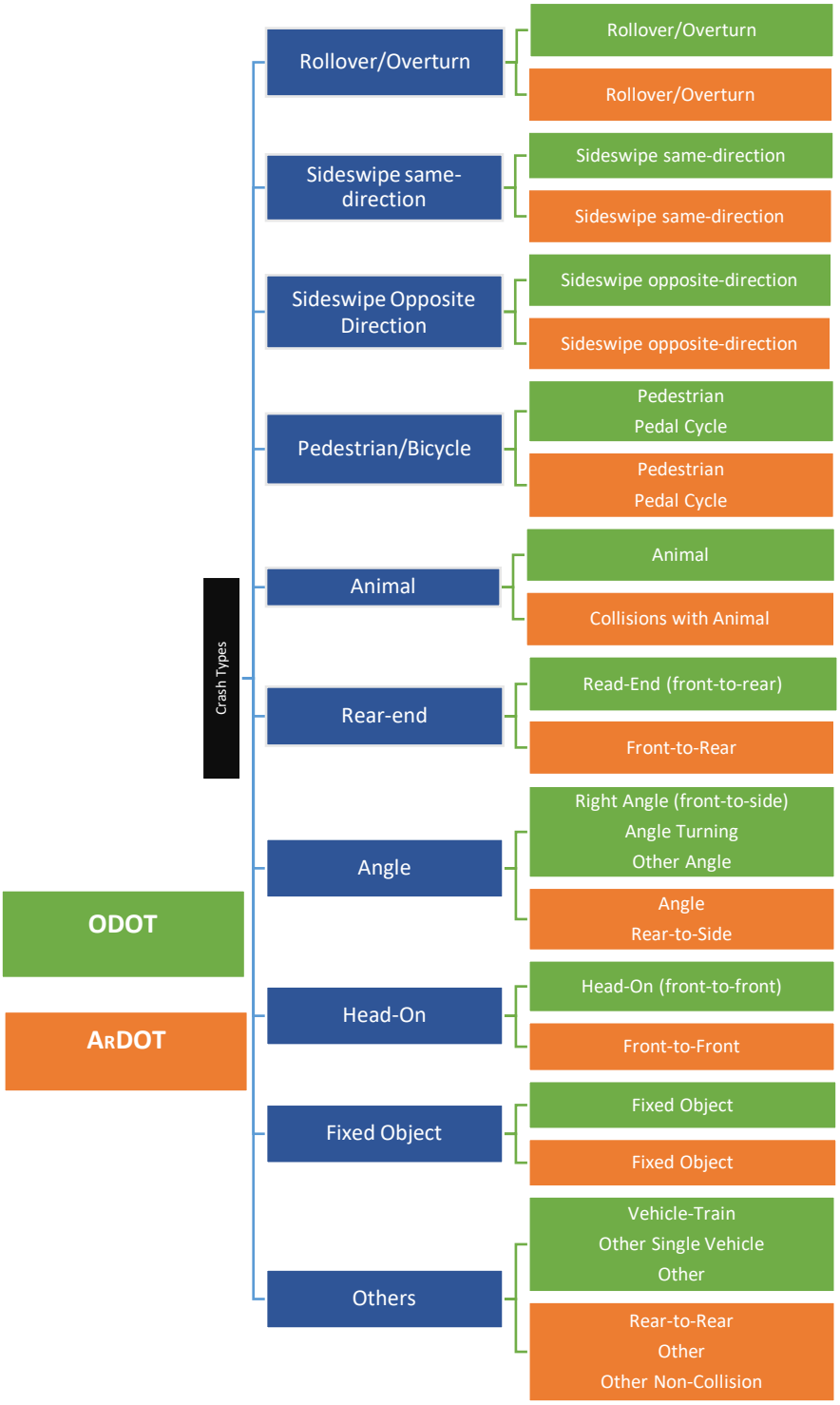
The two ODOT and ARDOT data sets were normalized with each other as much as reasonably possible. This included combining crash types, road conditions, or lighting conditions within one dataset to match the schema of the other. Combined Crash characteristics that were evaluated in this safety analysis consist of the following:

- **Crash Severities:** Fatality (K), Incapacitating Injury (A), Non-Incapacitating Injury (B), Possible Injury (C), Property Damage Only (O)
- **Crash Types:** Rollover/Overturn, Rear-End, Head On, Angle, Sideswipe Same-Direction, Sideswipe Opposite-Direction, Pedestrian/Bicycle, Animal, Fixed Objects, Other crashes, etc.

- **Roadway Surface Conditions:** Dry, Wet, Snow, Slush, Ice/Frost, Mud/Dirt/Gravel, Sand, Oil, Water, Other.
- **Light Conditions:** Daylight, Dark-Lighted, Dark-Not Lighted, Dark-Unknown Lighting, Dawn, Dusk, Other.
- **Vehicle Types:** Passenger Car, Heavy Vehicle/Truck, Motorcycle, Bus/Van, Others, Unknown.

Figure 2 shows how crash-type fields were consolidated. The "Type of Collision (Derived)" data field from the ODOT database and the "Manner of Collision" data field from the ARDOT dataset was used to categorize the crash types. It is important to note that the "First Harmful Event" data field was used to specify the Fixed Objects, Rollover /Overturn, Pedestrian/Bicycle, and Animal crashes in the ARDOT crash data.

Figure 2: Crash Type Categories



The "Vehicle Type" data fields from both databases were used to categorize the vehicle types. The Passenger Cars category included various types of vehicles that carry passengers, such as passenger cars, SUVs, pickups, and others. The heavy vehicles/trucks comprised single unit trucks with or without trailer (all axles), Semi (double, triple) and other heavy vehicles.

Once crash characteristics had been quantified for each segment, crash rates for total crashes and fatal and incapacitating injury (KA) crashes for all highway mainline segments were calculated. The following equations were used to determine the crash rates for Oklahoma total crashes as well as KA crashes:

$$\boldsymbol{Total\ \ Crash\ Rate} = \frac{\boldsymbol{Number\ of\ Total\ Crashes\ \times\ 100,000,000}}{\boldsymbol{ADT\times\ 365\ \times\ Number\ of\ Years\ \times\ Length\ of\ Segment}}$$

$$\boldsymbol{KA\ \ Crash\ Rate} = \frac{\boldsymbol{Number\ of\ KA\ Crashes\times\ 100,000,000}}{\boldsymbol{ADT\ \times\ 365\ \times\ Number\ of\ Years\ \times\ Length\ of\ Segment}}$$

The following equations will be used to determine the crash rates for Arkansas total and KA crashes:

$$\boldsymbol{Total\ \ Crash\ Rate} = \frac{\boldsymbol{Number\ of\ Total\ Crashes\ \times\ 1,000,000}}{\boldsymbol{ADT\times\ 365\ \times\ Number\ of\ Years\ \times\ Length\ of\ Segment}}$$

$$\boldsymbol{KA\ \ Crash\ Rate} = \frac{\boldsymbol{Number\ of\ KA\ Crashes\times\ 100,000,000}}{\boldsymbol{ADT\ \times\ 365\ \times\ Number\ of\ Years\ \times\ Length\ of\ Segment}}$$

Source: Highway Safety Manual

ADT = *Average Daily Traffic, obtained from the traffic counts used in the traffic analysis for ODOT and* ARDOT.

Segment Length = *Centerline segment length of the polygon segment measured in miles. Distances are measured in ArcGIS.*

Crash rates were then compared to statewide crash averages for similar facilities (accounting for either urban or rural conditions as provided by the ODOT and ARDOT) for the same time period of the safety analysis. Brief descriptions of the crash summary of the segments that exceeded the statewide total crash rates or KA crash rates were provided. For more in-depth analysis, areas with a high concentration of KA crashes were examined, and KA crash reports were investigated to uncover any underlying causes. However, as of the publication of this report, only the KA crash reports from ARDOT were available.

3.0 U.S. 412 Crash Analysis

Approximately 190 miles of the U.S. 412 corridor from I-35 in Noble County, Oklahoma to I-49 in Benton County, Arkansas, divided into six planning segments was evaluated to identify potential safety issues. The following section details all the planning segments collectively, later in this memo each planning segment is discussed separately.

Crash Severity and Crash Type

A total of 4,863 crashes occurred along U.S. 412 corridor within the project study limits. Of the 4,861 crashes, 3,032 crashes (~62%) resulted in property damage only, 1,784 crashes (~37%) caused some form of injury to vehicle occupants, and 47 crashes (1%) resulted in fatalities (**Figure 3**). Fixed object collisions were the main crash types, accounting for approximately 32% (1,572 crashes) of all reported crashes within the project limit followed by rear-end collisions which represent 26% (1,267 crashes) of all crashes (**Figure 4**). The remaining 2,024 crashes (~42%) were associated with sideswipe same-direction collisions, angle collisions, rollovers/overturns, animals, pedestrians, head-on, sideswipe opposite-directions, and other crash types

Figure 4: Crash Severity-U.S. 412

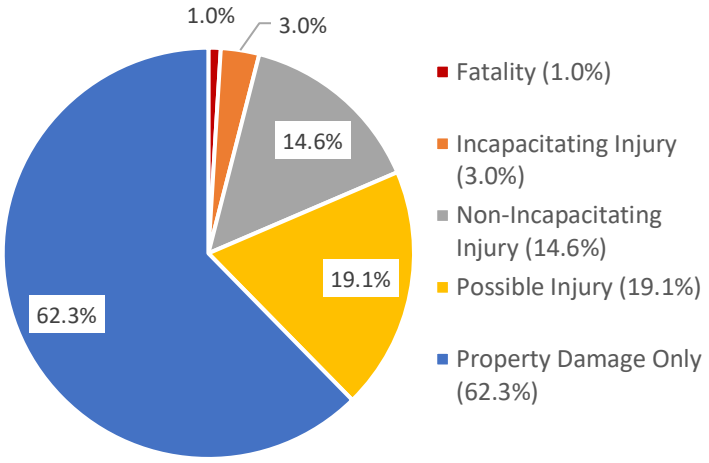
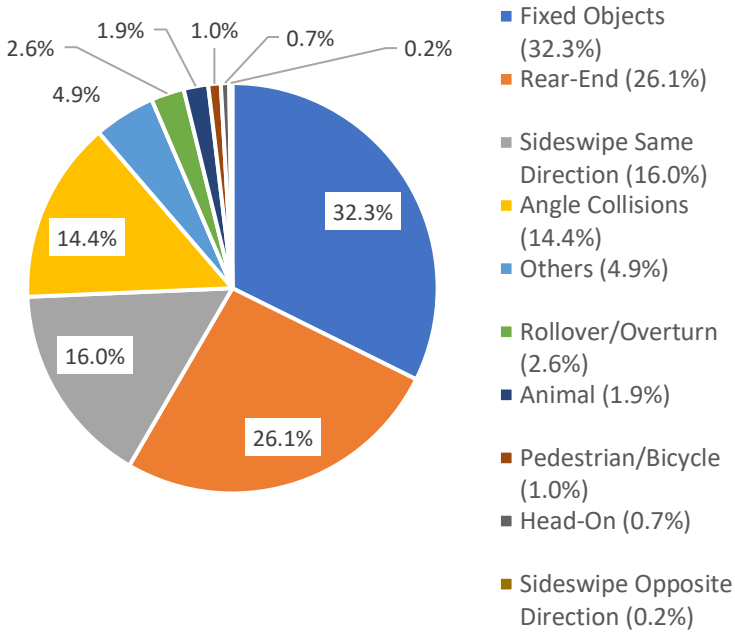


Figure 3: Crash Type – U.S. 412



Source: ODOT & ARDOT Crash Data 2017-2021

Vehicle Types

Passenger cars were involved in 4,286 crashes, accounting for approximately 88% of the overall total crashes along U.S. 412 corridor. Trucks were involved in 376 crashes, accounting for 8% of the total crashes. The remaining 201 (4%) crashes were associated with motorcycles, buses/vans, and all other vehicle types.

Roadway Surface and Lighting Conditions

Approximately 79% (3,828 crashes) of all crashes occurred on dry roadway surfaces whereas 17% (825 crashes) of all crashes occurred on wet surfaces and the remaining 4% (210 crashes) of all crashes occurred on other road surfaces including ice/frost, snow, and slush. Approximately 69% (3,342 crashes) of all crashes occurred during daylight, 27% (1,318 crashes) of crashes occurred during dark conditions either with streetlights or without streetlights and the remaining 4% (203 crashes) occurred during dusk, dawn, or other time. With higher percentages of fixed object collisions experienced along the corridor; lighting conditions might be a potential contributing factor. Approximately 42% of fixed object collisions occurred during dark conditions within the project study limits. The following table (**Table 1**) provides the crash attributes of the planning segments.

Table 1: Crash Attributes of the Planning Segments

Segments	Number of Crashes (% of Crashes Involving Heavy Vehicles)	Crash /Per Day	Planning Crash Severity -Number (%)	Crash Types -Number (%)
Cimarron Turnpike	447 (17%)	0.2	• Fatality -3 (0.7%) • Incapacitating Injury – 14 (3.1%) • Non-incapacitating Injury- 34 (7.6%) • Possible Injury – 56 (12.6%) • Property Damage Only – 340 (76.1%)	• Fixed objects -300 (67.1%) • Sideswipe same-directions- 36 (8.1%) • Others – 111 (24.8%)
Keystone	904 (6%)	0.5	• Fatality -8 (0.9%) • Incapacitating Injury – 20 (2.2%) • Non-incapacitating Injury- 120 (13.3%) • Possible Injury – 137 (15.2%) • Property Damage Only – 619 (68.5%)	• Fixed objects -431 (47.7%) • Rear-end – 185 (20.5%) • Sideswipe same-directions- 131 (14.5%) • Others – 157 (17.4%)
Tulsa	1853 (7%)	1.0	• Fatality -19 (1.0%) • Incapacitating Injury – 61 (3.3%) • Non-incapacitating Injury- 322 (17.3%) • Possible Injury – 497 (26.8%) • Property Damage Only – 954 (51.5%)	• Rear-end – 544 (29.4%) • Fixed objects -466 (25.1%) • Sideswipe same-directions- 388 (20.9%) • Angle Collisions-306 (16.5%) • Others – 149 (8.0%)
Inola	351 (10%)	0.2	• Fatality -9 (2.6%) • Incapacitating Injury – 25 (7.1%)	• Rear-end Collisions-102 (29.1%) • Angle Collisions - 100 (28.5%) • Fixed objects -63 (17.9%)

Segments	Number of Crashes (% of Crashes Involving Heavy Vehicles)	Crash /Per Day	Planning Crash Severity -Number (%)	Crash Types -Number (%)
			• Non-incapacitating Injury- 89 (25.4%) • Possible Injury – 58 (16.5%) • Property Damage Only – 170 (48.4%)	• Sideswipe same-directions- 36 (10.3%) • Others – 50 (14.2%)
Cherokee Turnpike	187 (10%)	0.1	• Fatality -3 (1.6%) • Incapacitating Injury – 1 (0.5%) • Non-incapacitating Injury- 37 (19.8%) • Possible Injury – 23 (12.3%) • Property Damage Only – 123 (65.8%)	• Fixed objects -100 (53.5%) • Rollover/Overturn – 25 (13.4%) • Animal -20 (10.7%) • Rear-end- 12 (6.4%) • Others – 30 (16.0%)
Siloam Springs	817 (6%)	0.5	• Fatality -3 (0.4%) • Incapacitating Injury – 16 (2.0%) • Non-incapacitating Injury- 66 (8.1%) • Possible Injury – 124 (15.2%) • Property Damage Only – 608 (74.4%)	• Rear-end – 362 (44.3%) • Angle Collisions -194 (23.7%) • Sideswipe same-directions- 151 (18.5%) • Fixed Objects-39 (4.8%) • Others – 71 (8.7%)
Springdale #1	284 (5%)	0.2	• Fatality -2 (0.7%) • Incapacitating Injury – 9 (3.2%) • Non-incapacitating Injury- 39 (13.7%) • Possible Injury – 31 (10.9%) • Property Damage Only – 203 (71.5%)	• Fixed objects -167 (58.8%) • Rear-end - 31 (10.9%) • Animal Collisions- 23 (8.1%) • Sideswipe same-directions- 20 (7.0%) • Others - 43 (15.1%)
Springdale #2	20	0.0	• Fatality -0 (0.0%) • Incapacitating Injury – 1 (5.0%) • Non-incapacitating Injury- 1 (5.0%) • Possible Injury – 3 (15.0%) • Property Damage Only – 15(75.0%)	• Animal Collisions- 9 (45%) • Fixed Objects - 6 (30%) • Sideswipe same-directions- 3 (15%) • Others - 2 (10%)

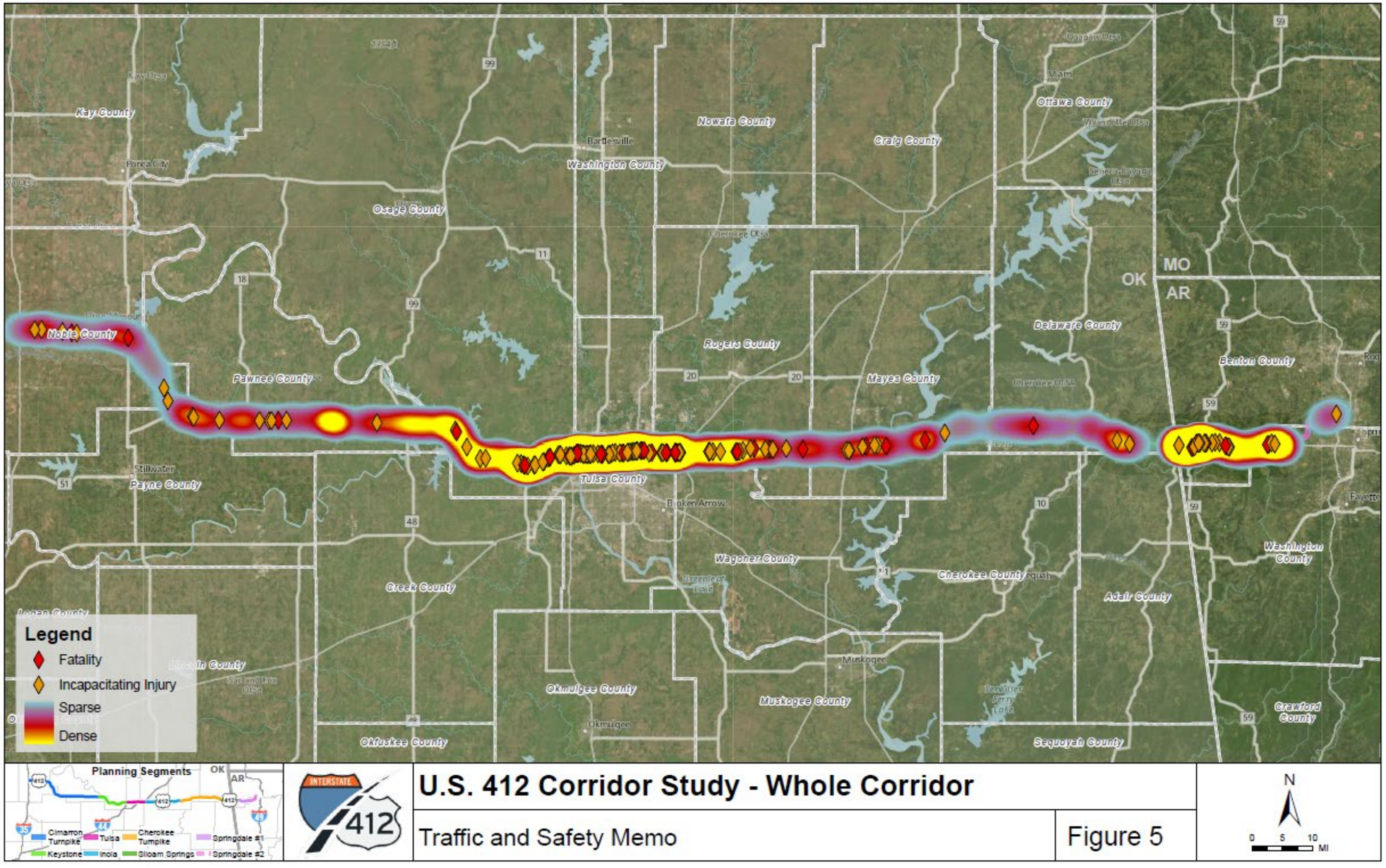
Source: ODOT & ARDOT Crash Data 2017-2021.

Crash Density

Crash density and the locations of KA crashes along U.S. 412 are presented in **Figure 5**. Among the planning segments, Tulsa, and east portions of Keystone in Oklahoma, and all of Siloam Springs in Arkansas

experienced the highest concentration of crashes. Similarly, KA crashes were concentrated from N 129th Avenue to OK-66 in Oklahoma and Siloam Springs in Arkansas.

Figure 5: Crash Density and the KA locations - U.S.412



Source: ODOT (2017-2021), ARDOT (2017-2021).

3.1. Cimarron Turnpike Crash Analysis

An approximate 59 miles stretch of U.S. 412 known as the Cimarron Turnpike, divided into 27 segments, was evaluated from I-35 to the OK-48/U.S. 64 interchange. This planning segment operates as a turnpike and is classified as a four-lane divided highway with full access control. The entire segment is considered rural. The following section provides detailed descriptions of the crash data analysis conducted for this planning segment.

Crash Severity and Crash Type

Between the years 2017-2021, 447 crashes were reported along this planning segment, representing 9% of all crashes reported along U.S. 412. Of the 447 crashes reported, 340 crashes (~76% of all crashes) resulted in property damage only, 104 crashes (~23% of all crashes) caused some form of injury to vehicle occupants, and three crashes (less than 1% of all crashes) resulted in fatalities (**Figure 6**). Fixed object collisions were the predominant crash types, accounting for approximately 67% (300 crashes) of all reported crash types in the planning segment (**Figure 7**). The remaining 147 crashes (33%) resulted from sideswipe same-directions, rear-end, rollovers/overturns, animals, angle collisions, sideswipe opposite-directions, and other collision types. Of the 300 fixed object collisions, 170 crashes (57% of fixed object collisions) resulted from collisions with cable barriers. This high number of collisions with cable barriers points to the concerns related to the design of roadway with a center barrier.

Figure 6: Crash Severity – Cimarron Turnpike

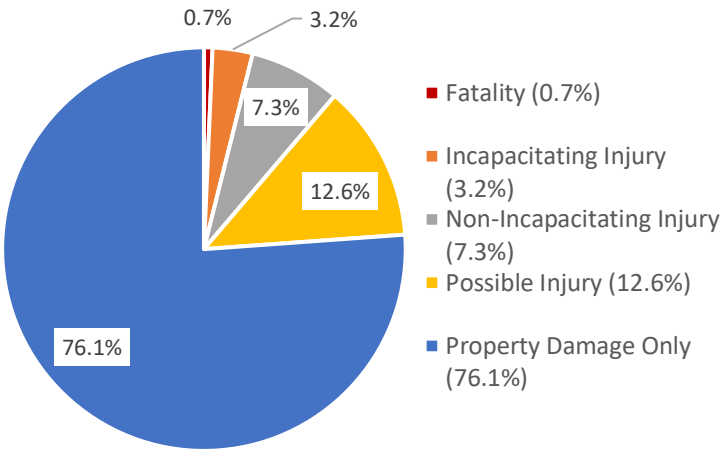
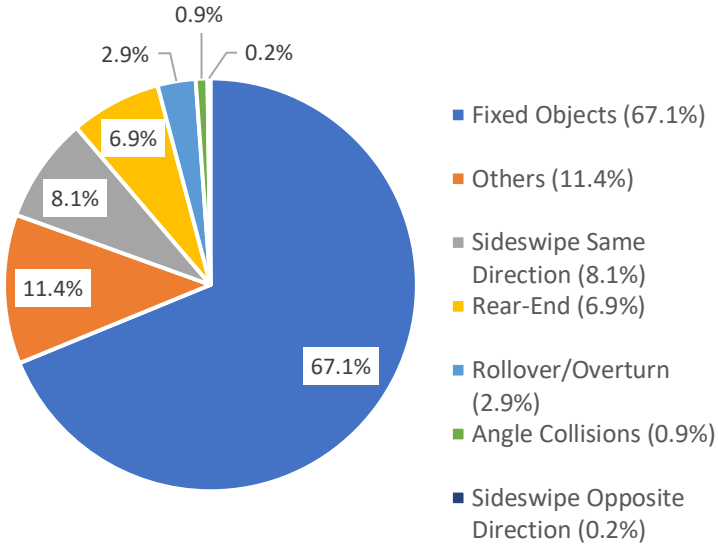


Figure 7: Crash Type – Cimarron Turnpike



Source: ODOT Crash Data 2017-2021

Vehicle Types

Passenger cars were involved in 361 crashes, accounting for approximately 81% of the overall total crashes in the Cimarron Turnpike planning segment. Heavy vehicles/trucks were involved in 73 crashes and accounting for approximately 16% of the total reported crashes in this segment. Analysis was conducted

to compare the percentage of crashes that involved heavy vehicles/trucks to the percentage of trucks that used the planning segment. It was found that while trucks accounted for 27% of all traffic in this planning segment, only 16% of reported crashes involved heavy vehicles/trucks. This suggests that crashes involving heavy vehicles may not be a significant concern in this planning segment. The remaining 13 (~3%) crashes were associated with motorcycles, buses/vans, and other vehicle types.

Roadway Surface and Lighting Conditions

Of the total number of crashes, 275 crashes (62%) occurred on dry road surfaces, while 145 crashes (32%) were reported to have occurred on wet surfaces. The remaining 27 crashes (6%) occurred on other road surfaces, including snow, slush, and ice/frost. Approximately 66% (294 crashes) of all crashes occurred during daylight, 27% (122 crashes) of crashes occurred during dark conditions, either with streetlights or without streetlights, and the remaining 7% (31 crashes) occurred during dusk or dawn. With high percentages of fixed object collisions experienced along the corridor, roadway surface conditions and lighting conditions might be considered potential contributing factors. Approximately 42% (127 crashes) and 25% (75 crashes) of fixed object collisions occurred on wet road surfaces and during dark conditions with no streetlights respectively.

Crash Rates

The Cimarron Turnpike planning segment is classified as a rural four-lane divided highway with full access control. ODOT provided the statewide total crash rates for this type of road for the years 2018-2021. The average crash rates for total crashes as well as KA crashes were calculated based on the project area crash data. At the time this report was drafted statewide rates for combined KA (fatal and incapacitating injury) were not available from ODOT for comparison.

Table 2 below compares total crash rates for the 27 segments evaluated in the Cimarron Turnpike planning segment to the statewide crash averages. When looking at crash rates, it is important to note that shorter study segments (less than 1 mile) have the potential to skew crash rate results. As shown in the table, 18 segments surpassed Oklahoma's statewide average crash rates. Of the identified segments, the Cimarron Turnpike Spur interchange experienced the highest crash rate at approximately 143.08 crashes/hundred million vehicles miles traveled (HMVMT), more than three times the statewide average crash rate whereas the segment from U.S. 77 to N 3230 Road experienced the second highest crash rate with more than twice the statewide average. Brief descriptions of the segments that had a higher crash rate compared to the statewide average for total crashes are provided below.

Table 2: Cimarron Turnpike Crash Rates

Cimarron Turnpike Segments		Average Daily Traffic (2021)	Segment Length (Mile)	Total Crash Rate (HMVMT)		KA Crash Rate (HMVMT)	
Segment Number	Segment Name			Segment Crash Rate	Statewide 3-Year Average (2018-2020)	Segment Crash Rate	Statewide 3-Year Average (2018-2020)
1	I-35 Interchange	5,173	0.53	**139.90***	40.31[1]	0.00	N/A
2	I-35 Interchange to US 77	5,173	2.4	**61.79***	40.31[1]	4.41	N/A
3	US 77 to N3230 Rd	5,173	1.79	**118.35***	40.31[1]	5.92	N/A
4	N 3230 Rd to N3260 Rd	5,173	3.05	**65.99***	40.31[1]	6.95	N/A
5	N3260 Rd to Ranch Rd	5,710	2.94	39.17	40.31[1]	3.26	N/A
6	Ranch Rd to CR 210	5,710	2.05	**65.54***	40.31[1]	0.00	N/A
7	CR 210 to US 177	5,710	2.07	**50.99***	40.31[1]	4.64	N/A
8	US 177 to N3360 Rd	5,710	4.5	**61.84***	40.31[1]	0.00	N/A
9	N3360 Rd to US 64	5,710	3.03	25.34	40.31[1]	0.00	N/A
10	US 64 Interchange	6,095	0.27	33.30	40.31[1]	0.00	N/A
11	US 64 to E0510 Rd	6,095	1.22	7.37	40.31[1]	7.37	N/A
12	E0510 Rd to Cimarron Turnpike Spur	6,095	3.17	22.69	40.31[1]	2.84	N/A
13	Cimarron Turnpike Spur Interchange	6,095	0.44	**143.02***	40.31[1]	0.00	N/A
14	Cimarron Turnpike Spur to 3430 Rd	8,845	2.70	**61.95***	40.31[1]	4.59	N/A
15	3430 Rd to N3450 Rd	8,845	2.00	**65.05***	40.31[1]	0.00	N/A
16	N3450 Rd to N3480 Rd	8,845	2.88	**49.47***	40.31[1]	2.15	N/A
17	N 3480 Rd to OK-18	8,845	0.62	**89.93***	40.31[1]	0.00	N/A
18	OK -18 Interchange	8,845	0.68	36.44	40.31[1]	0.00	N/A
19	OK-18 to N3530 Rd	8,845	3.70	38.51	40.31[1]	5.02	N/A
20	N3530 Rd to N3550 Rd	8,845	1.93	32.10	40.31[1]	6.42	N/A
21	N3550 Rd to N3570 Rd	9,001	1.98	39.97	40.31[1]	0.00	N/A
22	N3570 Rd to N3600 Rd	9,001	2.00	**48.70***	40.31[1]	0.00	N/A
23	N3600 Rd to OK-99	9,001	1.83	**69.86***	40.31[1]	0.00	N/A
24	OK-99 to N3650 Rd	9,001	3.14	**93.06***	40.31[1]	0.00	N/A
25	N3650 Rd N3680 Rd	9,001	4.00	**53.27***	40.31[1]	1.52	N/A

Cimarron Turnpike Segments		Average Daily Traffic (2021)	Segment Length (Mile)	Total Crash Rate (HMVMT)		KA Crash Rate (HMVMT)	
Segment Number	Segment Name			Segment Crash Rate	Statewide 3-Year Average (2018-2020)	Segment Crash Rate	Statewide 3-Year Average (2018-2020)
26	N3680 Rd to OK-48	9,001	3.00	**68.99***	40.31[1]	0.00	N/A
27	OK-48/US 64 Interchange	14,500	0.68	**66.69***	40.31[1]	0.00	N/A
	Cimarron Turnpike Planning Segment Crash Rate	7,446**	59	56.13	40.31[1]	2.13	N/A

Source: ODOT Crash Data 2017-2021

HMVMT-Hundred million vehicles miles traveled.

[1] - Oklahoma Statewide 3-year average (2018-2020) total crash rate for rural four-lane divided highways with full access control.

***** - Segment exceeds the statewide crash rate for similar facilities.

** - Weighted average ADT.

N/A- Not available at the time of publishing the report.

Segment 1: I-35 Interchange

This segment surpassed the statewide total crash rate at 139.90 crashes/HMVMT. This segment at 0.34 miles long, experienced seven crashes. The short segment length potentially skewed the crash rate. Three incidents (~43%) reported along this segment resulted in property damage only, with four crashes causing non-incapacitating or possible injury to vehicle occupants, and no fatalities were reported. Crashes along this segment primarily consisted of collisions with fixed objects (four crashes, 57%).

Segment 2: I-35 Interchange to the U.S. 77

This segment exceeded the statewide total crash rate at 61.79 crashes/HMVMT. Fourteen crashes were reported along the approximate 2.4-mile stretch. Ten incidents (~71%) reported along this segment resulted in property damage only, with four crashes (29%) causing some form of injury to vehicle occupants, and no fatalities were reported. Collisions with fixed objects (nine crashes, 64%) were the leading crash types followed by rollovers/overturns (two crashes, 14%).

Segment 3: U.S. 77 to N 3230 Road

The crash rate along the approximate 1.79-mile segment of U.S. 412 from U.S. 77 to N 3230 Road was 118.35 crashes/HMVMT. Of the 20 crashes reported along this segment, 14 crashes (~70%) resulted in property damage only, with six crashes (30%) causing some form of injury to vehicle occupants, and no fatalities were reported. The highest percentage of crashes in this segment resulted from collisions with fixed objects (16 crashes, 8%) followed by rollovers/overturns (two crashes, 10%).

Segment 4: N 3230 Road to N 3260 Road

This segment surpassed the statewide total crash rate at 65.99 crashes/HMVMT. Of the 19 crashes reported along this segment, 12 incidents (~63%) resulted in property damage only, with five crashes

(32%) causing some form of injury to vehicle occupants, and one fatality was reported. Collisions with fixed objects were the predominant crash types accounting for 79% of the total crashes in this segment.

Segment 6: Ranch Road to CR 210 Road

The crash rate of this segment was 65.54 crashes/HMVMT. There were 14 crashes reported to have occurred along the approximate 2.05-mile stretch of U.S. 412 from Ranch Road to CR 210 Road. Of the 14 crashes reported along this segment, nine crashes (~64%) resulted in property damage only, with five crashes (~36%) causing some form of injury to vehicle occupants, and no fatalities were reported. Collisions with fixed objects were the leading crash types, accounting for 71% of the total crashes reported in this segment.

Segment 7: CR 210 Road to the U.S. 177

This segment exceeded the statewide total crash rate at 50.99 crashes/HMVMT. There were 11 crashes occurred along the 2.07-mile stretch. Six incidents (~55%) reported along this segment resulted in property damage only, with four crashes (36%) causing some form of injury to vehicle occupants, and one fatal crash was reported. Collisions with fixed objects were the predominant crash types representing 45% of the total crashes reported in this segment.

Segment 8: U.S. 177 to N 3360 Road

An approximate 4.5-mile segment of U.S. 412 from U.S. 177 to N 3360 Road exceeded the statewide total crash rate at 61.84 crashes/HMVMT. Of the 29 crashes reported along this segment, 28 crashes (~97%) resulted in property damage only, with one crash causing non-incapacitating injury to vehicle occupants, and no fatalities were reported. Collisions with fixed objects were the leading crash types, accounting for 52% of the total crashes reported in this segment.

Segment 13: Cimarron Turnpike Spur Interchange

The crash rate of this segment was 143.02 crashes/HMVMT. The short segment length (0.44 miles) potentially skewed the crash rate. Seven crashes occurred at this interchange resulting in property damage only. Crashes along this segment primarily consisted of fixed object collisions (five crashes, 71%) followed by rear-end and sideswipe same-direction collisions.

Segment 14: Cimarron Turnpike Spur to N 3430 Road

This segment surpassed the statewide total crash rate at 61.95 crashes/HMVMT. There were 27 crashes reported along the approximately 2.7-mile stretch. Of the 27 crashes, 22 crashes (~81%) reported along this segment resulted in property damage only, with five crashes causing some form of injury to vehicle occupants. and no fatalities were reported. Collisions with fixed objects were the leading crash types, accounting for 85% of the crashes reported in this segment.

Segment 15: N 3430 Road to N 3450 Road

The crash rate of the approximately 2-mile segment from N 3430 Road to N 3450 Road was 65.05 crashes/HMVMT. Of the 21 crashes reported along this segment, 16 crashes (~76%) resulted in property damage only, with five crashes causing some form of injury to vehicle occupants and no fatalities were

reported. Collisions with fixed objects were the predominant crash types, accounting for 81% of the total crashes reported in this segment.

Segment 16: N 3450 Road to N 3480 Road

The crash rate of the approximately 2-mile segment of U.S. 412 from N 3450 Road to N 3480 Road was 49.47 crashes/HMVMT. Of the 23 crashes reported along this segment, 20 crashes (~87%) resulted in property damage only, with three crashes causing some form of injury to vehicle occupants, and no fatalities were reported. Collisions with fixed objects were the leading crash types, accounting for 57% of the total crashes reported in this segment.

Segment 17: N 3480 Road to the OK -18

An approximate 0.62-mile segment of U.S. 412 from N 3480 Road to the OK -18 experienced nine crashes and had a crash rate of 89.93 crashes/HMVMT. Eight incidents (~89%) reported along this segment resulted in property damage only, with one crash causing possible injury to vehicle occupants, and no fatalities were reported. Collisions with fixed objects were the main crash types (four crashes, 44%).

Segment 22: N 3570 Road to N 3600 Road

This segment exceeded the statewide total crash rate at 40.31 crashes/HMVMT. Of the 16 crashes reported along this 2-mile segment, 13 crashes (~81%) resulted in property damage only, with three crashes causing some form of injury to vehicle occupants, and no fatalities were reported. Collisions with fixed objects were the leading crash types, accounting for 75% of the total crashes reported in this segment.

Segment 23: N 3600 Road to the OK-99

This segment had the crash rate of 69.86 crashes/HMVMT. There were 21 crashes reported along this approximate 1.83-mile stretch. Of the 21 crashes, 17 crashes (~81%) reported along this segment resulted in property damage only, with four crashes (~19%) causing some form of injury to vehicle occupants, and no fatalities were reported. Collisions with fixed objects were the leading crash types, accounting for 67% of the total crashes reported in this segment.

Segment 24: OK-99 to the N 3650 Road

This approximate 3.14-mile segment of U.S. 412 from OK-99 to N 3650 Road experienced 48 crashes and had a crash rate of 93.06 crashes/HMVMT. Of the 48 crashes, 39 incidents (~81%) reported along this segment resulted in property damage only, with nine crashes causing possible injury to vehicle occupants, and no fatalities were reported. Collisions with fixed objects were the leading crash types, representing 52% of the total crashes reported in this segment.

Segment 25: N 3650 Road to the N 3680 Road

This segment had a crash rate of 53.27 crashes/HMVMT. There were 35 crashes reported along this approximate 4-mile segment. Of the 35 crashes, 25 crashes (~71%) reported along this segment resulted in property damage only, with ten crashes (~29%) causing some form of injury to vehicle occupants, and

no fatalities were reported. Collisions with fixed objects were the leading crash types, accounting for 74% of the total crashes reported in this segment.

Segment 26: N 3680 Road to the OK-48

The crash rate of this segment was 68.99 crashes/HMVMT. There were 34 crashes that occurred along the approximate 3-mile stretch. Of the 34 crashes, 25 crashes (~74%) reported along this segment resulted in property damage only, with nine crashes (~26%) causing some form of injury to vehicle occupants, and no fatalities were reported. Collisions with fixed objects were the leading crash types, representing 74% of the total crashes reported in this segment.

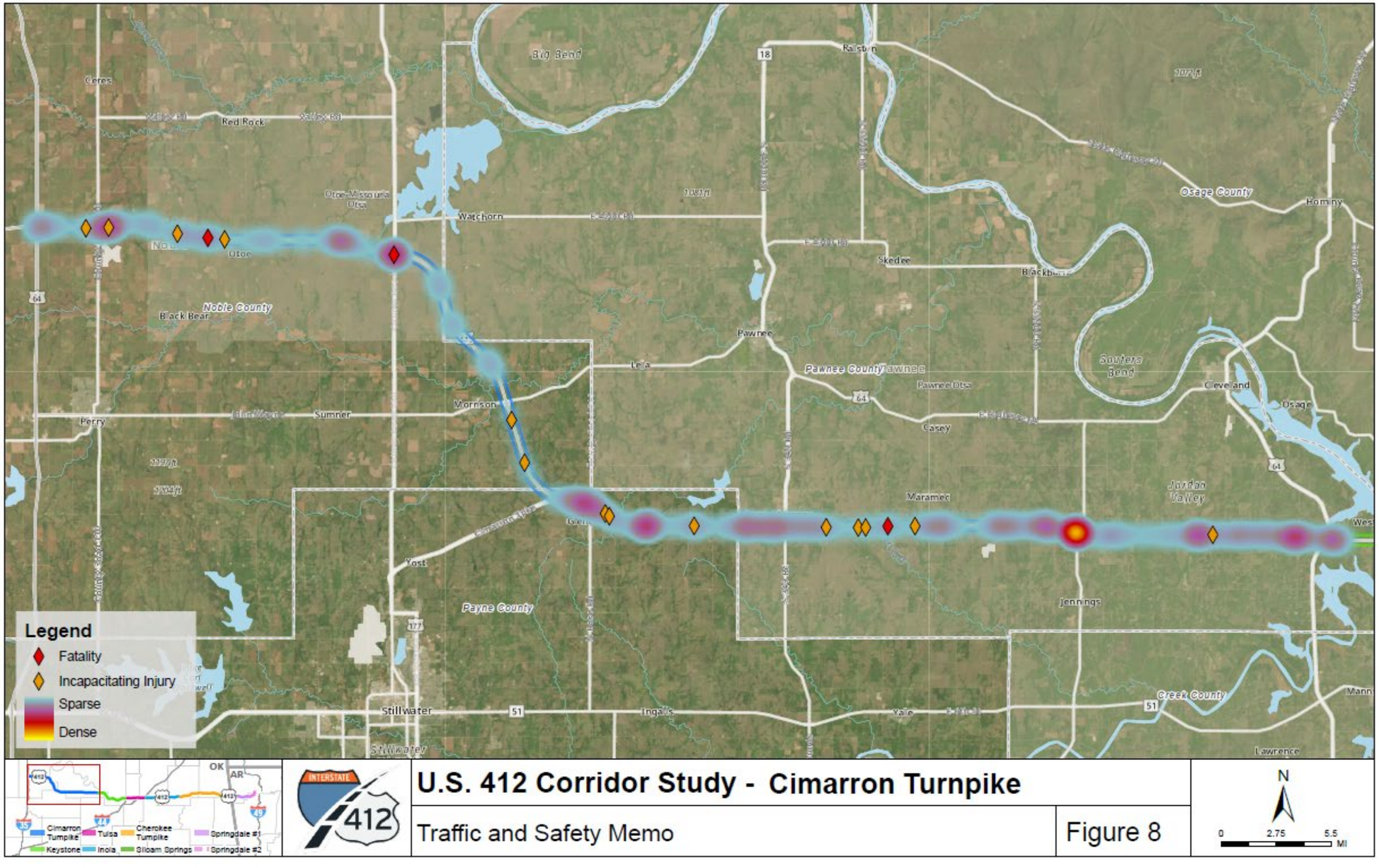
Segment 27: OK-48/U.S. 64 Interchange

The crash rate of the OK-48/U.S. 64 interchange was 66.69 crashes/HMVMT. There were 12 crashes occurred at this 0.68-mile segment. Nine incidents (~75%) reported along this segment resulted in property damage only, with three crashes (25%) causing non-incapacitating or possible injury to vehicle occupants, and no fatalities were reported. Crashes along this segment primarily consisted of fixed objects, representing 67% of the total crashes reported in this segment.

Crash Density

Figure 8 presents the crash density and the KA crash locations along the Cimarron Turnpike planning segment. Along with other segments, several locations including the segments from I-35 to N 3360 Road, The U.S. 177 interchange, Cimarron Turnpike Spur to OK-18, and the OK-99 interchange were identified as high-density locations. The crash rate results also confirmed that these segments had higher crash rates compared to the other segments. High clusters of KA crashes were identified on the Cimarron Turnpike Spur to N 3430 Road and OK-18 to N 3550 Road segments. Two incapacitating injury crashes occurred on the segment from Cimarron Turnpike to N 3430 Road, while three incapacitating injury crashes were reported on the segment from OK-18 to N 3550 Road. It is also noteworthy that road segments near the U.S. 77 interchange observed three incapacitating injury crashes resulted from rollovers/overturns.

Figure 8: Crash Density and the KA locations - Cimarron Turnpike



Source: ODOT (2017-2021), ARDOT (2017-2021).

Cimarron Turnpike Safety Analysis Summary

This 59-mile stretch of U.S. 412 corridor experienced 447 crashes and accounted for 9% of all crashes (4,863 crashes) reported along U.S. 412 within the project study limits. Of the 447 crashes reported, approximately 340 crashes (~76% of all crashes) resulted in property damage only, 104 crashes (~23% of all crashes) caused some form of injury to vehicle occupants, and three crashes (less than 1% of all crashes) resulted in fatalities. Fixed object collisions were the predominant crash types, accounting for approximately 67% (300 crashes) of all reported crash types in the planning segment. Higher percentages of collisions with fixed objects occurring along the corridor during dark conditions without streetlights indicate that lighting conditions might be a potential contributing factor to such crashes observed in this segment. Moreover, cable barriers were involved in high number of collisions, suggesting potential issues with roadway design elements.

Looking at the total crash rates, 18 segments surpassed Oklahoma's statewide average crash rates. Several consecutive road segments, such as I-35 to N 3260 Road, Ranch Road to N 3360, Cimarron Turnpike Spur to OK-18, and N 3570 Road to OK-48, exhibited higher crash rates compared to the statewide average. Most of the segments with a higher crash rate than the statewide average experienced collisions with fixed objects, resulting in property damage only. High clusters of KA crashes were identified on the Cimarron Turnpike Spur to N 3430 Road and OK-18 to N 3550 Road segments. Attention should be provided to increasing lighting facilities and improving roadway design elements to reduce the number of fixed object crashes in this planning segment.

3.2. Keystone Crash Analysis

This approximate 24-mile stretch of U.S. 412, known as the Keystone, divided into 31 segments, was evaluated from the OK-48/U.S. 64 interchange to the I-244 Interchange. This segment is considered rural west of the N 129th overpass and urban to the east. The segments from U.S. 64 to Katy Trail entrance ramp are classified as four-lane divided highway with full access control, and the rest of road segments are classified as more than four-lane divided highways with full access control. The following section provides a detailed description of the crash data analysis conducted for this planning segment.

Crash Severity and Crash Type

There were 904 crashes that occurred along this planning segment, accounting for approximately 19% of all crashes (4,863 crashes) reported along U.S. 412 within the project study limits. Of the 904 crashes reported, 619 crashes (~69% of all crashes) resulted in property damage only, 277 crashes (~31% of all crashes) caused some form of injury to vehicle occupants, and eight crashes (~1% of all crashes) resulted in fatalities (**Figure 9**). Fixed objects collisions were the predominant crash types, accounting for approximately 48% (431 crashes) of all reported collisions in the planning segment followed by rear-end collisions (185 crashes, ~21%) and sideswipe same-direction collisions (131 crashes, ~15%). The remaining 157 crashes (~17%) resulted from angle collisions, rollovers/overturns, pedestrians/bicycles, animals, and other types of collisions. (**Figure 10**). Approximately 44% of fixed object collisions (189 collisions) resulted from collisions with barriers suggesting the presence of problems associate with roadway design.

Figure 9: Crash Severity - Keystone

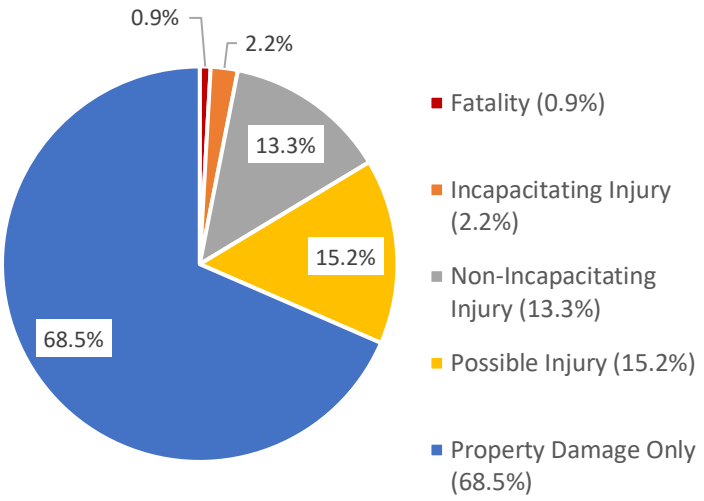
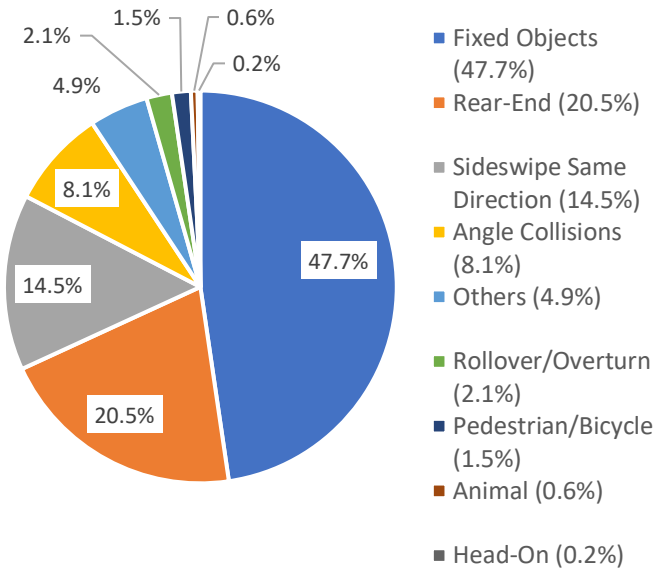


Figure 10: Crash Type - Keystone



Source: ODOT Crash Data 2017-2021

Vehicle Types

Passenger cars were involved in 825 crashes, representing approximately 91% of all crashes reported in the Keystone planning segment. Heavy vehicles/trucks were involved in 58 crashes, accounting for approximately 6% of the total reported crashes in this segment. Further analysis was conducted to compare the percentage of crashes that involved heavy vehicles/trucks to the percentage of trucks that used the planning segment. While trucks accounted for 13% of all traffic on this planning segment, only 6% of reported crashes involved heavy vehicles/trucks. This suggests that crashes involving heavy vehicles may not be a significant concern in this planning segment. The remaining 3% of crashes were associated with motorcycles, Buses/Vans, and other types of vehicles.

Roadway Surface and Lighting Conditions

Approximately 70% (630 crashes) of all crashes occurred on dry roadway surfaces whereas 23% (212 crashes) of all crashes occurred on wet surfaces. The remaining 7% (62 crashes) of all crashes occurred on other road surfaces including ice/frost, snow, and slush. Approximately 68% (617 crashes) of all crashes occurred during daylight, 28% (257 crashes) of crashes occurred during dark conditions either with streetlights or without streetlights, and the remaining 3% (30 crashes) occurred during dusk, dawn, or other times. With higher percentages of fixed object collisions experienced along the corridor, wet surface and lighting conditions might be potential contributing factors. Approximately 34% (148 crashes) and 33% (141 crashes) of fixed objects collisions occurred on wet road surfaces and during dark conditions respectively. The percentage of fixed object collisions (33%) during dark conditions were higher compared to all crashes occurred during dark condition (27%). Further analysis revealed that 84 fixed object

collisions occurred during dark conditions with no streetlights while 57 fixed object collisions occurred during dark conditions with streetlights. Though these numbers are not mutually exclusive, high percentages of fixed object collisions do appear to occur during adverse weather and dark lighting conditions.

Crash Rates

The Keystone planning segment consists of both rural and urban areas. The segment from U.S. 64 to N 129th W Avenue is classified as a rural four-lane divided highway with full access control, the segments from the N 129th W Avenue to the Katy Trail entrance ramp are considered as an urban four-lane divided highway with full access control, and the rest of the road segments are classified as an urban more than four-lane divided highway with full access control. ODOT provided the statewide total crash rates for these types of facilities for the years 2018-2020. The average crash rates for the total, as well as KA crashes, were calculated based on the project area crash data. At the time this report was drafted statewide rates for combined KA (fatal and incapacitating injury) were not available from ODOT for comparison.

Table 3 below compares total crash rates for the 31 segments evaluated in the Keystone planning segment to the statewide crash averages. As shown in the table, of the 31 segments, 18 surpassed Oklahoma's statewide average for total crash rates. Although the crash rate of the Wilson Avenue interchange was 399.50 crashes/HMVMT, more than six times the statewide average, its' short segment length (0.24 miles) likely skewed the results. The N 129th W Avenue interchange had a crash rate of 254.53 crashes/HMVMT, more than four times the statewide average. Brief descriptions of the segments that had higher crash rates compared to the statewide average for total crashes are provided below.

Table 3: Keystone Crash Rates

Keystone Segments		Average Daily Traffic (2021)	Segment Length (Mile)	Total Crash Rate (HMVMT)		KA Crash Rate (HMVMT)	
Segment Number	Segment Name			Segment Crash Rate	Statewide 3-Year Average (2018-2020)	Segment Crash Rate	Statewide 3-Year Average (2018-2020)
1	OK-48/US 64 Interchange to N Peninsula Dr W	14,500	1.59	**61.79***	40.31[1]	0.00	N/A
2	N Peninsula Dr W Interchange	14,500	0.2	37.79	40.31[1]	0.00	N/A
3	N Peninsula Dr W to S Peninsula Dr E	14,500	3.23	**71.37***	40.31[1]	0.00	N/A
4	Peninsula Dr Interchange near Old Keystone Rd	14,500	0.17	**88.92***	40.31[1]	0.00	N/A
5	S Peninsula Dr E to W Peninsula Dr near Appalachia Bay area	14,500	1.65	**64.13***	40.31[1]	4.58	N/A
6	W Peninsula Dr Interchange near Appalachia Bay area	15,400	0.17	**41.86***	40.31[1]	0.00	N/A

Keystone Segments		Average Daily Traffic (2021)	Segment Length (Mile)	Total Crash Rate (HMVMT)		KA Crash Rate (HMVMT)	
Segment Number	Segment Name			Segment Crash Rate	Statewide 3-Year Average (2018-2020)	Segment Crash Rate	Statewide 3-Year Average (2018-2020)
7	Peninsula Dr near Bay area to OK-151	21,800	2.4	37.70	40.31[1]	1.05	N/A
8	OK-151 Interchange	21,800	0.31	**89.19***	40.31[1]	0.00	N/A
9	OK-151 Interchange to S 209th W Ave	21,800	0.72	**48.87***	40.31[1]	0.00	N/A
10	S 209th W Ave Interchange	21,800	0.37	**88.31***	40.31[1]	6.79	N/A
11	S 209th W Ave to W Wekiwa Rd	21,800	1.62	32.58	40.31[1]	1.55	N/A
12	W Wekiwa Rd Interchange	29,900	0.38	**48.23***	40.31[1]	0.00	N/A
13	W Wekiwa Rd to N 129th W Ave	29,900	2.8	**41.89***	40.31[1]	0.65	N/A
14	N 129th W Ave Interchange	29,900	0.36	**254.53***	61.72[2]	0.00	N/A
15	N 129th W Ave to Wilson Ave	29,900	0.85	**88.40***	61.72[2]	6.47	N/A
16	Wilson Ave Interchange	36,400	0.26	**399.50***	61.72[2]	5.79	N/A
17	Wilson Ave to Katy Trail entrance ramp	36,400	0.42	**78.85***	61.72[2]	0.00	N/A
18	Katy Trail entrance ramp to Adam Rd exit ramp	36,400	0.46	**107.99***	99.66[3]	3.27	N/A
19	Adam Rd exit ramp to S 81st W Ave	40,200	0.65	54.52	99.66[3]	2.10	N/A
20	S 81st W Ave Interchange	40,200	0.39	90.87	99.66[3]	0.00	N/A
21	S 81st W Ave to S 65th W Ave	40,200	0.82	43.22	99.66[3]	3.32	N/A
22	S 65th W Ave Interchange	47,100	0.33	**165.69***	99.66[3]	3.53	N/A
23	Gilcrease Expy Interchange	47,100	0.61	59.12	99.66[3]	3.81	N/A
24	Gilcrease Expy to N 49th W Ave	47,100	0.2	17.45	99.66[3]	0.00	N/A
25	N 49th W Ave Interchange	47,100	0.3	54.29	99.66[3]	0.00	N/A
26	N 49th W Ave to N 33rd W Ave	58,400	0.94	44.92	99.66[3]	3.99	N/A
27	N 33rd W Ave to Gilcrease Museum Rd	58,400	0.3	50.04	99.66[3]	0.00	N/A
28	Gilcrease Museum Rd Interchange	58,400	0.28	**137.39***	99.66[3]	3.35	N/A

Keystone Segments		Average Daily Traffic (2021)	Segment Length (Mile)	Total Crash Rate (HMVMT)		KA Crash Rate (HMVMT)	
Segment Number	Segment Name			Segment Crash Rate	Statewide 3-Year Average (2018-2020)	Segment Crash Rate	Statewide 3-Year Average (2018-2020)
29	N Gilcrease Museum Rd to N Quanah Ave	58,400	0.42	87.12	99.66[3]	6.70	N/A
30	N Quanah Ave Interchange	58,400	0.31	**193.71***	99.66[3]	6.05	N/A
31	I-244 Interchange	57,900	0.41	43.86	99.66[3]	2.31	N/A
OK-48/US 64 Interchange to N 129th W Ave[1]		28,865**	14.02	35.51	40.31[1]	0.73	N/A
N 129th W Ave to Katy Trail		32,239**	1.89	163.67	61.72[2]	3.60	N/A
Katy Trail to the I-244 Interchange		48,984**	6.42	74.92	99.66[3]	3.14	N/A

Source: ODOT Crash Data 2017-2021

HMVMT-Hundred million vehicles miles traveled.

[1] - Oklahoma Statewide 3-year average (2018-2020) total crash rate for rural four-lane divided highways with full access control.

[2] - Oklahoma Statewide 3-year average (2018-2020) total crash rate for urban four-lane divided highways with full access control.

[3] - Oklahoma Statewide 3-year average (2018-2020) total crash rate for urban more than four-lane divided highways with full access control.

***** - Segment exceeds the statewide crash rate for similar facilities.

** - Weighted average ADT.

N/A- Not available at the time of publishing the report.

Segment 1: OK-48/U.S. 64 Interchange to N Peninsula Drive West

This segment had the crash rate of 61.79 crashes/HMVMT. Of the 26 crashes reported along this segment, 20 crashes (~77%) resulted in property damage only, with six crashes (23%) causing some form of injury to vehicle occupants, and no fatalities were reported. Collisions with fixed objects were the leading crash types (13 crashes, 50%) followed by rear-end collisions (two crashes, 17%).

Segment 3: N Peninsula Drive West to N Peninsula Drive East

The crash rate of this approximate 3.23-mile stretch was 71.37 crashes/HMVMT. Of the 61 crashes reported along this segment, 49 crashes (~80%) resulted in property damage only, with 12 crashes (~20%) causing some form of injury to vehicle occupants, and no fatalities were reported. Collisions with fixed objects were the leading crash types (42 crashes), accounting for 69% of the crashes, followed by sideswipe same-direction collisions.

Segment 4: Peninsula Drive Interchange near Old Keystone Road

The crash rate of this segment was 88.92 crashes/HMVMT. Short segment length (0.17 miles) potentially skewed the crash rate. Four crashes were reported at the Peninsula Drive interchange near Old Keystone Road. All the crashes reported along this segment resulted in property damage only. Collisions with fixed objects were the leading crash types (3 crashes, 75%) followed by rollovers/overturns.

Segment 5: S Peninsula Drive E to W Peninsula Drive near Appalachia Bay area

An approximate 1.65-mile segment from S Peninsula Drive East to W Peninsula Drive near Appalachia Bay area experienced 28 crashes. The crash rate of this segment was 64.13 crashes/HMVMT. Of the 28 crashes, 22 crashes (~79%) resulted in property damage only, with five crashes (~18%) causing some form of injury to vehicle occupants, and one fatal crash was reported. Collisions with fixed objects were the leading crash types (20 crashes, 75%) followed by rear-end collisions.

Segment 6: Peninsula Drive Interchange near Appalachia Bay area

The crash rate of this segment was 41.86 crashes/HMVMT. Two crashes were reported at the Peninsula Drive interchange near the Old Keystone Road. All the crashes reported along this segment resulted in property damage only. Collisions with fixed objects (20 crashes. 71%) and were the main crash types followed by rear-end collisions.

Segment 8: OK-151 Interchange

The crash rate of the OK-151 interchange was 89.19 crashes/HMVMT, more than twice the statewide average. However, the short segment length (0.31 miles) caused the elevated crash rate. Eleven crashes were reported at this interchange. Of the 11 crashes, eight crashes (~73%) reported along this segment resulted in property damage only, with three crashes (~27%) causing some form of injury to vehicle occupants, and no fatalities were reported. Crashes in this segment predominantly consisted of fixed objects collisions (eight crashes,73%), rear-end collisions (two crashes, 18%), and Rollover/overturn (one crash, 9%).

Segment 9: OK-151 to S 209th W Avenue

This segment exceeded the statewide total crash rate at 48.87 crashes /HMVMT. Fourteen crashes were reported, of them, 10 crashes (~71%) resulted in property damage only, with four crashes (~29%) causing non-incapacitating injury to vehicle occupants, and no fatalities. Crashes in this segment predominantly consisted of fixed objects collisions (nine crashes, 82%).

Segment 10: S 209th W Avenue Interchange

This segment had the crash rate of 88.31 crashes/HMVMT, more than twice the statewide average. Short segment length (0.37 miles) potentially skewed the crash rate. Of the 13 crashes reported along this segment, seven crashes (~54%) resulted in property damage only, with six crashes (~46%) causing some form of injury to vehicle occupants, and no fatalities were reported. Collisions with fixed objects were the predominant crash types (eight crashes,62%).

Segment 12: W Wekiwa Road Interchange

The crash rate of this segment was 48.23 crashes/HMVMT. Of the 10 crashes reported along this segment, seven crashes (70%) resulted in property damage only, with three crashes (30%) causing some form of injury to vehicle occupants, and no fatalities were reported. Crashes in this segment predominantly consisted of fixed object collisions (five crashes, 50%) and sideswipe same-directions collisions (two crashes, 20%).

Segment 13: W Wekiwa Road N 129th W Avenue

The approximate 2.8-mile stretch from Wekiwa Road to N 129th Avenue exceeded the statewide total crash rate at 41.89 crashes/HMVMT. Of the 64 crashes reported along this segment, 40 crashes (~63%) resulted in property damage only, with 24 crashes (~37%) causing some form of injury to vehicle occupants, and no fatalities were reported. Collisions with fixed objects were the predominant crash types (34 crashes, 54%) by sideswipe same-direction collisions (two crashes, 20%).

Segment 14: N 129th W Avenue Interchange

The crash rate of this segment was 254.53 crashes/HMVMT, more than four times the statewide average. However short segment length (0.36 miles) skewed the crash rate. Of the 50 crashes reported along this segment, 37 crashes (~74%) resulted in property damage only, with 13 crashes (~26%) causing some form of injury to vehicle occupants, and no fatalities were reported. Crashes in this segment predominantly consisted of fixed objects collisions (24 crashes, 48%), angle collisions (10 crashes, 20%), and rear-end collisions (eight crashes, 16%).

Segment 15: N 129th W Avenue to Wilson Avenue

The approximate 0.85-mile segment from N 29th W Avenue to Wilson Avenue had the crash rate of 88.40 crashes/HMVMT. Of the 41 crashes reported along this segment, 33 crashes (~80%) resulted in property damage only, with seven crashes (~17%) causing some form of injury to vehicle occupants, and one fatal crash was reported. Collisions with fixed objects were the leading crash types, accounting for 73% of the total crashes reported in this segment.

Segment 16: Wilson Avenue Interchange

The Wilson Avenue interchange had a higher crash rate of 399.50 crashes/HMVMT compared to the statewide average. However, this elevated crash rate can be attributed to the short length of the segment. Of the 69 crashes reported along this segment, 57 crashes (~83%) resulted in property damage only, with 12 crashes (~17%) causing some form of injury to vehicle occupants, and no fatalities were reported. Crashes in this segment predominantly consisted of angle collisions (32 crashes,46%), fixed objects collisions (12 crashes, 17%), rear-end collisions (12 crashes, 16%), and sideswipe same-directions collisions (11 crashes, 16%).

Segment 17: Wilson Avenue to the Katy Trail entrance ramp

The crash rate of the approximate 0.42 -mile segment from Wilson Avenue to Katy Trail entrance ramp was 78.85 crashes/HMVMT. Of the 22 crashes reported along this segment, 15 crashes (~68%) resulted in property damage only, with seven crashes (~32%) causing some form of injury to vehicle occupants, and no fatalities were reported. Collisions with fixed objects were the leading crash types (13 crashes, 59%) followed by sideswipe same-direction collisions (eight crashes,36%).

Segment 18: Katy Trail entrance ramp to Adam Road

This segment exceeded the statewide total crash rate at 107.99 crashes/HMVMT. Of the 33 crashes reported along this segment, 24 crashes (~73%) resulted in property damage only, with nine crashes

(~27%) causing some form of injury to vehicle occupants, and no fatalities were reported. Collisions with fixed objects and rear-ends were the leading crash types followed by sideswipe same-direction collisions.

Segment 22: S 65th W Avenue Interchange

The crash rate of this segment was 165.69 crashes/HMVMT. Of the 47 crashes reported along this segment, 33 crashes (~70%) resulted in property damage only, with 14 crashes (~30%) causing some form of injury to vehicle occupants, and no fatalities were reported. Fixed object collisions were the predominant crash types (29 crashes, 62%) followed by rear-end collisions (10 crashes, 21%).

Segment 28: Gilcrease Museum Road Interchange

Although this segment had a higher crash rate of 137.39 crashes/HMVMT compared to the statewide average, short segment length (0.28 miles) likely skewed the crash rate result. Of the 41 crashes reported at the Gilcrease Museum Road interchange, 22 crashes (~54%) resulted in property damage only, with 19 crashes (~46%) causing some form of injury to vehicle occupants, and no fatalities were reported. Crashes in this segment mostly consisted of rear-end collisions (13 crashes, 32%), angle collisions (nine crashes, 22%), and sideswipe same-direction crashes (five crashes, 12%).

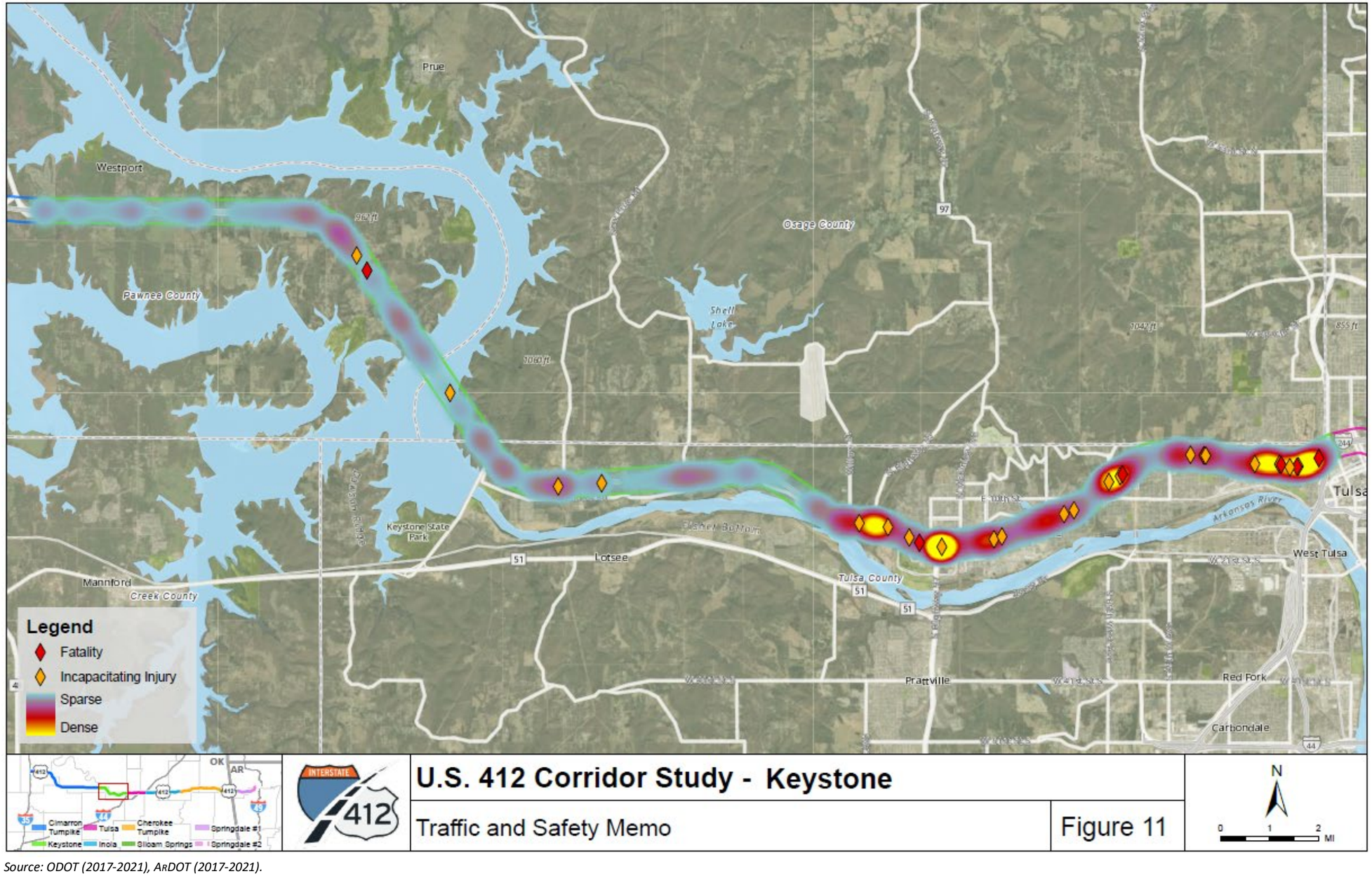
Segment 30: N Quanah Avenue Interchange

The crash rate of the N Quanah Avenue interchange was 193.71 crashes/HMVMT, more than twice the statewide average. However, this elevated crash rate can be attributed to short segment length (0.31 miles). Of the 64 crashes reported along this segment, 43 crashes (~67%) resulted in property damage only, with 20 crashes (~31%) causing some form of injury to vehicle occupants, and one fatal crash was reported. Crashes in this segment mostly consisted of rear-end collisions (32 crashes, 50%), fixed objects (20 crashes, 22%), and sideswipe same-direction collisions (five crashes, 12%).

Crash Density

Figure 11 presents the crash density and KA crash locations along the Keystone segments. This segment experienced low crash density compared to the other planning segments. However, several locations including the N 129th W Avenue interchange, the Wilson Avenue interchange, the S 65th W Avenue, the Gilcrease Museum interchange, and the Quanah Avenue interchange experienced high clusters of crashes. As shown in **Figure 11**, KA crashes were mostly concentrated near the N 129th W Avenue interchange, from N 129th W Avenue to Wilson Avenue, from N 49th W Avenue to N 33rd W Avenue, and from N Gilcrease Museum Road to N Quanah Avenue interchange. Approximately 50% of KA crashes occurred during dark conditions. One pedestrian fatality and two pedestrian incapacitating injury crashes were reported in the segment from N 129th Avenue to Wilson Avenue interchange during dark conditions. Road segments from Gilcrease Museum Road and N Quanah Avenue interchange also experienced three pedestrian KA crashes during dark conditions. These crash dense locations experienced several fatal and serious injury crashes involving pedestrians, further attention to these areas may be necessary to determine causes for pedestrian activity.

Figure 11: Crash Density and the KA Locations - Keystone



Source: ODOT (2017-2021), ARDOT (2017-2021).

Keystone Safety Analysis Summary

This approximate 24-mile stretch of U.S. 412, divided into 31 segments, was evaluated from OK-48/U.S. 64 to the I-244 Interchange. Of the 904 crashes reported in this segment, 619 crashes (~69% of all crashes) resulted in property damage only, 277 crashes (~31% of all crashes) caused some form of injury to vehicle occupants, and eight crashes (~1% of all crashes) resulted in fatalities. Fixed object collisions were the predominant crash types, accounting for approximately 48% followed by rear-end collisions at 21%. The high occurrence of cable barrier collisions, which made up 44% of all fixed object collisions, suggests potential roadway design issues.

Several consecutive road segments, such as OK-151 to S 209th W Avenue, W Wekiwa Road to Adam Road exit ramp, and N 3570 Road to OK-48, exhibited higher crash rates compared to the statewide average. Most segments with higher crash rates experienced collisions with fixed objects, resulting in property damage only. However, the Wilson Avenue interchange observed angle-turning collisions while segments west of I-244 such as the Gilcrease Museum Road interchange and N Quanah Avenue interchange experienced a high number of rear-end collisions. Crash types shift as the segment moves from the rural and suburban area into the edges of Tulsa from fixed Object to rear-end collisions. This indicates a change in roadway characteristics as well as traffic patterns. Rear-end collisions usually indicate highly congested areas and are typically attributed to lower-speed crashes. The high percentage of crashes occurring during dark conditions indicates that attention should be paid to increasing lighting facilities.

The KA crashes were mostly concentrated near the N 129th W Avenue interchange, from N 129th W Avenue to Wilson Avenue, N 49th W Avenue to N 33rd W Avenue, and N Gilcrease Museum Road to N Quanah Avenue interchange. More in-depth analysis revealed that the segments from N 129th Avenue to Wilson Avenue, the Wilson Avenue interchange, Gilcrease Museum Road to N Quanah Avenue, and the N Quanah Avenue interchange experienced several pedestrian incapacitating injury crashes during dark conditions, further emphasizing the need to increase lighting facilities. The high number of fatal and serious injury crashes involving pedestrians observed in these locations indicates that further attention to these locations may be necessary to determine causes for pedestrian activity.

3.3. Tulsa Crash Analysis

An approximate 14-mile stretch of U.S. 412, known as the Tulsa, divided into 28 segments, was evaluated from I-244 to the I-44 interchange. The entire segment is considered as highly developed urban area and fully access controlled. This segment experienced the highest number of crashes within the project study limits. The following section describes the crash data analysis conducted for this planning segment in detail.

Crash Severity and Crash Type

Tulsa planning segment experienced 1,853 crashes, accounting for approximately 38% of all crashes (4,863 crashes) reported along U.S. 412 within the project study limits. This equals one crash per day on average over the five-year period in this planning segment. Of the 1,853 crashes reported, 954 crashes (~52% of all crashes) resulted in property damage only, 880 crashes (~48% of all crashes) caused some form of injury to vehicle occupants, and 19 crashes (1% of all crashes) resulted in fatalities (**Figure 12**). Rear-end collisions are the predominant crash types, accounting for approximately 29% (544 crashes) of all reported crash types on the planning segment followed by fixed object collisions (466 crashes, 25%), sideswipe same-direction collisions (388 crashes, 21%), and angle collisions (306 crashes, 16%) (**Figure 13**). The remaining 149 crashes were resulted from rollovers/overturns, pedestrian/bicycle, head-on, and other types of crashes.

Figure 12: Crash Severity - Tulsa

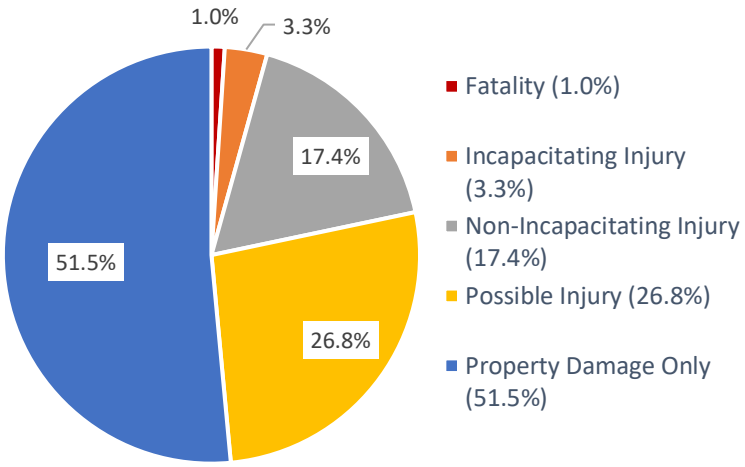
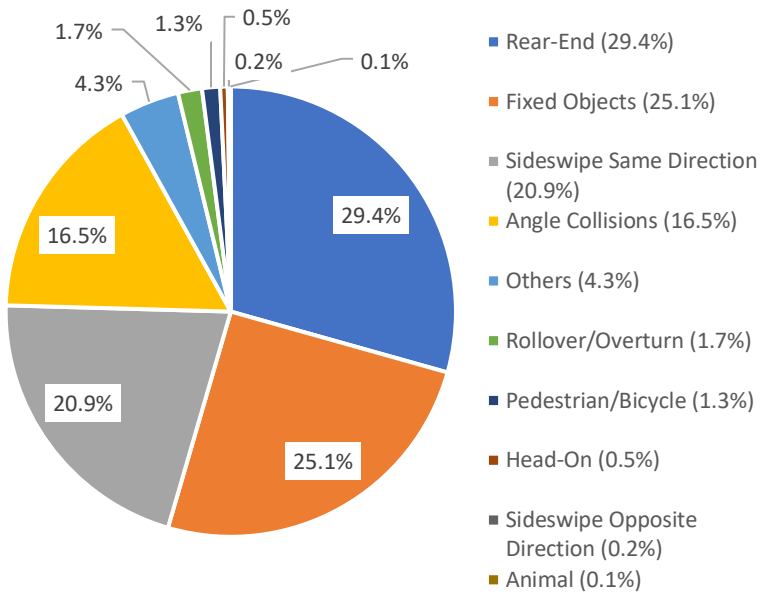


Figure 13: Crash Type - Tulsa



Source: ODOT Crash Data 2017-2021

Vehicle Types

Passenger cars were involved in 1,631 crashes, accounting for approximately 88% of the overall total crashes in the Tulsa planning segment. Heavy vehicles/trucks were involved in 124 crashes, accounting for 7% of the total reported crashes in this planning segment. Further analysis was conducted to compare the percentage of crashes that involved heavy vehicles/trucks to the percentage of trucks that used the planning segment. While trucks accounted for 11% of all traffic on this planning segment, only 7% of reported crashes involved heavy vehicles/trucks. This suggests that crashes involving heavy vehicles may not be a significant concern in this planning segment. The remaining 98 crashes were associated with motorcycles, buses/vans, and all other vehicle types.

Roadway Surface and Lighting Conditions

Of the total number of crashes, 1,602 crashes (~87% of all crashes) occurred on dry roadway surfaces whereas 195 crashes (~11%) were occurred on wet surfaces and 56 crashes (~3%) occurred on other road surfaces including snow, slush, ice/frost, and oil. When it comes to lighting conditions, 1,274 crashes (69%) occurred during daylight, 523 crashes (28%) occurred during dark conditions either with streetlights or without streetlights and 56 crashes (3%) occurred during dusk or dawn. During dark conditions, approximately 20% of rear collisions, 45% of fixed object collisions, 26% of angle collisions occurred. With higher percentages of fixed object collisions experienced along the corridor, lighting conditions might be a potential contributing factor. Further analysis revealed that 145 fixed object collisions occurred during dark conditions with streetlights while 66 fixed object collisions occurred during dark conditions with no streetlights.

Crash Rates

The Tulsa planning segment consists functional classifications of urban four-lane divided highway with full access control, and urban more than four-lane divided highway with full access control. ODOT provided the statewide total rates for these types of facilities for the years 2018-2020. The average crash rate for the total crash and KA crash was calculated based on the project area crash data. At the time this report was drafted statewide rates for combined KA (fatal and incapacitating injury) were not available from ODOT for comparison.

Table 4 below compares total crash rates for the 28 segments evaluated in the Tulsa planning segment to the statewide crash averages. Crash rates of more than half of the total roadway segments in Tulsa planning (58% of Tulsa planning segment mileage) exceeded the statewide average crash rate for total crashes. When looking at crash rates, it is important to note that shorter study segments (less than 1 mile) have the potential to skew crash rate results. Of the identified segments, the crash rate of the segment from the U.S. 169 to N Garnett Road was 308.52 crashes/HMVMT, more than three times the statewide average crash rate whereas the segments from the I-244 interchange to the U.S. 75 experienced crash rates more than twice the statewide average. Brief descriptions of the segments that had higher crash rates compared to the statewide average for total crashes are provided below.

Table 4: Tulsa Crash Rates

Tulsa Segments		Average Daily Traffic (2021)	Segment Length (Mile)	Total Crash Rate (HMVMT)		KA Crash Rate (HMVMT)	
Segment Number	Segment Name			Segment Crash Rate	Statewide 3-Year Average (2018-2020)	Segment Crash Rate	Statewide 3-Year Average (2018-2020)
1	I-244 Interchange to M.L.K. Jr Blvd/N Detroit Ave	62,200	0.21	**260.09***	99.66[1]	20.97	N/A

Tulsa Segments		Average Daily Traffic (2021)	Segment Length (Mile)	Total Crash Rate (HMVMT)		KA Crash Rate (HMVMT)	
Segment Number	Segment Name			Segment Crash Rate	Statewide 3-Year Average (2018-2020)	Segment Crash Rate	Statewide 3-Year Average (2018-2020)
2	M.L.K Jr Blvd /N Detroit Ave Interchange	62,200	0.26	**257.51***	99.66[1]	6.78	N/A
3	M.L.K Jr Blvd/N Detroit Ave to US 75	69,424	0.24	**256.51***	99.66[1]	6.58	N/A
4	US 75/I-444 Interchange	69,424	0.51	**145.47***	99.66[1]	4.64	N/A
5	US 75/I-444 Interchange to Utica Ave	69,424	0.32	**140.59***	99.66[1]	7.40	N/A
6	Utica Ave Interchange	69,424	0.48	**169.36***	99.66[1]	11.51	N/A
7	Utica Ave to Delaware Ave	69,424	0.53	34.25	99.66[1]	1.49	N/A
8	Delaware Ave Interchange	69,424	0.45	91.20	99.66[1]	1.75	N/A
9	Harvard Ave Interchange	69,424	0.4	39.46	99.66[1]	1.97	N/A
10	Harvard Ave to Yale Ave	69,424	0.65	94.71	99.66[1]	3.64	N/A
11	Yale Ave Interchange	66,100	0.41	**216.34***	99.66[1]	4.04	N/A
12	Yale Ave to Sheridan Rd	66,100	0.70	37.90	99.66[1]	2.37	N/A
13	Sheridan Rd Interchange	66,100	0.34	80.46	99.66[1]	2.44	N/A
14	Sheridan Rd to OK-11	66,100	0.63	**125.00***	99.66[1]	1.32	N/A
15	OK-11 Interchange	62,900	0.61	**152.81***	99.66[1]	2.86	N/A
16	N 89th E Ave to N 97th E Ave	62,900	0.38	**174.23***	99.66[1]	6.88	N/A
17	N Mingo Rd Interchange	62,900	0.35	**164.27***	99.66[1]	2.49	N/A
18	US 169 Interchange	62,900	0.47	**190.91***	99.66[1]	5.56	N/A
19	US 169 to N Garnett Rd	39,700	0.51	**308.52***	99.66[1]	24.36	N/A
20	N Garnett Rd to N 129th E Ave	39,700	0.81	**93.72***	61.72[2]	5.11	N/A
21	N 129th E Ave Interchange	39,700	0.42	55.87	61.72[2]	0.00	N/A
22	OK-66 Interchange	37,900	0.6	**96.38***	61.72[2]	2.41	N/A
23	OK-66 to 165th E Ave	37,900	1.15	**110.63***	61.72[2]	1.26	N/A
24	165th Ave Interchange	37,900	0.33	**214.67***	61.72[2]	8.76	N/A
25	165th E Ave to County Line Rd	70,600	1.51	41.63	61.72[2]	1.54	N/A

Tulsa Segments		Average Daily Traffic (2021)	Segment Length (Mile)	Total Crash Rate (HMVMT)		KA Crash Rate (HMVMT)	
Segment Number	Segment Name			Segment Crash Rate	Statewide 3-Year Average (2018-2020)	Segment Crash Rate	Statewide 3-Year Average (2018-2020)
26	County Line Rd Interchange	70,600	0.43	**171.47***	61.72[2]	23.46	N/A
27	OK-66/Historic Route 66 Interchange	70,600	0.48	59.83	61.72[2]	8.08	N/A
28	OK-66 to I-44/Creek Turnpike	70,600	0.44	26.46	61.72[2]	0.00	N/A
I-244 Interchange to N Garnett Rd		65,013**	8.45	137.25	99.66[1]	5.19	N/A
N Garnett Rd to I-44/Creek Turnpike		53,416**	6.17	79.30	61.72[2]	4.66	N/A

Source: ODOT Crash Data 2017-2021

HMVMT-Hundred million vehicles miles traveled.

[1] - Oklahoma Statewide 3-year average (2018-2020) total crash rate for urban more than four-lane divided highways with full access control.

[2] - Oklahoma Statewide 3-year average (2018-2020) total crash rate for urban four-lane divided highways with full access control.

***** - Segment exceeds the statewide crash rate for similar facilities.

** - Weighted average ADT.

N/A- Not available at the time of publishing the report.

Segment 1: I-244 Interchange to M.L.K. Jr Boulevard/N Detroit Avenue

Although this segment had a crash rate of 260.09 crashes/HMVMT, more than twice the statewide average, short segment length (0.21 miles) potentially skewed the results. Of the 62 crashes reported in this segment, 31 incidents (~50%) reported along this segment resulted in property damage only, with 29 crashes (~47%) causing some form of injury to vehicle occupants, and two fatal crashes (3%) were reported. Crashes along this segment primarily consisted of fixed objects (26 crashes, ~42%) and sideswipe same-direction collisions (18 crashes, ~29%).

Segment 2: M.L.K Jr Boulevard /N Detroit Avenue Interchange

The crash rate of this segment was 257.51 crashes/HMVMT, more than twice the statewide average. However, this elevated crash rate can be attributed to the short length (0.26 miles) of the segment. This segment experienced 76 crashes. Among these crashes, 42 crashes (~55%) reported along this segment resulted in property damage only, with 36 crashes (45%) causing some form of injury to vehicle occupants, and no fatalities were reported. Crashes along this segment primarily consisted of angle collisions (27 crashes, ~36%), fixed object collisions (17 crashes, 22%), and sideswipe same-direction collisions (16 crashes, ~21%). Angle collisions include angle turning and all other types of angle collisions. The elevated number of angle collisions might be attributed to the closely spaced merging and diverging ramps.

Segment 3: M.L.K. Jr Boulevard/N Detroit Avenue to U.S. 75

This segment surpassed the statewide total crash rate at 256.51 crashes/HMVMT. However, short segment length (0.24 miles) potentially skewed the crash rate. Among the 78 crashes reported in this

segment, 42 incidents (~54%) resulted in property damage only, with 36 crashes causing some form of injury to vehicle occupants, and no fatalities were reported. Crashes along this segment primarily consisted of angle collisions (25 crashes, ~32%) and rear-end collisions (22 crashes, ~28%). The elevated number of angle collisions might be attributed to the short distance between the merging and diverging ramps.

Segment 4: U.S. 75/I-444 Interchange

The crash rate of this segment was 140.49 crashes/HMVMT. However, short segment length (0.32 miles) potentially skewed the crash rate. Of the 94 crashes reported at the U.S.75/I-444 interchange, 47 incidents (~50%) resulted in property damage only, with 47 crashes (~50%) causing some form of injury to vehicle occupants, and no fatalities were reported. Crashes along this segment primarily consisted of rear-end (45 crashes, ~48%), fixed objects (26 crashes, ~28%), and side swipe same-direction collisions (22 crashes, ~22%).

Segment 5: U.S. 75/I-444 Interchange to Utica Avenue

An approximate 0.32 mile stretch from U.S. 75/I-444 to Utica Avenue had the crash rate of 140.59 crashes/HMVMT. This segment experienced 57 crashes with 28 incidents (~49%) resulted in property damage only, 29 crashes (~51%) causing some form of injury to vehicle occupants, and no fatal crashes. Crashes along this segment primarily consisted of fixed objects (24 crashes, ~42%) and sideswipe same-direction collisions (15 crashes, ~26%).

Segment 6: Utica Avenue Interchange

The crash rate of the Utica Avenue interchange was 169.36 crashes/HMVMT. This elevated crash rate likely attributed to the short segment length (0.48 miles). There were 103 crashes occurred at the Utica Avenue interchange. Among these crashes, 46 incidents (~45%) reported along this segment resulted in property damage only, with 54 crashes (52%) causing some form of injury to vehicle occupants, and three fatalities were reported. Crashes along this segment primarily consisted of angle collisions (35 crashes, ~34%), sideswipe same-direction collisions (19 crashes, ~18%), rear-end collisions (16 crashes, ~16%), and fixed object collisions (16 crashes, 16%).

Segment 11: Yale Avenue Interchange

The crash rate of the Yale Avenue interchange was 216.34 crashes/HMVMT. Short segment length (0.41 miles) potentially skewed the crash rate. There were 107 crashes occurred at the Yale Avenue interchange. Of these crashes, 58 incidents (~54% of total crashes) resulted in property damage only, with 49 crashes (46% of total crashes) causing some form of injury to vehicle occupants, and no fatalities were reported. Crashes along this segment primarily consisted of angle collisions (42 crashes, ~39%) and rear-end collisions (28 crashes, ~26%).

Segment 14: Sheridan Road to OK-11

The approximate 0.63 mile stretch from Sheridan Road to OK- 11 had a crash rate of 125 crashes/HMVMT. This segment had 95 crashes Among these crashes, 53 incidents (~56%) reported along this segment resulted in property damage only, with 42 crashes (~44%) causing some form of injury to vehicle

occupants, and no fatalities were reported. Crashes along this segment primarily consisted of rear-end (25 crashes, ~26%), angle collisions (24 crashes, ~25%), and sideswipe same-direction collisions (18 crashes, ~19%).

Segment 15: OK-11 Interchange

The crash rate of the OK-11 interchange was 152.81 crashes/HMVMT which can be attributed to short segment length (0.61 miles). Of the 107 crashes reported at the OK-11 interchange, 52 incidents (~49% of total crashes) resulted in property damage only, with 54 crashes (~50% of total crashes) causing some form of injury to vehicle occupants, and one fatal crash was reported. Crashes along this segment primarily consisted of fixed objects (28 crashes, ~26%), rear-end (26 crashes, ~24%), and angle collisions (25 crashes, ~23%).

Segment 16: N 89th E Avenue to N 97th E Avenue

The crash rate of this segment was 174.23 crashes/HMVMT which can be attributed to short segment length (0.38 miles). There were 76 crashes occurred in this segment. Among these crashes, 34 incidents (~45%) reported along this segment resulted in property damage only, with 41 crashes (~54%) causing some form of injury to vehicle occupants, and one fatal crash was reported. Crashes along this segment primarily consisted of rear-end (27 crashes, ~36%), fixed object collisions (22 crashes, ~29%), and sideswipe same-direction collisions (19 crashes, 25%).

Segment 17: Mingo Road Interchange

The Mingo Road interchange experienced a crash rate of 164.27 crashes/HMVMT. Short segment length (0.35 miles) potentially skewed the crash rate. Of the 66 crashes reported at the Mingo Road interchange. 26 incidents (~40% of total crashes) resulted in property damage only, with 40 crashes (~60% of total crashes) causing some form of injury to vehicle occupants, and no fatalities were reported. Crashes along this segment primarily consisted of rear-end (38 crashes, ~58%) and sideswipe same -direction collisions (19 crashes, ~29%).

Segment 18: U.S. 169 Interchange

This segment surpassed the statewide total crash rate at 190.91 crashes/HMVMT. Of the 103 crashes occurred in this 0.5 mile stretch, 47 incidents (~46% of total crashes) resulted in property damage only, with 56 crashes (~54% of total crashes) causing some form of injury to vehicle occupants, and no fatalities were reported. Crashes along this segment primarily consisted of rear-end (40 crashes, ~39%) and sideswipe same-direction collisions (27 crashes, ~26%).

Segment 19: U.S. 169 to N Garnett Road

The crash rate of this segment was 308.52 crashes/HMVMT, more than three times the statewide average. However, short segment length (0.51 miles) potentially skewed the crash rate. Of the 114 crashes reported in this segment, 57 incidents (~50%) resulted in property damage only, with 54 crashes (~47%) causing some form of injury to vehicle occupants, and three fatal crashes were reported. Crashes along this segment primarily consisted of rear-end (44 crashes, ~39%) and fixed object collisions (37 crashes, ~33%).

Segment 20: N Garnett Road to N 129th E Avenue

The crash rate of this segment was 93.72 crashes/HMVMT. The elevated crash rate is likely attributed to short segment length (0.81 miles). Of the 55 crashes reported in this segment, 30 incidents (~55%) reported along this segment resulted in property damage only, with 23 crashes (~42%) causing some form of injury to vehicle occupants, and two fatal crashes were reported. Crashes along this segment primarily consisted of fixed objects (25 crashes, ~46%) and angle collisions (16 crashes, ~29%).

Segment 22: OK-66 Interchange

The crash rate of the OK-66 interchange was 96.38 crashes/HMVMT. Short segment length (0.48 miles) potentially skewed the crash rate. Of the 40 crashes reported along this segment, 19 incidents (~48% of total crashes) resulted in property damage only, with 21 crashes (~52% of total crashes) causing some form of injury to vehicle occupants, and no fatalities were reported. Crashes along this segment primarily consisted of fixed objects (19 crashes, ~48%) and rear-end collisions (11 crashes, ~28%).

Segment 23: OK-66 to 165th E Avenue

The segment had a crash rate of 110.63 crashes/HMVMT. There were 88 crashes occurred in this 1.15-mile segment. Of these crashes, 59 incidents (~67% of total crashes) reported along this segment resulted in property damage only, with 28 crashes (~32% of total crashes) causing some form of injury to vehicle occupants, and one fatal crash was reported. Crashes along this segment primarily consisted of rear-end (35 crashes, ~40%) and sideswipe same-direction collisions (31 crashes, ~35%).

Segment 24: 165th Avenue Interchange

This segment exceeded the statewide crash rate at 214.67 crashes/HMVMT. However, short segment length (0.33 miles) potentially skewed the crash rate. Of the 49 crashes reported along this segment , 27 incidents (~55% of total crashes) resulted in property damage only, with 22 crashes (~45% of total crashes) causing some form of injury to vehicle occupants, and no fatalities were reported. Crashes along this segment primarily consisted of rear-end (21 crashes, ~43%) and angle collisions (10 crashes, ~21%), sideswipe same directions (eight crashes, ~16%), and fixed object collisions (eight crashes, ~16%).

Segment 26: County Line Road Interchange

The approximately 0.43 miles segment had the crash rate of 171.47 crashes/HMVMT. There were 95 crashes occurred at the County Line Road interchange. In this segment, 47 incidents (~50% of total crashes) reported along this segment resulted in property damage only, with 46 crashes (~48% of total crashes) causing some form of injury to vehicle occupants, and two fatal crashes (~2%) were reported. Crashes along this segment primarily consisted of angle (36 crashes, ~38%) and rear-end collisions (34 crashes, ~36%).

Crash Density

Figure 14 presents the crash density and the KA crash locations along the Tulsa planning segments. Although the high number of crashes were spread across the whole segment, several high-risk crash locations including road segments from the I-244 interchange to M.L.K. Jr Boulevard/N Detroit Avenue,

the U.S. 75/I-444 interchange, the Utica Avenue interchange, N 89th E Avenue to N 97th E Avenue, U.S. 169 to N 129th Road, the County Line Road interchange, and the OK-66 interchange were identified. Similarly, although KA crashes were spread across the planning segment, several segments such as segments from the I-244 interchange to M.L.K. Jr Boulevard /N Detroit Avenue, N 89th E Avenue to N 97th E Avenue, U.S. 169 to N 129th Road and County Line Road to the OK-66 are characterized by the high number of such crashes. The subsequent section discussed the KA crashes occurred in these segments.

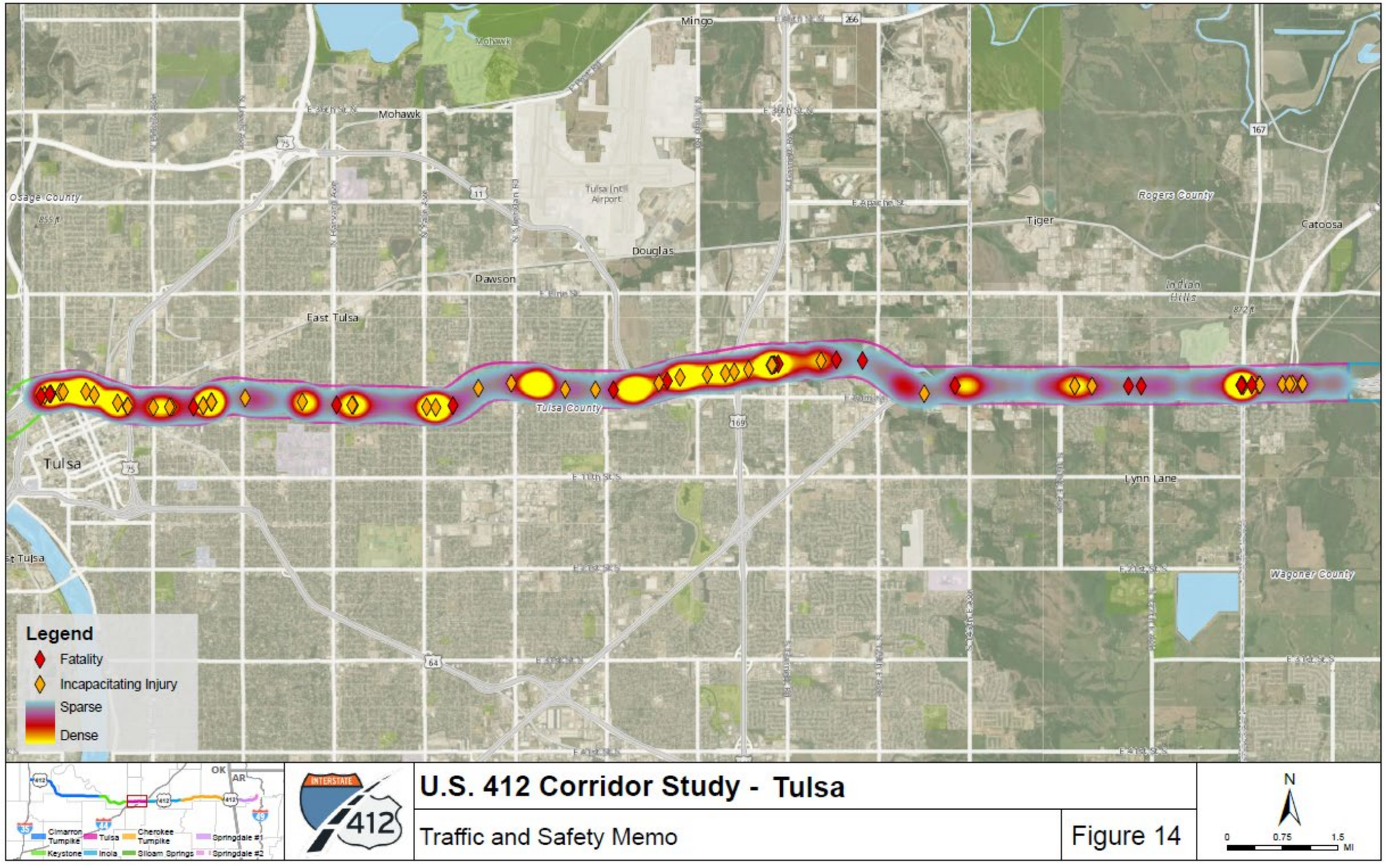
I-244 to M.L.K. Jr Boulevard experienced two fatal pedestrian crashes and three incapacitating injury crashes. Of the three incapacitating injury crashes, two crashes resulted from collisions with fixed objects while one crash resulted from other crash types.

Road segments from U.S. 169 to N Garnett experienced three fatal crashes and six incapacitating injury crashes. Two pedestrian fatalities during dark conditions with no streetlight and one motorcycle fatality due to a collision with a guardrail were reported in this segment. Of the six incapacitating injuries reported in this segment, three crashes resulted from fixed object collisions.

The County line Road interchange experienced two pedestrian fatal crashes and 11 incapacitating injury crashes. Both fatal crashes occurred during dark conditions. Of the 11 incapacitating injury crashes, six crashes occurred due to angle collisions, two crashes occurred due to rear-end collisions, one crash occurred resulted from a sideswipe same direction collision while the other crash occurred on wet road surfaces. Also. N 89th E Avenue to N 97th E Avenue experienced one fatal crash during dark conditions and two incapacitating injury crashes due to rollover and collision with tree.

Most of the fatal crashes occurred during dark conditions, further emphasizing the potential need of improving lighting facilities.

Figure 14: Crash Density and the KA locations - Tulsa



Source: ODOT (2017-2021), ARDOT (2017-2021).

Tulsa Safety Analysis Summary

An approximate 14-mile stretch of U.S. 412, divided into 28 segments, was evaluated from the OK-48/U.S. 64 to I-244. The Tulsa planning segment experienced the highest number of total crashes within the project study limits. Of the 1,853 crashes reported, 954 crashes (~52% of all crashes) resulted in property damage only, 880 crashes (~47% of all crashes) caused some form of injury to vehicle occupants, and 19 crashes (1% of all crashes) resulted in fatalities. Rear-end collisions were the predominant crash types, accounting for approximately 29% (544 crashes) of all reported crash types on the planning segment followed by fixed object collisions (25%).

Crash rates of more than half of the total roadway segments in Tulsa planning segment exceeded the statewide average. Multiple stretches of road, namely, I-244 to Utica Avenue, Sheridan Road to N 129th E Avenue, and OK-66 to 165th Avenue exhibited high crash rates than the statewide average. The high traffic volume and roadway design issues contribute to the combination of rear-end, fixed objects, and angle collisions in these fully developed urban areas. Several segments such as segments from the I-244 interchange to M.L.K. Jr Boulevard /N Detroit Avenue, N 89th E Avenue to N 97th E Avenue, U.S. 169 to N 129th Road and County Line Road to the OK-66 had high clusters of KA crashes.

Rear-end collisions can be attributed to high traffic volume, as rear-end collisions usually indicate highly congested areas and are typically attributed to lower-speed crashes. A high percentage of fixed object collisions occurring during dark conditions in this planning segment indicates that lighting conditions might be a potential contributing factor to such crashes. Enhancing lighting facilities and delineation treatments including installing delineators and appropriate warning signs might reduce the frequency and severity of fixed object collisions in this planning segment. Furthermore, angle collisions are mostly attributable to the closely spaced ramp terminals. Attention to geometrics at ramp merge and diverge ought to be considered to avoid such collisions.

3.4. Inola Crash Analysis

An approximately 28-mile stretch of U.S. 412, known as the Inola, from the I-44 interchange to the ALT U.S. 412 interchange was evaluated. This segment is not access controlled with many at-grade crossings. The following sections provide a detailed description of the crash data analysis conducted for this planning segment.

Crash Severity and Crash Type

This planning segment experienced 351 crashes, accounting for approximately 7% of all crashes (4,863 crashes) reported along U.S. 412 within the project study limits. Of the 351 crashes reported, 170 crashes (~48% of all crashes) resulted in property damage only, 172 crashes (~47% of all crashes) caused some form of injury to vehicle occupants, and nine crashes (~3% of all crashes) resulted in fatalities (**Figure 15**). Rear-end collisions were the predominant crash types, accounting for approximately 29% (102 crashes) of all reported crash types on the planning segment followed by angle collisions (100 crashes, ~28%), fixed

objects (63 crashes, 18%), and sideswipe same-direction collisions (36 crashes, 10%) (**Figure 16**). The remaining 50 crashes (14%) resulted from rollovers/overturns, animals, and other types of collisions.

Figure 16: Crash Severity - Inola

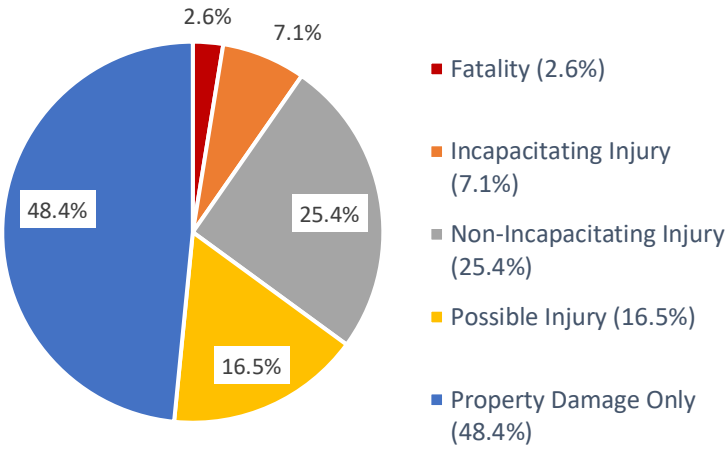
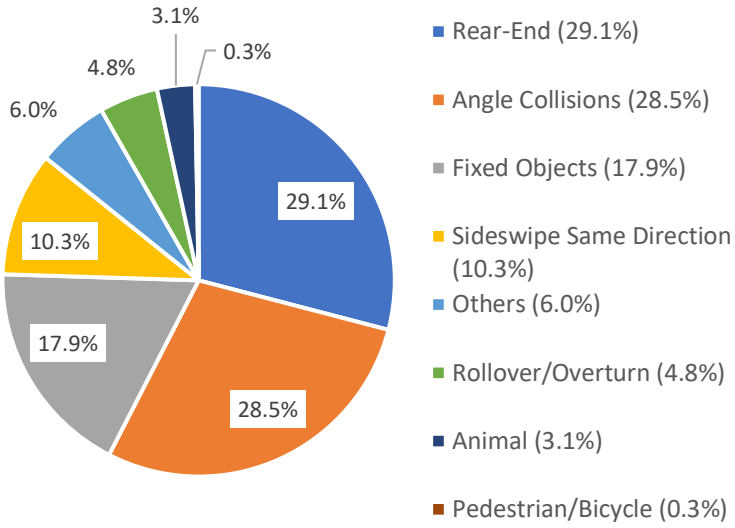


Figure 15: Crash Type - Inola



Source: ODOT Crash Data 2017-2021

Vehicle Types

Passenger cars were involved in 301 crashes, accounting for approximately 86% of the overall total crashes in the Inola planning segment. Heavy vehicles/trucks were involved in 35 crashes and made up 10% of the total reported crashes in this planning segment. Further analysis was conducted to compare the percentage of crashes that involved heavy vehicles/trucks to the percentage of trucks that used the planning segment. While trucks accounted for 15% of all traffic on this planning segment, only 10% of reported crashes involved heavy vehicles/trucks. This suggests that crashes involving heavy vehicles/trucks may not be a significant concern in this planning segment. The remaining 16 crashes were associated with motorcycles and other vehicle types.

Roadway Surface and Lighting Conditions

In the Inola planning segment, 278 crashes (~79% of all crashes) occurred on dry roadway surfaces whereas 43 crashes (~12%) occurred on wet surfaces and 26 crashes (~7%) occurred on icy road surfaces. When it comes to lighting conditions, 211 crashes (60%) occurred during daylight, 115 crashes (33%) occurred during dark conditions either with streetlights or without streetlights, and 25 crashes (7%) occurred during dusk or dawn. Approximately 31% of angle collisions and 41% of the fixed object collisions occurred during dark conditions whereas 33% of all crashes occurred during dark conditions in this segment. Further analysis revealed that 31 angle collisions and 24 fixed object collisions occurred during

dark conditions. With high percentages of fixed object collisions occurring during dark conditions along the corridor, lighting conditions might be a potential contributing factor. Several consecutive segments including segments from I-44 to S 4160 Road, S 4180 Road to NS-4195 Road, S 4240 Road to S 4259 Road, S 431 Road to S 432 Road, N 4335 Road to ALT U.S. 412 observed higher number of crashes occurred during dark conditions.

Crash Rates

The Inola planning segment functional classification consists of a combination of rural four-lane divided highway with full access control and rural four-lane divided highway with partial access control. ODOT provided the statewide 3-year average rates for these types of facilities. The average crash rates for the total and KA crashes were calculated based on the project area crash data. At the time this report was drafted statewide rates for combined KA (fatal and incapacitating injury) were not available from ODOT for comparison.

Table 5 below compares total crash rates for the 30 segments evaluated in the Inola planning segment to the statewide crash averages. When looking at the crash rates, it is important to note that shorter study segments (less than 1 mile) have the potential to skew crash rate results. As shown in the table, of the 30 segments, seven segments surpassed Oklahoma's statewide average crash rates. Of the identified segments, the crash rates of the segment from U.S. 69 to S 431 Road was 87.44 crashes/HMVMT whereas the segment from N 4335 Road to 412B/N 4340 Road had a crash rate of 85.23 crashes/HMVMT. Brief descriptions of the segments that had higher crash rates compared to the statewide average for total crashes are provided below.

Table 5: Inola Crash Rates

Inola Segments		Average Daily Traffic (2021)	Segment Length (Mile)	Total Crash Rate (HMVMT)		KA Crash Rate (HMVMT)	
Segment Number	Segment Name			Segment Crash Rate	Statewide 3-Year Average (2018-2020)	Segment Crash Rate	Statewide 3-Year Average (2018-2020)
1	I-44/Creek Turnpike Interchange – West side	70,600	0.48	16.17	61.72[1]	0.00	N/A
2	I-44/Creek Turnpike Interchange-East	23,500	0.25	9.33	61.72[1]	0.00	N/A
3	I-44/Creek Turnpike to 265th Ave	23,500	2.6	33.18	57.34[2]	0.00	N/A
4	265th E Ave to N 289th E Ave	19,900	1.5	**67.92***	57.34[2]	14.69	N/A
5	N 289th Ave to N 305th E Ave	22,100	1.0	54.55	57.34[2]	2.48	N/A
6	N 305th E Ave to S 4160 Rd	22,100	2.2	**61.98***	57.34[2]	4.51	N/A
7	S 4160 Rd to S 4170 Rd	22,100	1.04	33.38	57.34[2]	2.38	N/A

Inola Segments		Average Daily Traffic (2021)	Segment Length (Mile)	Total Crash Rate (HMVMT)		KA Crash Rate (HMVMT)	
Segment Number	Segment Name			Segment Crash Rate	Statewide 3-Year Average (2018-2020)	Segment Crash Rate	Statewide 3-Year Average (2018-2020)
8	S 4170 Rd to S 4180 Rd	22,100	1.0	42.15	57.34[2]	7.44	N/A
9	S 4180 Rd to NS-4190 Rd	18,180	1.0	33.15	57.34[2]	0.00	N/A
10	NS-4190 Rd to NS-4195 Rd	18,180	0.5	**60.28***	57.34[2]	12.06	N/A
11	NS -4195 Rd to S 4200 Rd	18,180	0.5	48.22	57.34[2]	18.08	N/A
12	S 4200 Rd to OK-88	18,180	0.3	50.23	57.34[2]	20.09	N/A
13	OK-88 Interchange	18,180	0.23	13.10	40.31[3]	0.00	N/A
14	OK-88 to S 4210 Rd	17,200	0.52	18.38	40.31[3]	0.00	N/A
15	S 4210 Rd to S 4230 Rd	17,200	2.0	12.74	40.31[3]	1.59	N/A
16	S 4230 Rd to S 4240 Rd	17,200	1.0	25.49	57.34[2]	0.00	N/A
17	S 4240 Rd to S 4250 Rd/County Line Rd	17,200	1.0	44.60	57.34[2]	3.19	N/A
18	S 4250 Rd/County Line Rd to S 426 Rd	18,800	1.0	23.32	57.34[2]	0.00	N/A
19	S 426 Rd to S 427 Rd	18,800	1.0	14.57	57.34[2]	0.00	N/A
20	S 427 Rd to S 428 Rd	18,800	1.02	20.00	57.34[2]	0.00	N/A
21	S 428 Rd to S 429 Rd	18,800	1.02	17.14	57.34[2]	0.00	N/A
22	S 429 Rd to S 430 Rd	18,800	1.02	17.14	57.34[2]	2.86	N/A
23	S 430 Rd to US 69	18,800	0.3	29.15	40.31[3]	19.43	N/A
24	US 69 Interchange	18,800	0.52	**44.84***	40.31[3]	0.00	N/A
25	US 69 to S 431 Rd	18,800	0.2	**87.44***	57.34[2]	0.00	N/A
26	S 431 Rd to S 432 Rd	13,600	1.08	26.11	57.34[2]	3.73	N/A
27	S 432 Rd to Old Hwy 33 E	13,600	0.95	38.17	57.34[2]	8.48	N/A
28	Old Hwy 33 E to N 4335 Rd	13,600	0.54	22.38	57.34[2]	0.00	N/A
29	N 4335 Rd to 412B/N 4340 Rd	13,600	0.52	**85.23***	57.34[2]	7.75	N/A
30	412B/N 4340 Rd to D0583 Rd	13,600	0.62	**58.49***	57.34[2]	6.50	N/A
I-44/Creek Turnpike Interchange		54,470**		17.91	61.72[1]	0.00	N/A

Inola Segments			Average Daily Traffic (2021)	Segment Length (Mile)	Total Crash Rate (HMVMT)		KA Crash Rate (HMVMT)	
Segment Number	Segment Name				Segment Crash Rate	Statewide 3-Year Average (2018-2020)	Segment Crash Rate	Statewide 3-Year Average (2018-2020)
I-44/Creek to OK-88			21,355**	12	47.62	57.34[2]	5.29	N/A
OK-88 to D0583 Rd	16,996**	15	27.10	40.31[3]		2.22	N/A	

Source: ODOT Crash Data 2017-2021

HMVMT-Hundred million vehicles miles traveled.

[1] - Oklahoma Statewide 3-year average (2018-2020) total crash rate for urban four-lane divided highways with full access control.

[2] - Oklahoma Statewide 3-year average (2018-2020) total crash rate for rural four-lane divided highways with partial access control.

[3] - Oklahoma Statewide 3-year average (2018-2020) total crash rate for rural four-lane divided highways with full access control.

***** - Segment exceeds the statewide crash rate for similar facilities.

** - Weighted average ADT.

N/A- Not available at the time of publishing the report.

Segment 4: 265th E Avenue to N 289th E Avenue

An approximate 1.5 mile stretch from 265th E Avenue to N 289th Avenue had a crash rate of 67.92 crashes/HMVMT. Of the 37 crashes reported along this segment, 19 incidents (~51%) resulted in property damage only, with seven crashes causing incapacitating injury (19%), six crashes causing non-incapacitating injury (16%), four crashes causing possible injury (11%) and one fatality (3%) was reported. Crashes along this segment primarily consisted of angle collisions (20 crashes, 54%) followed by rear-end collisions (five crashes, 14%). Approximately 41% (15 crashes) of total crashes reported in this segment occurred during dark conditions.

Segment 6: N 305th E Ave to S 4160 Road

The crash rate of this segment was 61.98 crashes/HMVMT. This segment experienced 55 crashes. Of the 55 incidents, 25 crashes (~46%) reported along this segment resulted in property damage only, with 29 crashes (53%) causing some form of injury to vehicle occupants, and one fatality was reported. Crashes along this segment primarily consisted of angle collisions (20 crashes, 37%) and rear-end collisions (12 crashes, 22%). Approximately 38% (21 crashes) of total crashes reported in this segment occurred during dark conditions.

Segment 10: NS-4190 Road to NS-4195 Road

This segment exceeded the statewide total crash rate at 60.28 crashes/HMVMT. The elevated crash rate can be attributed to the short road segment (0.5 miles). There were 10 crashes reported in this segment. Among these crashes, one incident reported along this segment resulted in property damage only, with nine crashes causing some form of injury to vehicle occupants, and no fatalities were reported. Crashes along this segment primarily consisted of rear-ends (five crashes, 50%) and angle collisions (four crashes, 40%).

Segment 24: US 69 Interchange

The crash rate of the 0.52-mile segment was 44.84 crashes/HMVMT. This segment experienced eight crashes. All the crashes reported along this segment resulted in property damage only. Crashes along this segment primarily consisted of sideswipe same-direction collisions (four crashes, 50%) and rear-end collisions (three crashes, 38%).

Segment 25: U.S. 69 to S 431 Road

This segment experienced six crashes and had a crash rate of 87.44 crashes/HMVMT. The elevated crash rate is likely attributed to the short road segment (0.2 miles). Among these crashes, four incidents (~67%) reported along this segment resulted in property damage only, with two crashes causing some form of injury to vehicle occupants, and no fatalities were reported. Crashes along this segment primarily consisted of angle collisions (three crashes, ~50%) and fixed object collisions (two crashes, 33%).

Segment 29: N 4335 Road to 412B/N 4340 Road

This segment experienced 11 crashes and had a crash rate of 85.23 crashes/HMVMT. Of the 11 incidents, six crashes (~55%) reported along this segment resulted in property damage only, with five crashes (45%) causing some form of injury to vehicle occupants, and no fatalities were reported. Crashes along this segment primarily consisted of angle collisions (five crashes, ~46%) and rear-end collisions (two crashes, 18%), and other crashes (two crashes, ~18%).

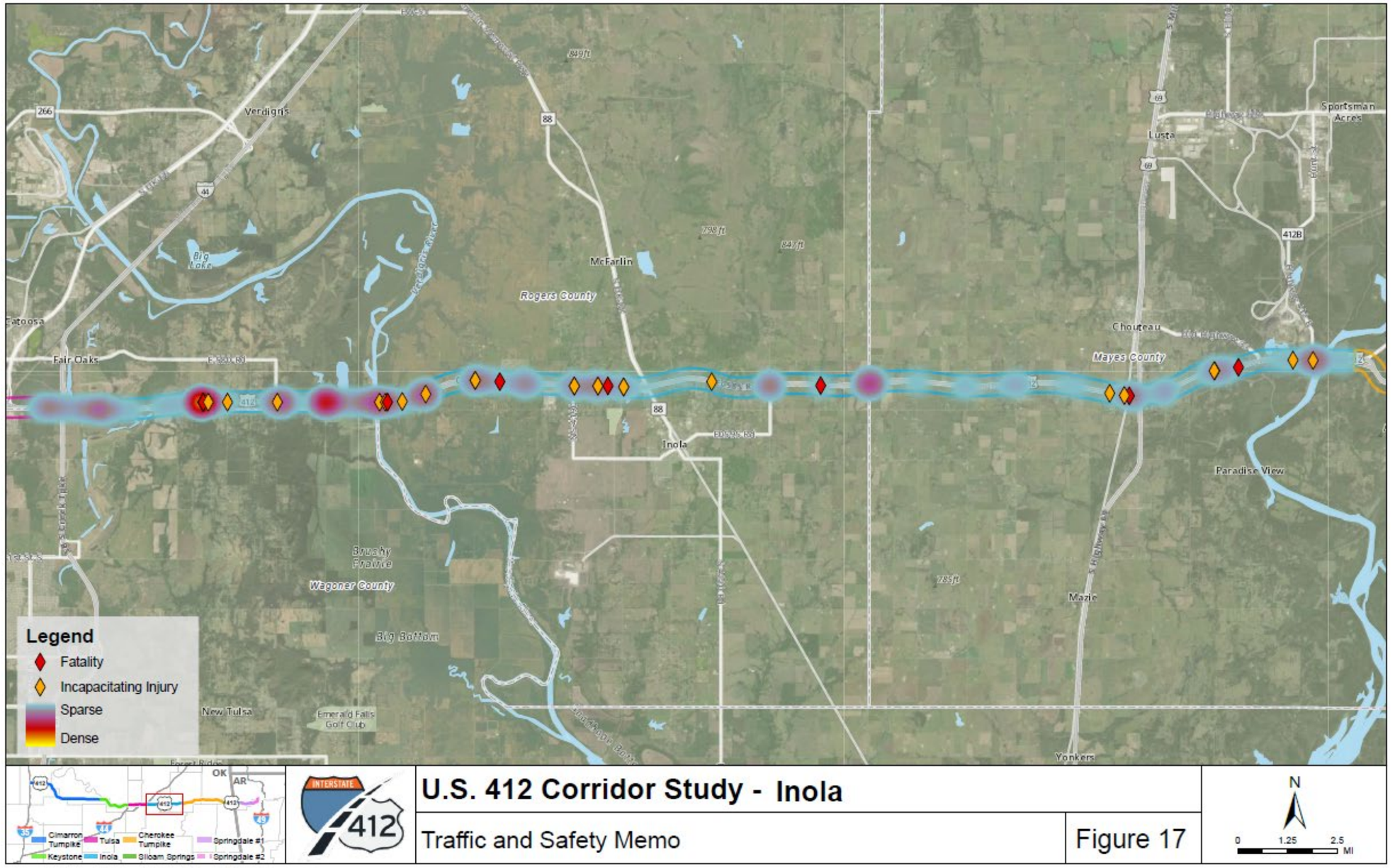
Segment 30: 412B/N 4340 Rd to D0583 Road

The crash rate of this 0.62-mile-long segment was 58.49 crashes/HMVMT, slightly higher than the statewide average. Nine crashes were reported in this segment. The elevated crash rate is likely attributed to the short road segment (0.2 miles). Among these crashes, seven incidents (~78%) reported along this segment resulted in property damage only, with two crashes causing some form of injury to vehicle occupants, and no fatalities were reported. Crashes along this segment primarily consisted of fixed object collisions (three crashes, 33%) and rear-end collisions (two crashes, 22%).

Crash Density

Figure 17 presents the crash density and the KA crash locations along the Inola planning segment. Several high-risk crash locations including the segments from I-44 to OK-88, near the S 4250 Road interchange, and the U.S. 69 interchange were identified. As shown in **Figure 17**, KA crashes were mostly concentrated near the segment from 265th E Avenue to N 289th E Ave, N 305th Avenue to S 4160 Road, NS -4190 Road to S 4200 Road, and S 432 Road to Old Highway 33. The segment from 265th E Avenue to N 289th E Ave had one fatal crash and seven incapacitating injury crashes. Of these eight KA crashes, six were angle collisions. The segment from N 305th E Ave to S 4160 Road had three rear-end collisions resulting in incapacitating injuries and one pedestrian fatality, with three of the four crashes occurring during dark conditions. Additionally, the segment from NS-4195 road to the 4200 Road had two fatal crashes and one incapacitating injury crash, both fatal crashes occurring during dark conditions. S 432 Road to Old Highway 33 had two fatal crashes resulting from a sideswipe same direction and collision with a fixed object (tree) during daylight.

Figure 17: Crash Density and the KA Locations - Tulsa



Source: ODOT (2017-2021), ARDOT (2017-2021).

Inola Safety Analysis Summary

An approximately 28-mile stretch of U.S. 412 that begins from the I-44 interchange and ends at the ALT U.S. 412 interchange was evaluated. There were 351 crashes reported along the planning segment, accounting for approximately 7% of all crashes (4,863 crashes) reported along U.S. 412 within the project study limits. Of the 351 crashes reported, 170 crashes (~48% of all crashes) resulted in property damage only, 172 crashes (~49% of all crashes) caused some form of injury to vehicle occupants, and nine crashes (~3% of all crashes) resulted in fatalities. Rear-end collisions were the predominant crash types, accounting for approximately 29% (102 crashes) of all reported crash types on the planning segment followed by angle collisions (~28%).

Of the 30 segments, seven segments exceeded the statewide crash rate. A majority of the segments that exceeded the statewide average crash rate experienced angle collisions mostly, which often resulted in more severe crashes. This is supported by the higher proportion (50%) of KA crashes caused by angle collisions in this planning segment. KA crashes were mostly concentrated near the segment from 265th E Avenue to N 289th E Ave, N 305th Avenue to S 4160 Road, NS-4190 Road to S 4200 Road, and S 432 Road to Old Highway 33. Angle collisions are likely attributed to the conflict points at the intersections. Converting the at-grade intersections into grade-separated interchanges ought to be considered to avoid such collisions. Also, with the higher number of crashes occurring during dark conditions indicated that further importance should be provided to increasing lighting facilities along this planning segment.

3.5. Cherokee Turnpike Crash Analysis

The road segments along U.S. 412 from D0583 Road to the ALT U.S. 412 interchange were evaluated as Cherokee Turnpike planning segment. This planning segment serves as a turnpike and fully access controlled. The following sections provide a detailed description of the crash data analysis conducted for this planning segment.

Crash Severity and Crash Type

There were 187 crashes reported along the planning segment, accounting for approximately 4% of all crashes (4,863 crashes) reported along U.S. 412 within the project study limits. Of the 187 crashes reported, 123 crashes (~66% of all crashes) resulted in property damage only, 61 crashes (~33% of all crashes) caused some form of injury to vehicle occupants, and three crashes (~2% of all crashes) resulted in fatalities (**Figure 18**). Fixed object collisions were the predominant crash types, accounting for approximately 54% (100 crashes) of all reported crash types on the planning segment followed by rollovers/overturns (25 crashes, ~13%) and animal collisions (20 crashes, ~11%). The remaining 23% of crashes include rear-end collisions, sideswipe same-directions, angle collisions, sideswipe opposite-directions, head-on, pedestrians, and other types of crashes (**Figure 19**).

Several locations including road segments from Cherokee Turnpike west limit to S 437 Road, S 437 Road to OK-82, the OK-82 interchange, N 4540 Road to 4560 Road, S 444 Road to S 447 road experienced high

clusters of fixed object collisions. Approximately 16%, 15%, and 12% of fixed object collisions occurred due to the collisions with sand barrel, traffic sign, and guardrail face respectively. The elevated number of fixed object collisions indicates the presence of issues associated with the roadway design elements.

Figure 19: Crash Severity – Cherokee Turnpike

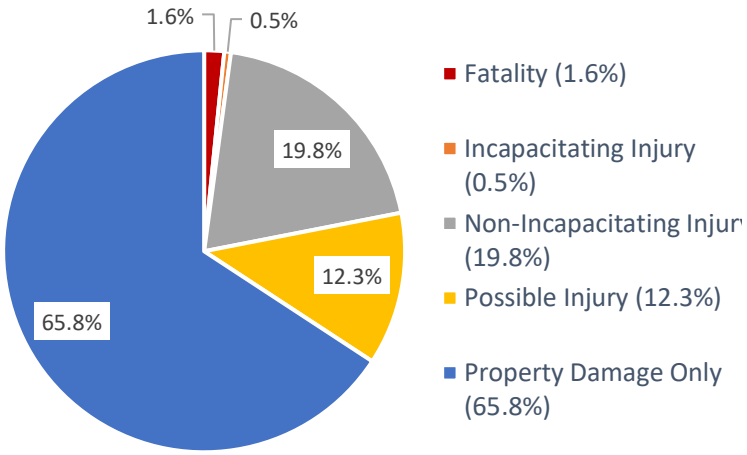
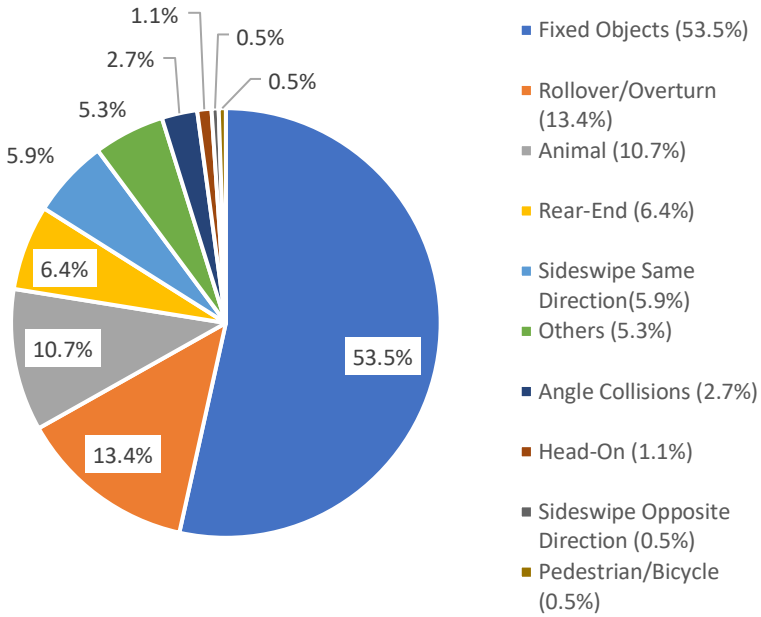


Figure 18: Crash Type – Cherokee Turnpike



Source: ODOT Crash Data 2017-2021

Vehicle Types

Passenger cars were involved in 159 crashes, accounting for approximately 85% of the overall total crashes in the Cherokee Turnpike planning segment. Heavy vehicles/trucks were involved in 22 crashes and made up 12% of the total reported crashes in this planning segment. Further analysis was conducted to compare the percentage of crashes that involved heavy vehicles/trucks to the percentage of trucks that used the planning segment. While trucks accounted for 25% of all traffic on this planning segment, only 12% of reported crashes involved heavy vehicles/trucks. This suggests that crashes involving heavy vehicles may not be a significant concern in this planning segment. The remaining three crashes were associated with buses/vans and other vehicle types.

Roadway Surface and Lighting Conditions

In this planning segment, 132 crashes (~71% of all crashes) occurred on dry roadway surfaces whereas 41 crashes (~22%) were noted to have occurred on wet surfaces and 14 crashes (~7%) occurred on other road surfaces. When it comes to lighting conditions, 116 crashes (62%) occurred during daylight, 65 crashes (35%) occurred during dark conditions either with streetlights or without streetlights and six crashes (3%) occurred during dusk, dawn, or other times. Approximately 70% (14 crashes) of animal collisions and 64% of fixed object collisions occurred during dark conditions. With high percentages of animal collisions and fixed object collisions experienced along the corridor; lighting conditions appears to

be a potential contributing factor. Several segments including S 437 Road to OK-82, the OK-82 interchange, S 444 Road to S 447 Road, ALT U.S. 412 to N 4540 Road, N 4540 Road to N 4580 Road, U.S 59 to Cherokee Turnpike East experienced a high number of crashes during dark conditions.

Crash Rates

The Cherokee Turnpike planning segment functional classification is rural four-lane divided highway with full access control. ODOT provided the statewide total crash rates for these types of facilities. The average crash rate for total and KA crashes was calculated based on the project area crash data. At the time this report was drafted statewide rates for combined KA (fatal and incapacitating injury) were not available from ODOT for comparison.

Table 6 below compares total crash rates for the 14 segments evaluated in the Cherokee Turnpike planning segment to the statewide crash averages. When looking at crash rates, it is important to note that shorter study segments (less than 1 mile) have the potential to skew crash rate results. As shown in the table, of the 14 segments, six segments surpassed the statewide average crash rates. Of the identified segments, the crash rate of the segment at the OK-82 interchange was 221 crashes/HMVMT, more than five times the statewide average crash rate. Several other segments including S 437 Rd to the OK -82 interchange , ALT U.S. 412 to N 4540 Road, and N 4540 Road to N 4560 Road had higher crash rates than the statewide average. Brief descriptions of the segments that had higher crash rates compared to the statewide average for total crashes are provided below.

Table 6: Cherokee Turnpike Crash Rates

Cherokee Turnpike Segments		Average Daily Traffic (2021)	Segment Length (Mile)	Total Crash Rate (HMVMT)		KA Crash Rate (HMVMT)	
Segment Number	Segment Name			Segment Crash Rate	Statewide 3-Year Average (2018-2020)	Segment Crash Rate	Statewide 3-Year Average (2018-2020)
1	D0583 Rd to S 437 Rd	10,628	2.85	30.75	40.31[3]	1.81	N/A
2	S 437 Rd to OK-82	10,628	3.51	**42.60***	40.31[1]	1.47	N/A
3	OK-82 Interchange	10,628	0.42	**220.96***	40.31[1]	0.00	N/A
4	OK-82 to E 570 Rd	7,396	1.55	9.56	40.31[1]	0.00	N/A
5	E 570 Rd to S 444 Rd	7,396	2.04	14.53	40.31[1]	3.63	N/A
6	S 444 Rd to S 447 Rd	7,396	3	29.63	40.31[1]	0.00	N/A
7	S 447 Rd to ALT US 412	7,396	3.67	18.17	40.31[1]	0.00	N/A
8	ALT US 412 Interchange at Cherokee	7,226	0.4	**56.87***	40.31[1]	0.00	N/A
9	ALT US 412 to N 4540 Rd	7,226	2.52	**51.15***	40.31[1]	0.00	N/A

Cherokee Turnpike Segments		Average Daily Traffic (2021)	Segment Length (Mile)	Total Crash Rate (HMVMT)		KA Crash Rate (HMVMT)	
Segment Number	Segment Name			Segment Crash Rate	Statewide 3-Year Average (2018-2020)	Segment Crash Rate	Statewide 3-Year Average (2018-2020)
10	N 4540 Rd to N 4560 Rd	7,226	2.4	**63.19***	40.31[1]	3.16	N/A
11	N 4560 Rd N 4580 Rd	7,226	2	30.33	40.31[1]	0.00	N/A
12	N 4580 Rd to US 59	7,226	3.8	21.95	40.31[1]	0.00	N/A
13	US 59 Interchange	7,226	0.5	**106.16***	40.31[1]	0.00	N/A
14	US 59 to ALT U.S. 412/ Cherokee Turnpike East	13,400	3.95	31.06	40.31[1]	0.00	N/A
Cherokee Turnpike planning segment Crash rate		8281**	32.61	37.94	40.31[1]	0.81	N/A

Source: ODOT Crash Data 2017-2021

HMVMT-Hundred million vehicles miles traveled.

[1] - Oklahoma Statewide 3-year average (2018-2020) total crash rate for rural four-lane divided highways with full access control.

* - Segment exceeds the statewide crash rate for similar facilities.

** - Weighted average ADT.

N/A- Not available at the time of publishing the report.

Segment 2: S 437 Road to OK-82

An approximately 3.51-mile segment from S 437 Road to OK- 88 exceeded the statewide total crash rate at 42.60 crashes/HMVMT. This segment experienced 29 crashes. Of the 29 incidents, 18 crashes (62%) reported along this segment resulted in property damage only, with 10 crashes (34%) causing some form of injury to vehicle occupants, and one fatal crash was reported. Crashes along this segment primarily consisted of fixed objects (21 crashes, ~72%) and animal collisions (5 crashes, 17%).

Segment 3: OK-82 Interchange

The crash rate of the OK-82 interchange was 220.96 crashes/HMVMT, more than five times the statewide average. The elevated crash rate is potentially attribute to the short segment length (0.42 miles). There were 18 crashes reported to have occurred in this segment. Among these crashes, 12 incidents (~67%) reported along this segment resulted in property damage only, with six crashes (33%) causing some form of injury to vehicle occupants, and no fatalities were reported. Crashes along this segment mostly consisted of fixed objects (nine crashes, ~50%), rear-end collisions (four crashes, 22%), angle collisions (three crashes, 17%), and rollover/overturn (one crash, 6%).

Segment 8: ALT U.S. 412 Interchange

This segment exceeded the statewide total crash rate at 56.87 crashes/HMVMT. Short segment length (0.4 miles) potentially skewed the crash rate. Three crashes were reported in this segment. Among these crashes, two incidents (~67%) reported along this segment resulted in property damage only, with one

crash (33%) causing non-incapacitating injury to vehicle occupants, and no fatalities were reported. Crashes along this segment primarily consisted of fixed object (two crashes, 67%) and angle collisions (one crash, ~33%).

Segment 9: ALT U.S. 412 to N 4540 Road

The crash rate of this segment was 51.15 crashes/HMVMT. This segment experienced 17 crashes. Of the 17 incidents, 12 crashes (~71%) reported along this segment resulted in property damage only, with five crashes (29%) causing some form of injury to vehicle occupants, and no fatalities were reported. Crashes along this segment primarily consisted of fixed objects (nine crashes, ~53%), animals (three crashes, 18%), rollovers/ overturns (two crashes, 12%), others (two crashes, 12%), and rear-end collision (one crash, 6%).

Segment 10: N 4540 Road to N 4560 Road

This segment surpassed the statewide total crash rate at 63.19 crashes/HMVMT. This segment experienced 20 crashes between the years 2017-2021. Of the 20 incidents, 13 crashes (~65%) reported along this segment resulted in property damage only, with six crashes (30%) causing some form of injury to vehicle occupants, and one fatal crash was reported. Crashes along this segment primarily consisted of fixed objects (11 crashes, ~55%), rollovers/ overturns (three crashes, 15%), others (three crashes, 15%), and sideswipe same-direction collision (one crash, 5%).

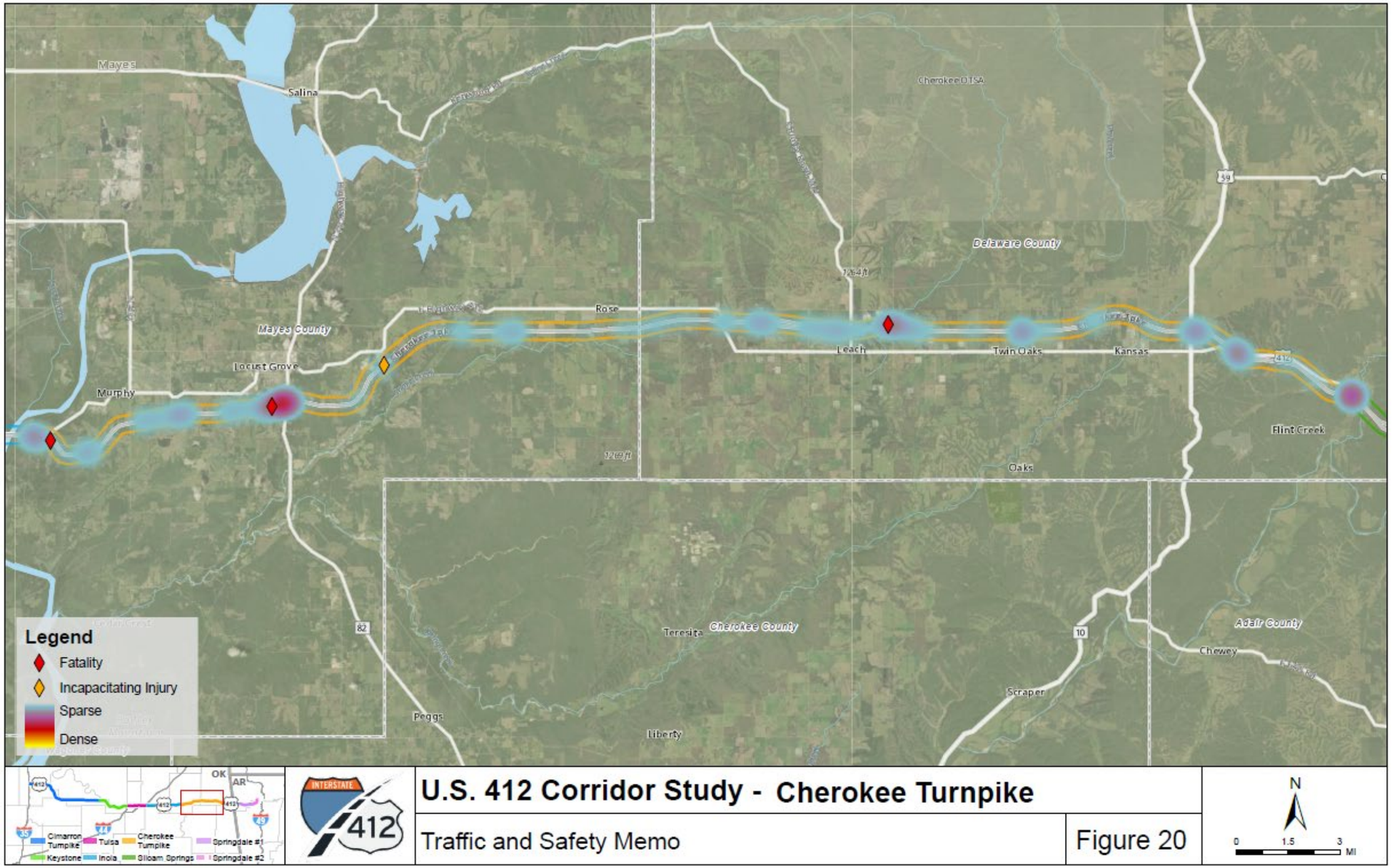
Segment 13: U.S. 59 Interchange

The crash rate of the segment was 106.16 crashes/HMVMT. The elevated crash rate is likely attributed to short segment length (0.5 miles). Seven crashes were reported in this segment. Among these crashes, six incidents (~86%) reported along this segment resulted in property damage only, with one crash (14%) causing possible injury to vehicle occupants, and no fatalities were reported. Crashes along this segment consisted of fixed objects (four crashes, 57%), rear-end (two crashes, 29%), and other collisions (one crash, ~14%).

Crash Density

Figure 20 presents the crash density and the KA crash locations along the Cherokee Turnpike planning segments. This planning segment experienced low crash density compared to the other planning segments. However, several locations including the OK-82 interchange, ALT U.S. 412 to N 4560 Road, and the U.S. 59 interchange experienced high clusters of crashes. The crash rates calculation also revealed that these segments exceeded the statewide average total crash rate. Several locations including road segments from Cherokee Turnpike west limit to S 437 Road, S 437 Road to OK-82, the OK-82 interchange, N 4540 Road to 4560 Road, S 444 Road to S 447 road experienced high clusters of fixed object collisions. There were three fatal and one incapacitating injury crashes occurred in this entire planning segment. Two fatal crashes resulted from collisions with embankments whereas the incapacitating injury crash resulted from rollover/overturn.

Figure 20: Crash Density and the KA locations - Cherokee Turnpike



Source: ODOT (2017-2021), ARDOT (2017-2021).

Cherokee Turnpike Safety Analysis Summary

The U.S. 412 road segments from D0583 Road to the ALT U.S. 412 interchange were evaluated in this segment. This planning segment experienced 187 crashes, accounting for approximately 4% of all crashes (4,863 crashes) reported along U.S. 412 within the project study limits. Of the 187 crashes reported, 123 crashes (~66% of all crashes) resulted in property damage only, 61 crashes (~33% of all crashes) caused some form of injury to vehicle occupants, and three crashes (~2% of all crashes) resulted in fatalities. Fixed object collisions were the predominant crash types followed by rollovers/overturns and animal collisions.

Analysis showed that segments that surpassed statewide total crash rates experienced fixed object collisions mostly, resulting in property damage only. Several locations including road segments from Cherokee Turnpike west limit to S 437 Road, S 437 Road to OK-82, the OK-82 interchange, N 4540 Road to 4560 Road, S 444 Road to S 447 road had high clusters of fixed object collisions during dark conditions. Lighting conditions and the design of roadway with center barriers might have significant impacts on such crashes. Attention should be provided to increasing lighting facilities along the segments to lessen the number of animal collisions and fixed objects collisions during dark conditions. The crash density map revealed that this planning segment experienced low crash density compared to the other planning segments. However, several locations including the OK-82 interchange, ALT U.S. 412 to N 4560 Road, and the U.S. 59 interchange experienced high clusters of crashes.

3.6. Siloam Springs Crash Analysis

The Siloam Springs planning segment consists of highways in both Oklahoma and Arkansas. Approximately 14-mile of U.S. 412 corridor that runs from U.S. 59/ALT U.S. 412 interchange to Airport Road was evaluated. The segment runs through the Siloam Springs community with many at-grade traffic signal-controlled intersections. The following sections provide detailed descriptions of the crash data analysis conducted for this planning segment.

Crash Severity and Crash Type

There were 817 crashes reported along the planning segment, accounting for approximately 17% of all crashes (4,863 crashes) reported along U.S. 412 within the project study limits. Of the 817 crashes reported, 608 crashes (~74% of all crashes) resulted in property damage only, 206 crashes (~25% of all crashes) caused some form of injury to vehicle occupants, and three crashes (less than 1% of all crashes) resulted in fatalities (**Figure 21)**. Rear-end collisions were the predominant crash types, accounting for approximately 44% (362 crashes) of all reported crash types on the planning segment followed by angle collisions (194 crashes, ~24%) and sideswipe same-direction collisions (151 crashes, ~19%). The remaining 14% of crashes include fixed objects, others, head-on collisions, animals, rollovers/overturns, pedestrians, and sideswipe opposite direction crashes. (**Figure 22**).

Figure 22: Crash Severity – Siloam Springs

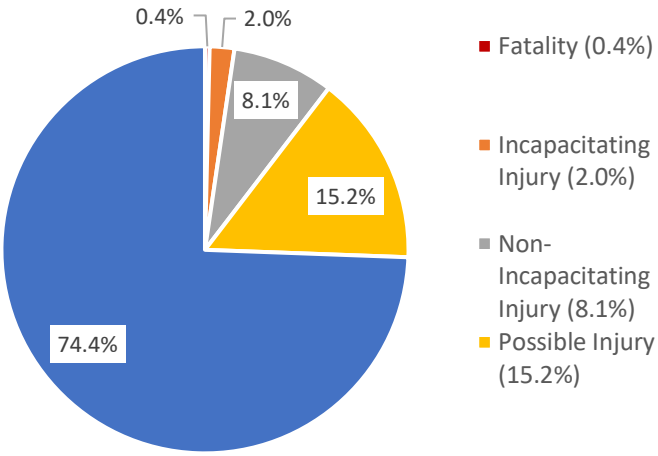
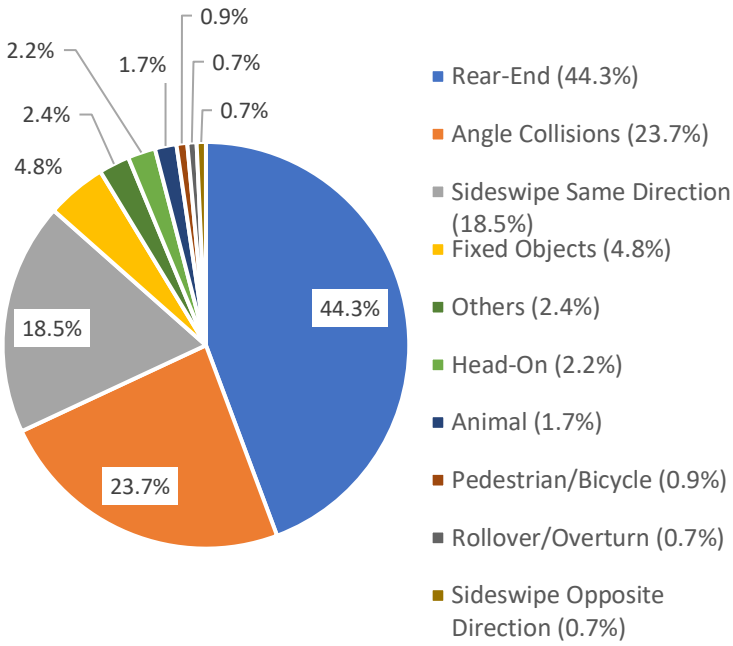


Figure 21: Crash Type – Siloam Springs



Source: ODOT & ARDOT Crash Data 2017-2021

Vehicle Types

Passenger cars were involved in 731 crashes, accounting for approximately 89% of the overall total crashes in the Siloam Springs planning segment. Heavy vehicles/trucks were involved in 50 crashes and made up approximately 6% of the total reported crashes in this planning segment. Further analysis was conducted to compare the percentage of crashes that involved heavy vehicles/trucks to the percentage of trucks that used the planning segment. It was found that while trucks accounted for 29% of all traffic on the segments (17% in highways in Oklahoma and 12% in Arkansas), only 6% of reported crashes involved heavy vehicles/trucks. This suggests that crashes involving heavy vehicles/trucks may not be a significant concern in this planning segment. The remaining 38 crashes were associated with motorcycles, buses/vans, and other vehicle types.

Roadway Surface and Lighting Conditions

In this planning segment, 707 crashes (~87% of all crashes) occurred on dry roadway surfaces whereas 108 crashes (~15%) were noted to have occurred on wet surfaces and two crashes (less than 1%) occurred on other road surfaces. When it comes to lighting conditions, 646 crashes (~79%) occurred during daylight, 132 crashes (~16%) occurred during dark conditions either with streetlights or without streetlights and 38 crashes (~5%) occurred during dusk, dawn, or other time. The lighting conditions and roadway surface conditions do not appear to have significant impact on crashes occurred in this planning segment.

Crash Rates

The Siloam Springs planning segment consists of both urban and rural areas. This planning segment comprised several functional classifications of highways-

- The road segments from the Siloam Springs west limit to DO581 Road are classified as a rural four-lane divided highway with full access control.
- The road segments from D0583 Road to N 4700 Road are classified as a rural four-lane divided highway with partial access control.
- The road segments from N 4700 Road to Cedar Drive Road are classified as an urban four-lane divided highways with partial access control.
- The road segments from Cedar drive to the state line are considered as an urban four-lane undivided highway.
- On the Arkansas side, road segments from S Washington Street to Airport Road are designated as an urban four-lane undivided highway with no control of access.

Although the segments from the Stateline to Washington Street are six-lane divided highways, crash rates of these segments were compared with the statewide crash rate of four-lane undivided highways with no access control due to the unavailability of the statewide crash rates of six-lane divided highways. ODOT provided the statewide three-year average total crash rate whereas ARDOT provided the statewide five-year average total and KA crash rates for these types of facilities.

As shown in **Table 7**, total and KA crash rates for the 30 segments were calculated and compared with the statewide averages. When looking at crash rates, it is important to note that shorter study segments (less than 1 mile) have the potential to skew crash rate results. As shown in the table, of the segments in Oklahoma, the crash rate of the segment at the U.S. 59/ALT U.S. 412 interchange and D0581 Road to S 663 Road were 177.20 crashes/HMVMT, more than four times the statewide average crash rate. On the Arkansas side, two segments such as E Main Street to N Progress Avenue and N Progress Avenue to Simon Sagar Avenue surpassed both statewide total and KA crash rates. Brief descriptions of the segments that exceeded both statewide average crash rates are provided below.

Table 7: Siloam Springs Crash Rates

Siloam Springs Segments		Average Daily Traffic (2021)	Segment Length (Mile)	Total Crash Rate (Crash/HMVMT- ODOT; Crash/MVMT - ARDOT)		KA Crash Rate (KA Crash/ HMVMT)	
Segment Number	Segment Name			Segment Crash Rate	ODOT- 3-Year Average (2018-2020)- ARDOT -5 Year Average (2017-2021	Segment Crash Rate	ODOT- 3-Year Average (2018-2020)- ARDOT -5 Year Average (2017-2021
1	US 59/ALT US 412 to D0581 Rd	13,400	0.21	9.36	40.31[1]	0.00	N/A
2	D0581 Rd to S 663 Rd	13,400	0.40	**177.20***	57.34[2]	0.00	N/A
3	S 663 Rd to D4665 Rd/N Barnett Rd	13,400	0.80	19.47	57.34[2]	0.00	N/A
4	D4665 Rd to E 578 Rd	13,400	0.63	**112.45***	57.34[2]	10.22	N/A
5	E 578 Rd to N 4680 Rd	13,400	0.35	30.67	57.34[2]	0.00	N/A
6	N 4680 Rd to S 690 Rd	17,200	1.00	38.94	57.34[2]	0.00	N/A
7	S 690 Rd to N 4700 Rd	17,200	1.00	**70.10***	57.34[2]	11.68	N/A
8	N 4700 Rd to N 4705 Rd	17,200	0.50	12.74	129.13[3]	0.00	N/A
9	N 4705 Rd to N 4710 Rd	17,200	0.50	6.37	129.13[3]	0.00	N/A
10	N 4710 Rd to N 4720 Rd	17,200	1.00	0.00	129.13[3]	0.00	N/A
11	N 4720 Rd to S 725 Rd	17,200	0.50	0.00	129.13[3]	0.00	N/A
12	S 725 Rd to Beaver Springs Rd	17,200	0.50	0.00	129.13[3]	0.00	N/A
13	Beaver Springs Rd to Cedar Dr	17,200	0.12	0.00	129.13[3]	0.00	N/A
14	Cedar Dr to Sassafras St	17,200	0.40	0.00	284.15[4]	0.00	N/A
15	Sassafras St to US 59	17,200	0.50	26.55	284.15[4]	0.00	N/A
16	US 59 to State Line	23,600	0.06	15.93	284.15[4]	0.00	N/A
Oklahoma-Arkansas Border							
17	State Line to S Holly St	29,000	0.34	3.11	4.45[5]	11.11	9.67[6]
18	S Holly Rd to S Carl St	29,000	0.51	3.33	4.45[5]	0.00	9.67[6]

Siloam Springs Segments		Average Daily Traffic (2021)	Segment Length (Mile)	Total Crash Rate (Crash/HMVMT- ODOT; Crash/MVMT - ARDOT)		KA Crash Rate (KA Crash/ HMVMT)	
Segment Number	Segment Name			Segment Crash Rate	ODOT- 3-Year Average (2018-2020)- ARDOT -5 Year Average (2017-2021	Segment Crash Rate	ODOT- 3-Year Average (2018-2020)- ARDOT -5 Year Average (2017-2021
19	S Carl St to S Elm St	29,000	0.26	2.91	4.45[5]	0.00	9.67[6]
20	S Elm St to S Mt Olive St	29,000	0.26	2.69	4.45[5]	0.00	9.67[6]
21	S Mt Olive St to S Washington St	29,000	0.26	3.49	4.45[5]	0.00	9.67[6]
22	S Washington St to S Lincoln St	26,000	0.46	1.05	4.45[5]	4.58	9.67[6]
23	S Lincoln St Intersection	26,000	0.12	1.40	4.45[5]	0.00	9.67[6]
24	S Lincoln St to E Kenwood St	26,000	0.31	2.11	4.45[5]	**13.60***	9.67[6]
25	E Kenwood St to Ravenwood Blvd	28,000	0.46	2.08	4.45[5]	0.00	9.67[6]
26	Ravenwood Blvd to E Main St	31,000	0.14	1.64	4.45[5]	**12.63***	9.67[6]
27	E Main St to N Progress Ave	27,000	0.14	**12.76***	4.45[5]	**28.99***	9.67[6]
28	N Progress Ave to Simon Sager Ave	27,000	0.44	**7.10***	4.45[5]	**18.45***	9.67[6]
29	N Simon Sager Ave to AR-59	22,000	0.56	3.87	4.45[5]	**13.34***	9.67[6]
30	AR -59 to Airport Rd	22,000	0.50	2.29	4.45[5]	**9.96***	9.67[6]
State Line Rd to S Washington St**			1.61	3.4	4.45[5]	2.52	9.67[6]
S Washington St to Airport Rd**			3.11	3.38	4.45[5]	**10.16***	9.67[6]

Source: ODOT & ARDOT Crash Data 2017-2021

[1] - Oklahoma Statewide 3-year average (2018-2020) total crash rate for rural four-lane divided highways with full access control.

[2] - Oklahoma Statewide 3-year average (2018-2020) total crash rate for rural four-lane divided highways with partial access control.

[3] - Oklahoma Statewide 3-year average (2018-2020) total crash rate for urban four-lane divided highways with partial access control.

[4]- Oklahoma Statewide 3-year average (2018-2020) total crash rate for urban four-lane undivided highways.

[5] - Arkansas Statewide 5-year average (2017-2021) total crash rate for urban four-lane undivided highways with no access control.

[6] - Arkansas Statewide 5-year average (2017-2021) KA crash rate for urban four-lane undivided highways with no access control.

***** - Segment exceeds the statewide crash rate for similar facilities.

****** – Segment crash rate provided by ARDOT.

N/A- Not available at the time of publishing the report.

Segment 2: D0581 Road to S 663 Road

The crash rate of this segment was 177.20 crashes/HMVMT, more than three times the statewide average. The elevated crash rate is likely attributed to the short segment length (0.40 miles). of the 11 crashes reported in this segment, six incidents (~55%) reported along this segment resulted in property damage only, with six crashes (~45%) causing non-incapacitating injury to vehicle occupants, and no fatalities were reported. Crashes along this segment consisted of angle collisions (six crashes, 55%), sideswipe same-direction collisions (two crashes, ~18%), rear-end (one crash, 9%), fixed objects (one crash, 9%), and other collisions (one crash, 9%).

Segment 4: D4665 Road to E 578 Road

The crash rate of this segment was 112.45 crashes/HMVMT, more than two times the statewide average. The elevated crash rate is likely attributed to the short segment length (0.63 miles). This segment experienced six crashes between the years 2017-2021. Of the six incidents, four crashes (67%) reported along this segment resulted in property damage only, with two crashes (33%) causing some form of injury to vehicle occupants, and no fatalities were reported. Crashes along this segment primarily consisted of angle collisions (three crashes, 50%) and sideswipe same-direction collisions (two crashes, 33%).

Segment 7: S 690 Road to N 4700 Road

The crash rate of this segment was 70.10 crashes/HMVMT. This segment experienced two crashes that resulted in property damage only. Crashes along this segment consisted of sideswipe same-direction and animal collisions.

Segment 27: E Main Street to N Progress Avenue

This segment exceeded both Arkansas's statewide total and KA crash rate. The total crash rate of this segments was 12.76 crashes/MVMT whereas the KA crash rate was 28.99 crashes/HMVMT. The elevated crash rates There were 88 crashes reported in this segment. Among these crashes, 65 incidents (~74%) reported along this segment resulted in property damage only, with 23 crashes (~26%) causing some form of injury to vehicle occupants, and no fatalities were reported. Crashes along this segment primarily consisted of rear-end (39 crashes, 44%) and angle collisions (34 crashes, 39%).

Segment 28: N Progress Avenue to Simon Sager Avenue

The roadway segments from N Progress Avenue to Simon Sager Avenue exceeded both the statewide crash rates at 7.10 crashes/MVMT and 18.45 KA crashes/HMVMT respectively. Of the 154 incidents observed in this segment, 114 crashes (74%) reported along this segment resulted in property damage only, with 40 crashes (26%) causing some form of injury to vehicle occupants, and no fatalities were reported. Crashes along this segment primarily consisted of angle collisions (57 crashes, ~37%) and rear-end collisions (53 crashes, 34%).

Crash Density

Figure 23 presents the crash density and the KA crash locations along the Siloam Springs planning segment. As shown in **Figure 23**, road segments in Arkansas including the segments from the Stateline to

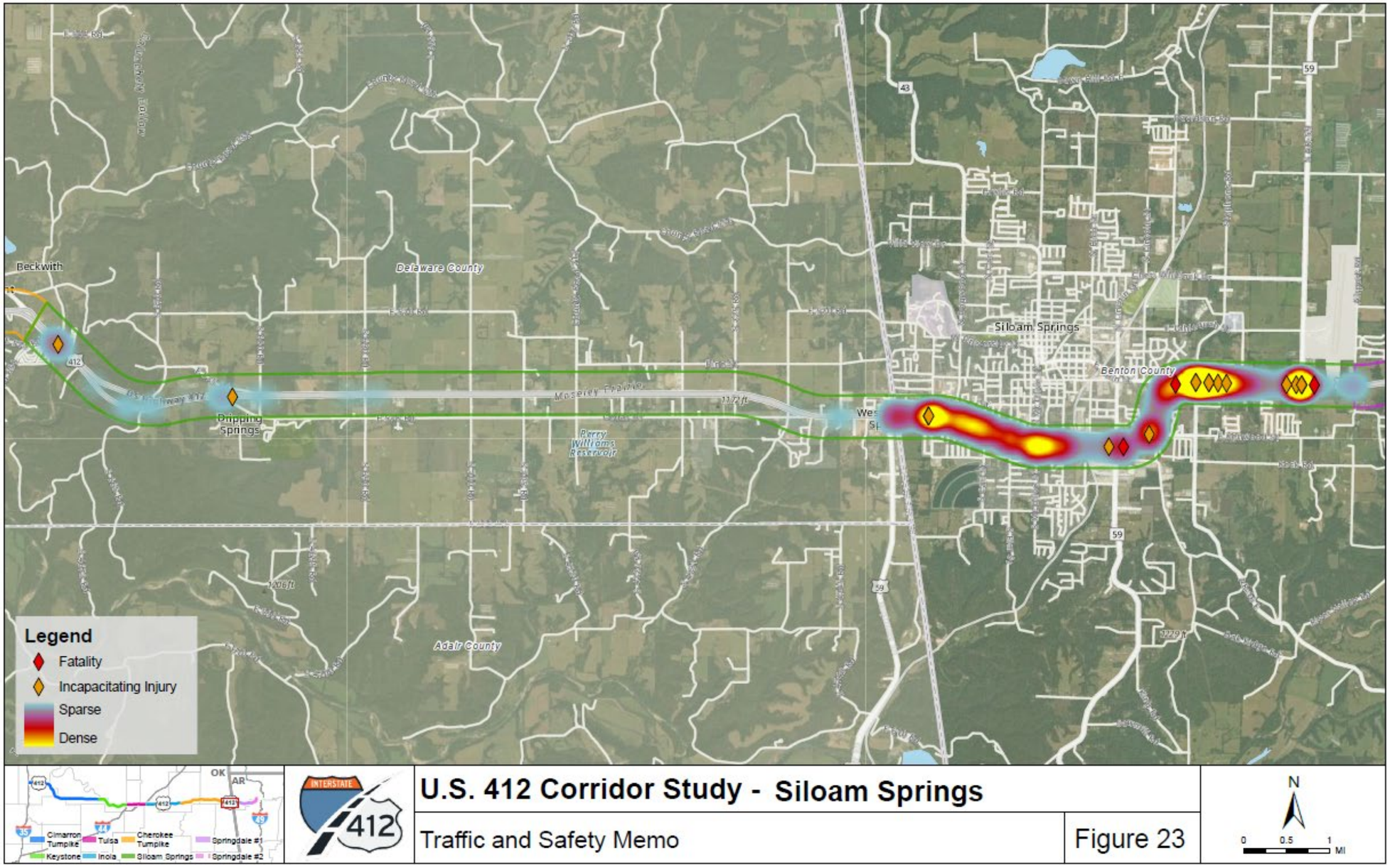
Washington Street, S Lincoln Street to Ravenwood Boulevard, E main Street to Simon Sager Avenue, and the AR-59 intersection experienced high crash density. It is noteworthy that seven KA crashes occurred between log mile 3.0 and log mile 3.52 whereases five KA crashes were reported between log mile 4.0 and log mile 4.35. A brief description of the KA crashes is provided based on their locations (log mile) along the planning segment.

- A fatal crash was reported to occur at log mile 3.04 resulting from collisions with a fixed object when a vehicle failed to maintain control while negotiating a curve and struck concrete cinderblocks. This crash occurred on a wet roadway surface during dark conditions with no streetlight.
- An incapacitating injury crash occurred at log mile 3.23 due to angle collisions when a vehicle was traveling at a higher speed westbound on the East U.S. 412 and struck a vehicle that is traveling southbound N Progress Avenue.
- An incapacitating injury crash was reported at log mile 3.23 resulting from an angle collision when a vehicle was turning left and was struck by an opposing vehicle.
- An incapacitating motorcycle injury crash occurred at log mile 3.35 due to angle collisions as a vehicle was turning north into a driveway across the westbound lanes of U.S. 412 and causing another vehicle that traveling westbound to strike. The first driver was issued a citation for careless driving.
- An Incapacitating injury crash was reported at log mile 3.35 resulting from a head-on collision when a vehicle crossed multiple lanes and collided with a vehicle traveling westbound U.S. 412.
- An incapacitating injury crash occurred at log mile 3.44 due to an angle collision as a northbound vehicle failed to yield from a private drive and a vehicle from the westbound U.S. 412 hit that vehicle.
- An Incapacitating injury crash was reported at log mile 3.52 resulting from a head-on collision when a vehicle traveling eastbound crossed multiple lanes and collided with a vehicle traveling westbound.
- An incapacitating injury crash occurred at log mile 4.09 due to rear-end collision when a vehicle failed to stop and struck the front vehicle.
- An incapacitating injury crash was reported at log mile 4.18 due to an angle collision when a vehicle traveling westbound was turning left and was struck by a vehicle that was traveling eastbound of East U.S. 412
- An incapacitating injury crash occurred at log mile 4.2303 due to an angle collision when a southbound vehicle was turning left and struck a vehicle that traveling westbound U.S. 412.
- An incapacitating injury crash occurred at log mile 4.349 due to an angle collision as northbound vehicle failed to yield from a private drive and a vehicle from the westbound U.S. 412 hit the first vehicle.

Based on the descriptions of KA crashes, angle collisions were the most common crash types resulting in incapacitating injury followed by head-on collisions whereas the fatal crash occurred due to a fixed object

collision during adverse weather and dark conditions. Angle collisions are mostly attributable to the undivided roadways with no access points and conflict points at the intersections. High traffic volume also contributes to rear-end collisions.

Figure 23: Crash Density and the KA locations - Keystone



Source: ODOT (2017-2021), ARDOT (2017-2021).

Siloam Springs Safety Analysis Summary

Siloam Springs planning segment experienced 817 crashes, accounting for approximately 17% of all crashes (4,863 crashes) reported along U.S. 412 within the project study limits. Of the 817 crashes reported, 608 crashes (~74% of all crashes) resulted in property damage only, 206 crashes (~26% of all crashes) caused some form of injury to vehicle occupants, and three crashes (less than 1% of all crashes) resulted in fatalities. Rear-end collisions were the predominant crash types, accounting for approximately 44% (362 crashes) of all reported crash types on the planning segment followed by angle collisions (194 crashes, ~24%) and sideswipe same-direction collisions (151 crashes, ~19%). Several segments including the U.S. 59/ALT U.S. 412 interchange, D0581 Road to S 663 Road, E Main Street to N Progress Avenue, N Progress Avenue to Simon Sagar Avenue, and Old Highway 68 to Siloam Springs surpassed at least one of the statewide total or KA crash rates.

Crash density analysis depicted that road segments in Arkansas experienced a higher number of crashes compared to the road segments in Oklahoma. Angle collisions were the most common crash types resulting in incapacitating injury followed by head-on collisions. Road segments stretching from Ravenwood Boulevard to AR-59 experienced higher KA crash rates compared to the statewide average. The roadway geometry such as undivided highways with no access control leads to the elevated number of angle collisions whereas heavy traffic volume contributes to the rear-end collisions.

3.7. Springdale #1 Crash Analysis

The Springdale #1 planning segment begins from Airport Road and ends at Old Highway 68. The entire planning segment is considered rural and partially access controlled. The following sections provide detailed descriptions of the crash data analysis conducted for this planning segment.

Crash Severity and Crash Type

This planning segment experienced 284 crashes, accounting for approximately 6% of all crashes (4,863 crashes) reported along U.S. 412 within the project study limits. Of the 284 crashes reported, 203 crashes (~72% of all crashes) resulted in property damage only, 79 crashes (~28% of all crashes) caused some form of injury to vehicle occupants, and two crashes (less than 1% of all crashes) resulted in fatalities (**Figure 24).** Collisions with fixed objects were the predominant crash types, accounting for approximately 59% (167 crashes) of all reported crash types on the planning segment followed by rear-end collisions (31 crashes, ~11%). The remaining 30% of crashes include sideswipe same direction, angle, others, animals, rollover/overturn, pedestrian, and sideswipe opposite direction collisions (**Figure 25**).

Figure 25: Crash Severity – Springdale #1

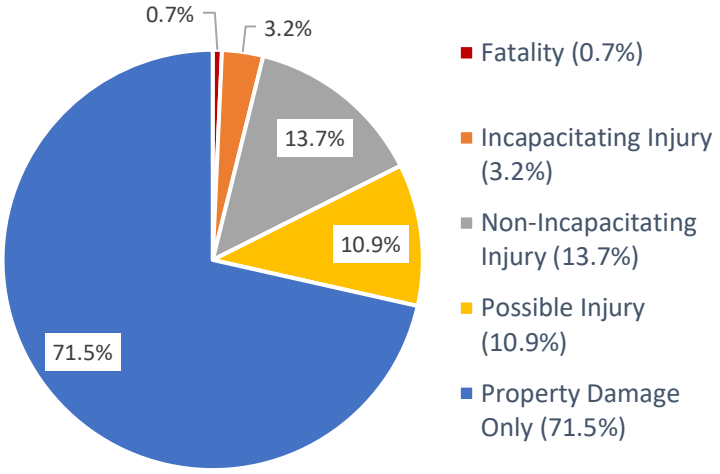
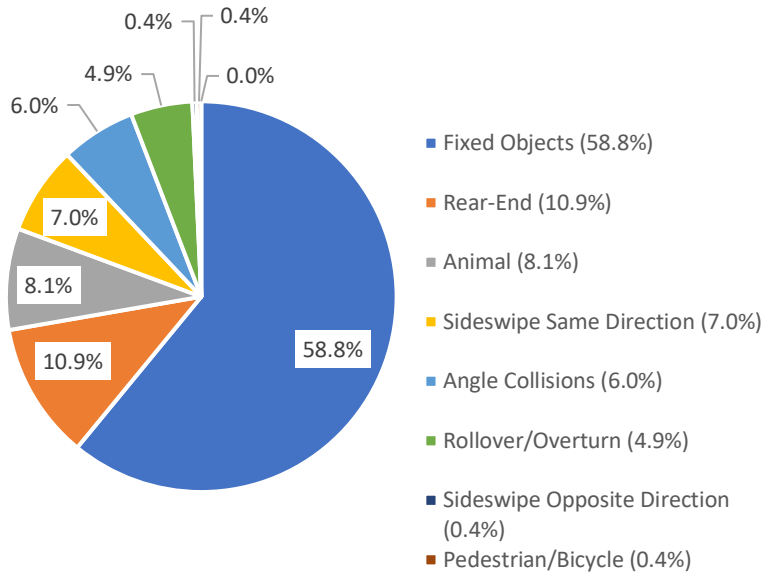


Figure 24: Crash Type – Springdale #1



Source: ARDOT Crash Data 2017-2021

Vehicle Types

Passenger cars were involved in 258 crashes, accounting for approximately 91% of the overall total crashes in the Springdale #1 segments. Heavy vehicles/trucks were involved in 14 crashes and made up approximately 5% of the total reported crashes in this segment. Further analysis was conducted to compare the percentage of crashes that involved heavy vehicles to the percentage of trucks that used the planning segment. It was found that while trucks accounted for 11% of all traffic on this planning segment, only 5% of reported crashes involved heavy vehicles. This suggests that crashes involving heavy vehicles may not be a significant concern in this planning segment. The remaining 12 crashes were associated with motorcycles, buses/vans, and other vehicle types.

Roadway Surface and Lighting Conditions

There were 189 crashes (~67% of all crashes) occurred on dry roadway surfaces whereas 77 crashes (~27%) were noted to have occurred on wet surfaces and 18 crashes (~7%) occurred on other road surfaces. Of the 77 crashes that occurred on wet surfaces, 52 crashes (76%) were resulted from fixed object collisions. When it comes to lighting conditions, 175 crashes (~62%) occurred during daylight, 96 crashes (~34%) occurred during dark conditions either with streetlights or without streetlights and 13 crashes (5%) occurred during dusk, dawn, or other time. With higher percentages of fixed object collisions experienced along the corridor, wet surfaces and lighting conditions might be potential contributing factors. Of the 167 fixed object collisions, 47 collisions (~28%) occurred during dark conditions with no streetlights and 58 collisions occurred on wet surfaces (~35%). Attention should be provided to increasing lighting facilities along the segments to lessen the number of fixed objects collisions during dark conditions and on wet surfaces.

Crash Rates

The Springdale #1 planning segment consists of rural four-lane divided highway with partial control of access. The average crash rate for total crashes and KA was calculated based on the project area crash data. **Table 8** below compares total and KA crash rates for the 14 segments evaluated in the Springdale #1 planning segment to the statewide crash averages. When looking at crash rates, it is important to note that shorter study segments (less than 1 mile) have the potential to skew crash rate results.

As shown in the table, of the 14 segments, four segments surpassed Arkansas's statewide average crash rates for total and KA crashes. The crash rate of the segment from Fairmount Road to Old Highway Road was 1.03 crashes/MVMT, more than two times the statewide average crash rate. Moreover, Fairmount Road to Old Highway Road, Old Hotel Road to Chamber Springs Road, and Littrell Road to Wildcat Creek (WC) Road 851, were noted to exceed both statewide crash rates. Brief descriptions of the segments that had higher crash rates compared to the statewide average for total crashes as well as KA crashes are provided below.

Table 8: Springdale #1 Crash Rates

Springdale #1 Segments		Average Daily Traffic (2021)	Segment Length (Mile)	Total Crash Rate (MVMT)		KA Crash Rate (HMVMT)	
Segment Number	Segment Name			Segment Crash Rate	Statewide 5-Year Average (2017-2021)	Segment Crash Rate	Statewide 5-Year Average (2017-2021)
1	Airport Rd to Old Hwy 68	22,000	0.40	0.37	0.49[1]	0.00	3.22[2]
2	Old Hwy 68 to Siloam Springs East	21,000	0.85	**0.74***	0.49[1]	**6.14***	3.22[2]
3	Old Hwy 68 to Fairmount Rd	21,000	1.2	0.43	0.49[1]	2.17	3.22[2]

Springdale #1 Segments		Average Daily Traffic (2021)	Segment Length (Mile)	Total Crash Rate (MVMT)		KA Crash Rate (HMVMT)	
Segment Number	Segment Name			Segment Crash Rate	Statewide 5-Year Average (2017-2021)	Segment Crash Rate	Statewide 5-Year Average (2017-2021)
4	Fairmount Rd to Old Hotel Rd	21,000	0.43	**1.03***	0.49[1]	**12.14***	3.22[2]
5	Old Hotel Rd to Chamber Springs Rd	21,000	0.55	**0.57***	0.49[1]	**9.49***	3.22[2]
6	Chamber Springs Rd to Kincheloe Rd	21,000	1.14	**0.55***	0.49[1]	0.00	3.22[2]
7	Kincheloe Rd to County Rd 105	21,000	0.5	**0.52***	0.49[1]	0.00	3.22[2]
8	County Rd 105 to Illinois River Bridge Access Rd	21,000	0.88	0.42	0.49[1]	0.00	3.22[2]
9	Illinois River Bridge Access Rd to Robinson Rd	21,000	1.5	**0.52***	0.49[1]	0.00	3.22[2]
10	Robinson Rd to County Rd 102	21,000	0.58	**0.67***	0.49[1]	0.00	3.22[2]
11	County Rd 102 to Littrell Rd	21,000	0.51	0.41	0.49[1]	**10.23***	3.22[2]
12	Littrell Rd to WC Rd 851	21,000	1.53	**1.19***	0.49[1]	**3.41***	3.22[2]
13	WC Rd 851 to WC Rd 855	21,000	1.04	**0.83***	0.49[1]	0.00	3.22[2]
14	Wc Rd 855 to Old Hwy 68	21,000	1.04	**0.03**	0.49[1]	0.00	3.22[2]
Airport Rd to Old Hwy 68**			**11.5**	**0.66***	**0.49[1]**	**2.51**	**3.22[2]**

Source: ARDOT Crash Data 2017-2021

[1] - Arkansas Statewide 5-year average (2017-2021) total crash rate for rural four-lane divided highways with partial access control.

[2] - Arkansas Statewide 5-year average (2017-2021) KA crash rate for rural four-lane divided highways with partial access control.

***** - Segment exceeds the statewide crash rate for similar facilities.

****** – Segment crash rate provided by ARDOT.

Segment 2: Old Highway 68 to Siloam Springs East Limit

This segment surpassed both the statewide total and KA crash rates. The total crash rate of this segment was 0.74 crashes/MVMT whereas the KA crash rate was 6.14 crashes/HMVMT. Among the 24 crashes reported in this segment,17 incidents (~71%) reported along this segment resulted in property damage only, three crashes (~13%) caused possible injury, two crashes (~8%) causing non-incapacitating injury, and two crashes (~8%) resulted in incapacitating injury. Crashes along this segment primarily consisted of fixed object collisions (16 crashes, 67%) and rollovers/overturns (3 crashes, 13%).

Segment 4: Fairmount Road to Old Hotel Road

This segment exceeded both the statewide total and KA crash rates at 1.03 crashes/MVMT and 12.14 crashes /HMVMT respectively. The short segment length (0.43 miles) potentially skewed the crash rates. Of the 17 crashes reported in this segment, 14 incidents (~82%) reported along this segment resulted in property damage only, with two crashes (~12%) causing some form of injury to vehicle occupants, and one fatality was reported. Crashes along this segment consisted of fixed objects collisions (13 crashes, 76%) and angle collisions (two crashes, 12%).

Segment 5: Old Hotel Road to Chamber Springs Road

The total crash rate of this segment was 0.57 crashes/MVMT whereas the KA crash rate was 9.49 crashes/HMVMT. The elevated crash rate is likely attributed to the short segment length (0.55 miles). This segment experienced 12 crashes between the years 2017-2021. Of the 12 incidents, seven crashes (74%) reported along this segment resulted in property damage only, two crashes causing possible injury, one causing non-incapacitating injury, and two crashes resulting in incapacitating injuries. Crashes along this segment primarily consisted of rear-end (four crashes, ~33%) and animal collisions (three crashes, 25%).

Segment 12: Littrell Road to Wildcat Creek Road 851

This segment surpassed both statewide total and KA crash rates at 1.19 crashes/MVMT AND 3.41 crashes/HMVMT respectively. Of the 70 crashes reported in this segment, 51 incidents (~73%) reported along this segment resulted in property damage only, with 19 crashes (~27%) causing some form of injury to vehicle occupants, and no fatalities were reported. Crashes along this segment consisted of fixed objects collisions (45 crashes, 64%) and sideswipe same-direction collisions (eight crashes, 11%).

Based on the description of the segments, the segments with higher crash rates than the statewide average experienced collisions with fixed objects mostly, resulting in property damage only.

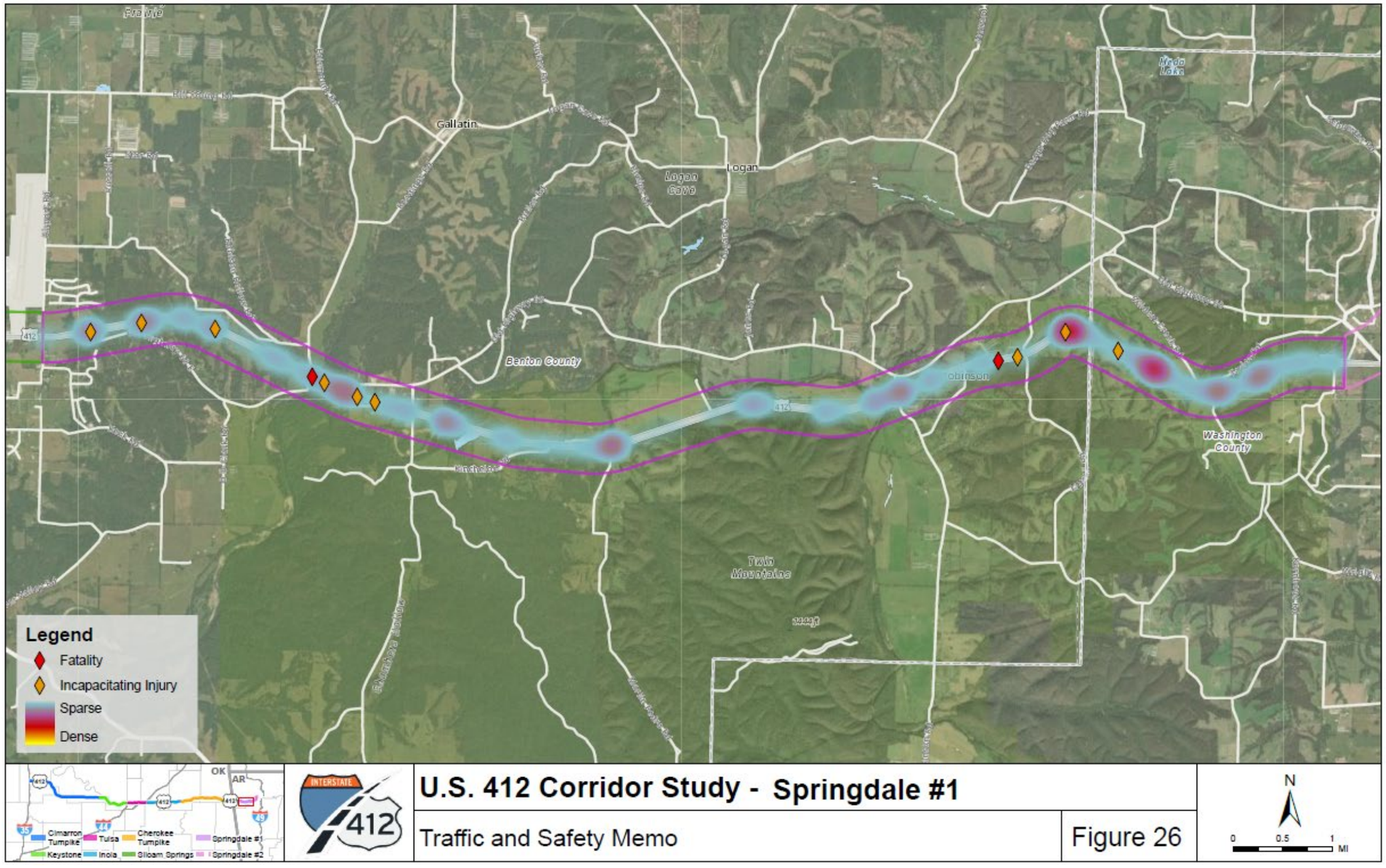
Crash Density

Figure 27 presents the crash density and the KA crash locations along the Springdale #1 planning segment. As shown in the figure, this planning segment had low crash density. Of the nine fatal and incapacitating injury crashes that occurred along the corridor, a high-density cluster of such crashes were reported near the segment from Fairmount Road to Chamber Springs Road and the segments from County Road 102 to WC Road 851. One fatal crash resulted from an angle collision and three incapacitating injury crashes occurred during dark conditions in the segment from Fairmount Road to Chamber Springs Road. One pedestrian fatality during dark conditions and one incapacitating injury crash resulted from collision with a fixed object were reported in the segment from Country Road 102 to WC Road 851.

- An incapacitating injury crash occurred at log mile 6.168 when a vehicle lost control while negotiating a curve.
- A fatal crash was reported at log mile 7.04 due to an angle collision when a vehicle failed to yield the right of way to a motorcycle and caused the motorcycle to strike it.

- An incapacitating injury crash was reported at log mile 7.16 when a vehicle lost control and struck a cable barrier during dark conditions with no streetlight.
- An incapacitating injury crash was reported at log mile 7.45 when a vehicle lost control and overturned during dark conditions with no streetlights.
- An incapacitating injury crash was reported at log mile 7.60 due to rear-end collision when a vehicle failed to slow down and collided with the forward vehicle during dark conditions with no streetlights.
- An incapacitating injury crash occurred at log mile 10.260 due to an angle collision when a vehicle struck an opposing vehicle while turning left.
- A pedestrian fatal crash occurred at log mile 12.86 because of a hit and run during dark conditions with no streetlights.
- A motorcycle crash occurred at log mile 13.01 when a motorcyclist tried to avoid a rear-end collision with a forward vehicle leading to cause him being ejected from the motorcycle.
- An incapacitating injury crash was reported at log mile 13.46 because of a rollover/overturn when a vehicle lost control while negotiating a curve.

Figure 26: Crash Density and the KA locations - Springdale #1



Source: ODOT (2017-2021), ARDOT (2017-2021).

Springdale #1 Safety Analysis Summary

There were 284 crashes that occurred along the planning segment, accounting for approximately 6% of all crashes (4,863 crashes) reported along U.S. 412 within the project study limits. Of the 284 crashes reported, 203 crashes (~72% of all crashes) resulted in property damage only, 79 crashes (~28% of all crashes) caused some form of injury to vehicle occupants, and two crashes (less than 1% of all crashes) resulted in fatalities. Collisions with fixed objects were the predominant crash types, accounting for approximately 59% (167 crashes) of all reported crash types on the planning segment followed by rear-end collisions (31 crashes, ~11%). With higher percentages of fixed object collisions experienced along the corridor, lighting conditions might be a potential contributing factor. Three segments such as Fairmount Road to Old Highway Road, Old Hotel Road to Chamber Springs Road, and Littrell Road to WC Road 851, were noted to exceed the statewide crash rates. Although this planning segment had low crash density, a high-density cluster of KA crashes were reported during dark conditions in the segment from Fairmount Road to Chamber Springs during dark conditions. Road. Attention should be paid to provide lighting facilities in this stretch of roads to reduce the KA crashes.

3.8. Springdale #2 Crash Analysis

An approximate 3-mile stretch of AR-612 corridor that runs from AR-112 to I-49 was evaluated as the Springdale #2 planning segment. The following sections provide a detailed description of the crash data analysis conducted for this planning segment.

Crash Severity and Crash Type

There were 20 crashes occurred along the planning segment, accounting for approximately 0.4% of all crashes (4,863 crashes) reported along U.S. 412 within the project study limits. Of the 20 crashes reported, 15 crashes (75% of all crashes) resulted in property damage only, three crashes (15% of all crashes) caused possible injury, one crash (5%) caused non-incapacitating injury, one crash (5%) resulted in incapacitating injury to vehicle occupants (**Figure 27**). Animal collisions were the predominant crash types, accounting for approximately 45% (nine crashes) of all reported crash types on the planning segment followed by fixed object collisions (six crashes, 30%).

Figure 27: Crash Severity – Springdale #2

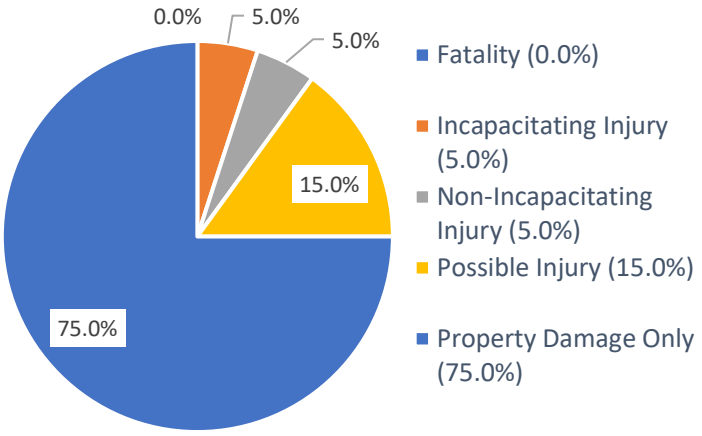
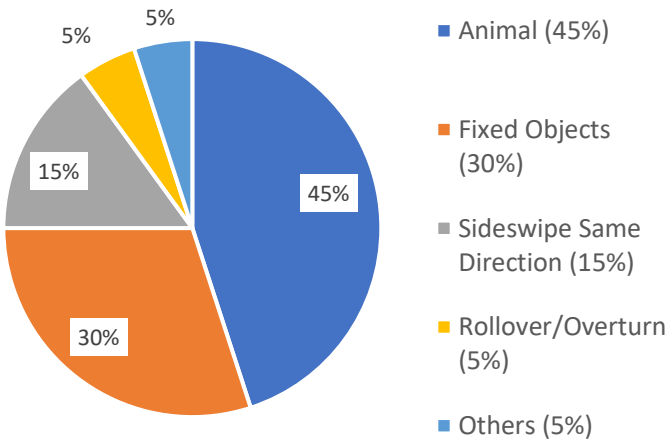


Figure 28: Crash Type – Springdale #2



Source: ARDOT Crash Data 2017-2021

Vehicle Types

The safety analysis revealed that passenger cars were involved in 20 crashes accounting for 100 % of the total reported crashes in this segment.

Roadway Surface and Lighting Conditions

There were 15 crashes (75% of all crashes) occurred on dry roadway surfaces whereas four crashes (20%) were noted to have occurred on wet surfaces and one crash (5%) occurred on an unknown road surface. When it comes to lighting conditions, nine crashes (45%) occurred during daylight, nine crashes (45%) occurred during dark conditions and three other crashes (15%) occurred during other or unknown lighting conditions. The higher number of crashes occurring during dark conditions indicate that inadequate lighting facilities have potential impacts on animal and fixed object collisions in this planning segment.

Crash Rates

The Springdale #2 planning segment consists of urban four-lane divided highways with full control of access. **Table 9** below compares total and KA injury crash rates for the two segments evaluated in the Springdale #2 to the statewide crash averages. As shown in the table, of the two segments, the segment from Zion Road overpass to I-49 surpassed Arkansas's statewide average KA crash rates. A brief description of this segment is provided below.

Table 9: Springdale #2 Crash Rates

Springdale #2 Segments		Average Daily Traffic (2021)	Segment Length (Mile)	Total Crash Rate (MVMT)		KA Crash Rate (HMVMT)	
Segment Number	Segment Name			Segment Crash Rate	Statewide 5-Year Average (2017-2021)	Segment Crash Rate	Statewide 5-Year Average (2017-2021)
1	AR-112 to Zion Rd	10,000	2.11	0.42	0.71[1]	0.00	2.34[2]
2	Zion Rd to I-49	10,000	1.16	0.19	0.71[1]	**4.72***	2.34[2]
AR -112 to I-49			3.27	0.56**	0.71[1]	**2.78****	2.34[2]

Source: ARDOT Crash Data 2017-2021

[1] - Arkansas Statewide 5-year average (2017-2021) total crash rate for urban four-lane divided highways with full access control.

[2] - Arkansas Statewide 5-year average (2017-2021) KA crash rate for urban four-lane divided highways with full access control.

***** - Segment exceeds the statewide crash rate for similar facilities.

****** – Segment crash rate provided by ARDOT.

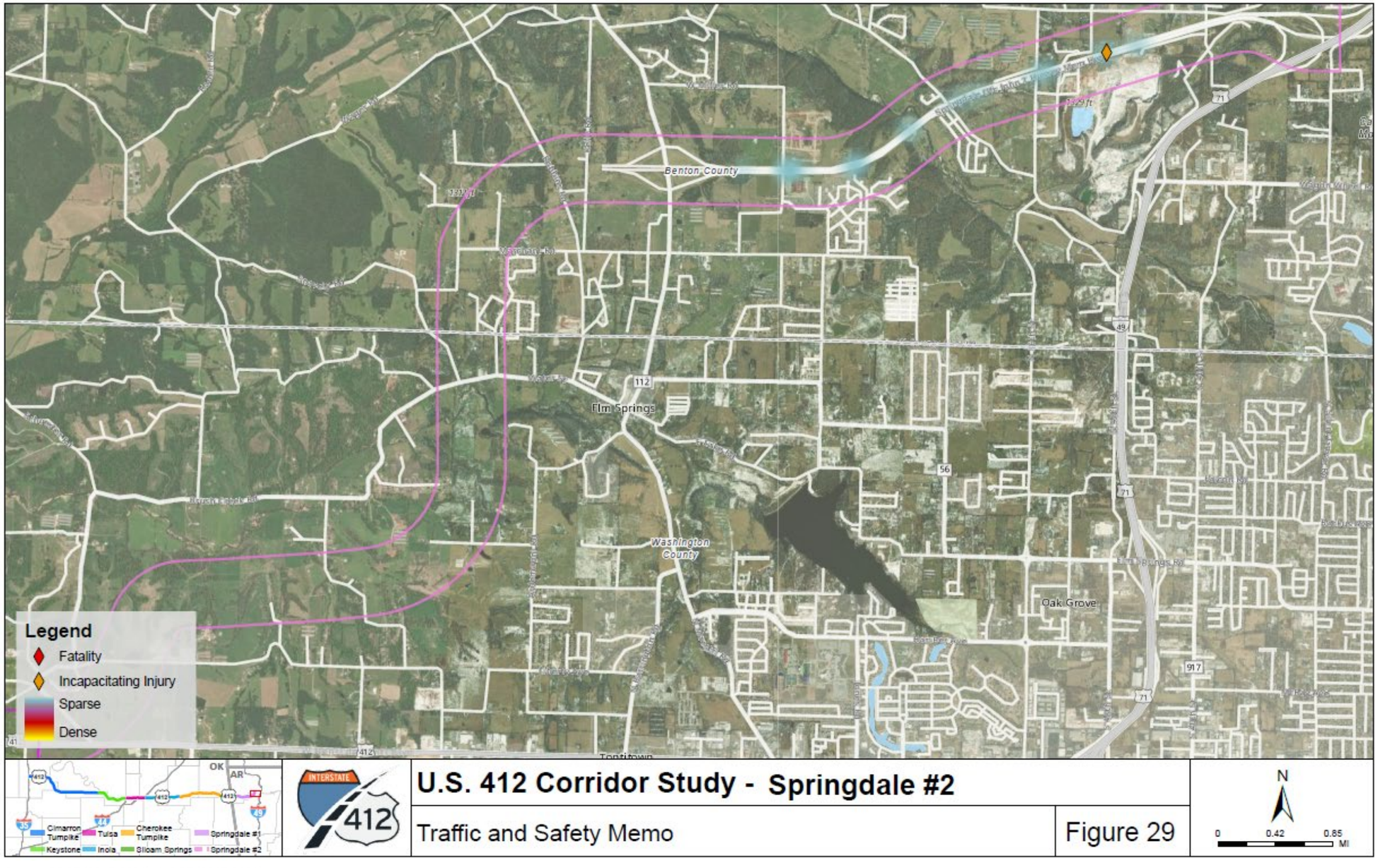
Segment 2: Zion Road to I-49

The segment from Zion Road overpass to I-49 surpassed Arkansas's statewide average KA crash rate at 4.72 crashes/HMVMT. However, this elevated crash rate is likely attributed to the short segment length (1.16 miles). Four crashes were reported in this segment. Among these crashes, two incidents (50 %) reported along this segment resulted in property damage only, with one crash causing possible injury, and one crash causing incapacitating injury. Crashes along this segment consisted of animal collisions (three crashes, 75%) and fixed object collisions (one crash, 75%).

Crash Density

Figure 29 presents the crash density and KA crash locations along the Springdale #2 segments. Only one incapacitating injury crash resulted from collision with an animal was reported approximately 15000 ft east of Zion Road overpass.

Figure 29: Crash Density and the KA locations - Springdale #2



Source: ODOT (2017-2021), ARDOT (2017-2021).

Springdale #2 Safety Analysis Summary

This planning segment experienced 20 crashes, accounting for approximately 0.4% of all crashes (4,861 crashes) reported along U.S. 412 within the project study limits. Of the 20 crashes reported, 15 crashes (75% of all crashes) resulted in property damage only, three crashes (15% of all crashes) caused possible injury, one crash caused non-incapacitating injury, and one crash resulted in incapacitating injury to the vehicle occupants. Animal collisions were the predominant crash type, accounting for approximately 45% (nine crashes) of all reported crash types on the planning segment followed by fixed object collisions (six crashes, 30%). Enhancing lighting facilities and installing rumble strips, delineators, and appropriate warning signs such as wildlife crossing signs might be considered to lessen the frequency and severity of animal collisions and fixed object collisions in this planning segment.

4.0 Future No-Build Safety

Under the No-Build scenario, traffic volumes are expected to increase across the U.S. 412 corridor. Current crash trends point to congestion-related crashes such as rear-end collisions, specifically along the Tulsa and Siloam Springs planning segments. Increases in traffic volumes will only increase this corridor congestion, likely leading to an increase in rear-end crashes. Angle collisions that are attributed to the at-grade intersections in Inola planning segment and Siloam Springs planning segment are also expected to increase. Without the development of capacity improvement or alternative routes, an elevated number of crashes will continue to cause critical safety concerns.

5.0 Conclusions

A total number of 4,863 crashes occurred along the U.S. 412 corridor within the project study limits, resulting in 47 fatalities. Among the planning segments, the Tulsa planning segment experienced the highest percentage of crashes (1853 crashes, 38.3% of total crashes) resulting in 19 fatalities and 61 incapacitating injury crashes. Fixed object collisions were the predominant crash types in Cimmaron Turnpike, Keystone, Cherokee Turnpike, and Springdale #1 planning segments. In contrast, rear-end collisions were the predominant crash types in Tulsa and Siloam Springs planning segments. In the Inola planning segment, which has many at-grade crossings, angle collisions resulted a higher percentage of fatalities and incapacitating injuries. As the planning segments transition between rural and urban areas, the shift in crash types from fixed object collisions to rear-end collisions and angle collisions indicates a change in both traffic patterns and roadway elements.

When compared with the statewide average, 58% of Cimarron Turnpike mileage, 47% of Keystone mileage, 63% of Tulsa mileage, 21% of Inola mileage, 13% of Cherokee Turnpike mileage, 18% of Siloam Springs mileage, 13% of Springdale #1 mileage, surpassed statewide average crash rates for total crashes. Crash density analysis showed that Tulsa and east portions of Keystone in Oklahoma, and all of Siloam Springs in Arkansas experienced the highest concentration of crashes. KA crashes were also mostly

concentrated in these same segments. Along with other segments, several segments experienced a substantial number of severe crashes within the project study limits. **Table 10** provides the list of high-crash risk locations with potential safety issues.

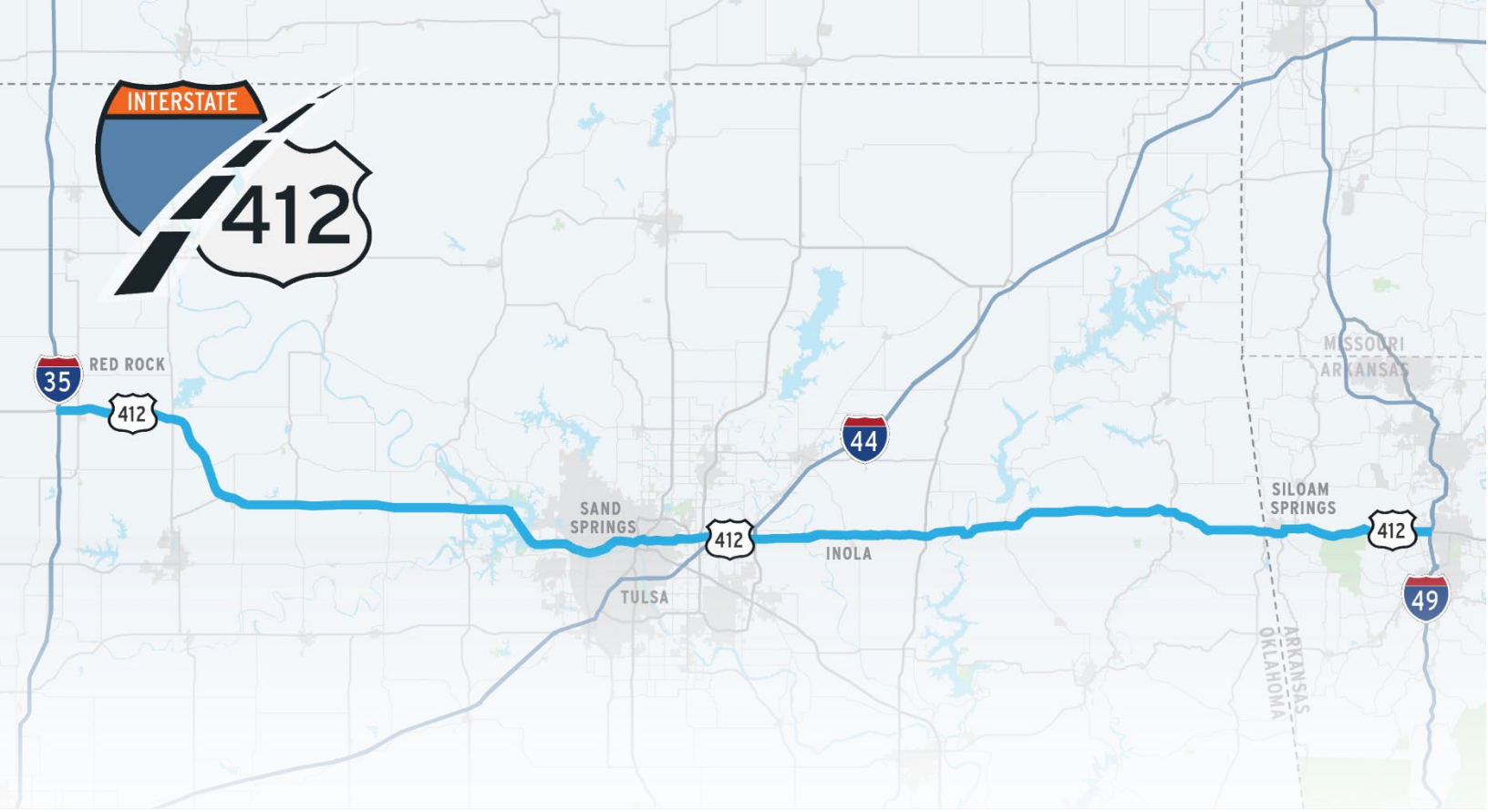
Table 10 : Locations with Potential Safety Issues

Planning Segments	Locations	Potential Safety Issues
Cimarron Turnpike	I-35 to N 3260 Road	• The design of the roadway with center barriers • Inadequate lighting facilities
	Cimarron Turnpike Spur to N 3430 Road	
	OK-18 to N 3550 Road segments	
	N 3570 Road to OK-48	
Keystone	N 129th W Avenue to Wilson Avenue	• The design of the roadway with center barriers • Inadequate lighting facilities • Closely spaced merging and diverging ramps • High Traffic
	N 49th W Avenue to N 33rd W Avenue	
	N Gilcrease Museum Road to N Quanah Avenue	
Tulsa	I-244 to Utica Avenue	• Closely spaced merging and diverging ramps • Inadequate lighting facilities • High traffic volume
	Sheridan Road to N 129th E Avenue	
	OK-66 to 165th Avenue	
	U.S. 169 to N 129th Road	
	County Line Road to the OK-66	
Inola	265th E Avenue to N 289th E Ave	• At-grade intersections • Inadequate lighting facilities
	N 305th E Ave to S 4160 Road	
	NS-4195 road to 4200 Road	
	S 432 Road to Old Highway 33	
Cherokee Turnpike	Cherokee Turnpike west limit to S 437 Road	• The design of the roadway with center barriers • Inadequate lighting facilities
	S 437 Road to OK-82	
	N 4540 Road to 4580 Road	
	S 444 Road to S 447	

Planning Segments	Locations	Potential Safety Issues
	ALT U.S. 412 to N 4540 Road	
	U.S. 59 interchange	
Siloam Springs	S Lincoln Street to Airport Road	• Undivided Highways with no access control
Springdale	Fairmount Road to Chamber Springs	• At-grade intersections in west side • Inadequate lighting facilities
	County Road 102 to WC Road 851	

Source: ODOT & ARDOT Crash Data 2017-2021.

Enhancing lighting facilities and delineation treatments including installing delineators and appropriate warning signs might be considered to lessen the frequency and severity of fixed object collisions within the project limits. Rear-end collisions in the Tulsa and Siloam Springs can be attributed to high traffic volume, as rear-end collisions are usually indicative of highly congested areas and are typically attributed to lower-speed crashes. Furthermore, angle collisions are mostly attributable to the conflict points at intersections and ramp terminals. Attention to geometrics at ramp merge and diverge as well as converting at-grade intersections into grade-separated interchanges ought to be considered to avoid such collisions.



OKLAHOMA Transportation

ARDOT ARKANSAS DEPARTMENT OF TRANSPORTATION

OKLAHOMA Turnpike Authority

U.S. Department of Transportation Federal Highway Administration

U.S. 412: from I-35 in Noble County, Oklahoma
to I-49 in Benton County, Arkansas

PEL Study

Traffic, Safety and Engineering Constraints Existing Conditions Report

Appendix C – Design Deficiencies

Table C- 1: Cimarron Identified Deficiencies

Segment	Station	Mile Marker	Criteria Element	Target Design Speed	Existing Posted Speed	Target Design Value	Existing Condition Value	Speed Met by Existing Condition	Controlling Criteria?	Comments
Cimarron	0+00.00	0.0	Median Type						No	Flush median through most of corridor, drains across travel lanes
Cimarron	0+00.00	0.0	Number of Lanes			2	1		Yes	Exist. Loop ramp (WB to SB), not an existing operational issue
Cimarron	0+00.00	0.0	Number of Lanes			2	1		Yes	Exist. Loop ramp (SB to EB), not an existing operational issue
Cimarron	0+00.00	0.0	Stopping Sight Distance (Crest Curve)	75mph	70mph	820'	600'	60mph	Yes	Exist K = 167 < 312 (75mph)
Cimarron	5+00.00	0.1	Number of Lanes			2	1		Yes	Exist. directional ramp (WB to NB), not an existing operational issue
Cimarron	5+00.00	0.1	Number of Lanes			2	1		Yes	Exist. directional ramp (NB to EB), not an existing operational issue
Cimarron	130+71.27	2.5	Median Type						No	Raised curbed median, drains across travel lanes
Cimarron	155+42.33	2.9	Superelevation Rate	75mph	75mph	2.60%	NC	50mph	Yes	9,549.297' on 8% Max Super E Tables
Cimarron	195+36.00	3.7	Superelevation Rate	75mph	75mph	2.60%	NC	50mph	Yes	9,549.297' on 8% Max Super E Tables
Cimarron	200+64.00	3.8	Median Type						No	Raised curbed median
Cimarron	216+48.00	4.1	Superelevation Rate	75mph	75mph	2.60%	NC	50mph	Yes	9,549.297' on 8% Max Super E Tables
Cimarron	313+17.25	5.9	Superelevation Rate	75mph	75mph	2.00%	NC	65mph	Yes	14,323.94' on 8% Max Super E Tables
Cimarron	453+42.89	8.6	Median Type						No	Raised curbed median, drains across travel lanes
Cimarron	541+77.35	10.3	Stopping Sight Distance (Sag Curve)	75mph	75mph	820'	713'	65mph	No	Exist K = 171 < 206 (75mph)
Cimarron	654+72.00	12.4	Stopping Sight Distance (Sag Curve)	75mph	75mph	820'	628'	60mph	No	Exist K = 152 < 206 (75mph)
Cimarron	670+56.00	12.7	Superelevation Rate	75mph	75mph	2.20%	NC	55mph	Yes	11,459.156' on 8% Max Super E Tables
Cimarron	723+36.00	13.7	Stopping Sight Distance (Sag Curve)	75mph	75mph	820'	740'	70mph	No	Exist K = 164 < 206 (75mph)
Cimarron	739+20.00	14.0	Superelevation Rate	75mph	75mph	2.40%	NC	55mph	Yes	10,742.96' on 8% Max Super E Tables
Cimarron	774+45.76	14.7	Vertical Clearance (Bridge Overpass)	75mph	75mph	16'	15'-9"		Yes	Assumed AETC will increase clearance and remove this deficiency
Cimarron	792+00.00	15.0	Superelevation Rate	75mph	75mph	2.60%	NC	50mph	Yes	9,549.297' on 8% Max Super E Tables
Cimarron	828+96.00	15.7	Superelevation Rate	75mph	75mph	2.60%	NC	50mph	Yes	9,549.297' on 8% Max Super E Tables
Cimarron	892+32.00	16.9	Superelevation Rate	75mph	75mph	2.60%	NC	50mph	Yes	9,549.297' on 8% Max Super E Tables
Cimarron	1003+20.00	19.0	Superelevation Rate	75mph	75mph	2.20%	NC	60mph	Yes	12,277.67' on 8% Max Super E Tables
Cimarron	1046+69.83	19.8	Median Type						No	Raised earth median, drains across travel lanes
Cimarron	1129+92.00	21.4	Superelevation Rate	75mph	75mph	2.60%	NC	50mph	Yes	9,549.297' on 8% Max Super E Tables
Cimarron	1172+16.00	22.2	Stopping Sight Distance (Sag Curve)	75mph	75mph	820'	625'	60mph	No	Exist K = 151 < 206 (75mph)
Cimarron	1192+39.42	22.6	Median Type						No	Raised earth median, drains across travel lanes
Cimarron	1273+15.61	24.1	Access Control						No	At-Grade Intersection, OTA Facility
Cimarron	1275+52.49	24.2	Access Control						No	At-Grade Intersection, Grade Separation Access

Table C- 2: Cimarron Identified Deficiencies

Segment	Station	Mile Marker	Criteria Element	Target Design Speed	Existing Posted Speed	Target Design Value	Existing Condition Value	Speed Met by Existing Condition	Controlling Criteria?	Comments
Cimarron	1356+96.00	25.7	Superelevation Rate	75mph	75mph	2.40%	NC	55mph	Yes	10,743.03' on 8% Max Super E Tables
Cimarron	1362+75.14	25.8	Median Type						No	Raised curbed median, drains across travel lanes
Cimarron	1399+20.00	26.5	Stopping Sight Distance (Sag Curve)	75mph	75mph	820'	673'	65mph	No	Exist K = 164 < 206 (75mph)
Cimarron	1436+16.00	27.2	Superelevation Rate	75mph	75mph	2.40%	NC	55mph	Yes	10,743.03' on 8% Max Super E Tables
Cimarron	1499+52.00	28.4	Superelevation Rate	75mph	75mph	2.40%	NC	55mph	Yes	10,742.96' on 8% Max Super E Tables
Cimarron	1518+48.42	28.8	Median Type						No	Raised curbed median, drains across travel lanes
Cimarron	1523+74.74	28.9	Superelevation Rate	75mph	75mph	2.40%	NC	55mph	Yes	10,742.96' on 8% Max Super E Tables
Cimarron	1564+43.11	29.6	Median Type						No	Raised curbed median, drains across travel lanes
Cimarron	1569+39.54	29.7	Superelevation Rate	75mph	75mph	2.40%	NC	55mph	Yes	10,742.96' on 8% Max Super E Tables
Cimarron	1574+13.84	29.8	Stopping Sight Distance (Sag Curve)	75mph	75mph	820'	746'	70mph	No	Exist K = 185 < 206 (75mph)
Cimarron	1594+56.00	30.2	Superelevation Rate	75mph	75mph	2.40%	NC	55mph	Yes	10,742.96' on 8% Max Super E Tables
Cimarron	1611+29.38	30.5	Access Control						No	At-Grade Intersection, Burkhart Street
Cimarron	1631+52.00	30.9	Superelevation Rate	75mph	75mph	2.40%	NC	55mph	Yes	10,742.96' on 8% Max Super E Tables
Cimarron	1647+36.00	31.2	Superelevation Rate	75mph	75mph	2.40%	NC	55mph	Yes	10,742.96' on 8% Max Super E Tables
Cimarron	1744+63.18	33.0	Median Type						No	Raised curbed median, drains across travel lanes
Cimarron	1884+96.00	35.7	Superelevation Rate	75mph	75mph	5.80%	4.80%	65mph	Yes	3,819.719' on 8% Max Super E Tables, two sets of three curves
Cimarron	1943+04.00	36.8	Stopping Sight Distance (Sag Curve)	75mph	75mph	820'	747'	70mph	No	Exist K = 185 < 206 (75mph)
Cimarron	2075+04.00	39.3	Stopping Sight Distance (Sag Curve)	75mph	75mph	820'	787'	70mph	No	Exist K = 185 < 206 (75mph)
Cimarron	2351+57.27	44.5	Stopping Sight Distance (Sag Curve)	75mph	75mph	820'	688'	65mph	No	Exist K = 169 < 206 (75mph)
Cimarron	2486+88.00	47.1	Superelevation Rate	75mph	75mph	2.20%	NC	55mph	Yes	11,459.156' on 8% Max Super E Tables
Cimarron	2567+96.12	48.6	Median Type						No	Raised curbed median, drains across travel lanes
Cimarron	2587+20.00	49.0	Superelevation Rate	75mph	75mph	2.00%	NC	65mph	Yes	14,323.94' on 8% Max Super E Tables
Cimarron	2687+05.13	50.9	Median Type						No	Raised curbed median, drains across travel lanes
Cimarron	2772+00.00	52.5	Stopping Sight Distance (Sag Curve)	75mph	75mph	820'	622'	60mph	No	Exist K = 150 < 206 (75mph)
Cimarron	2972+64.00	56.3	Stopping Sight Distance (Sag Curve)	75mph	75mph	820'	707'	65mph	No	Exist K = 174 < 206 (75mph)
Cimarron	2977+92.00	56.4	Superelevation Rate	75mph	75mph	2.20%	NC	55mph	Yes	11,459.156' on 8% Max Super E Tables
Cimarron	3020+16.00	57.2	Superelevation Rate	75mph	75mph	2.20%	NC	55mph	Yes	11,459.156' on 8% Max Super E Tables
Cimarron	3051+84.00	57.8	Superelevation Rate	75mph	75mph	2.20%	NC	55mph	Yes	11,459.156' on 8% Max Super E Tables
Cimarron	3088+80.00	58.5	Stopping Sight Distance (Sag Curve)	75mph	75mph	820'	707'	65mph	No	Exist K = 174 < 206 (75mph)

Table C- 3: Keystone Identified Deficiencies

Segment	Mile Marker	Criteria Element	Target Design Speed	Existing Posted Speed	Target Design Value	Existing Condition Value	Speed Met by Existing Condition	Controlling Criteria?	Comments
Keystone	59.2	Shoulder Width (Outside)			10'	8'		Yes	WB lanes to Penninsula N Dr. Limited by frontages in many locations.
Keystone	63.8	Superelevation Rate	70mph	70mph	3.80%	2.20%	50mph	Yes	5,515.56' on 8% Max Super E Tables
Keystone	64.5	Vertical Clearance (Bridge Overpass)			16'	15'-9"		Yes	Existing condition acquired from posted sign
Keystone	64.7	Shoulder Width (Inside)			4'	0'		Yes	No shoulder visible
Keystone	64.8	Median Type						No	EB, Raised curb median (1.8 miles)
Keystone	66.4	Vertical Clearance (Bridge Overpass)			16'	15'-11"		Yes	Existing condition acquired from posted sign
Keystone	66.4	Ramp Terminal Spacing			500'	370'		No	WB Exit to Entrance Spacing Inadequate
Keystone	68.3	Access Control						Yes	At-grade intersection, Diamond Head Drive
Keystone	68.8	Maximum Grade			4.00%	4.04%		Yes	Rolling terrain. 4.03% EB, 4.04% WB
Keystone	69.1	Superelevation Rate	70mph	70mph	3.40%	2.20%	50mph	Yes	6138.83' on 8% Max Super E Tables
Keystone	75.4	Vertical Clearance (Bridge Overpass)			16'	15'-0"		Yes	Existing condition acquired from posted sign
Keystone	75.8	Superelevation Rate	65mph	65mph	5.80%	4.10%	50mph	Yes	2,864.79' on 8% Max Super E Tables
Keystone	76.2	Stopping Sight Distance (Crest Curve)	65mph	65mph	645'	631'	60mph	Yes	Exist K = 184.3 < 193 (65mph)
Keystone	76.3	Superelevation Rate	65mph	65mph	4.60%	2.80%	45mph	Yes	3819.72' on 8% Max Super E Tables
Keystone	76.6	Stopping Sight Distance (Horizontal)	65mph	65mph	645'	555'	55mph	Yes	(EB) inside bridge rail
Keystone	76.6	Stopping Sight Distance (Crest Curve)	65mph	65mph	645'	583'	60mph	Yes	Exist K = 157.4 < 193 (65mph)
Keystone	76.7	Superelevation Rate	65mph	65mph	3.20%	2.30%	50mph	Yes	5,729.58' on 8% Max Super E Tables
Keystone	76.9	Stopping Sight Distance (Crest Curve)	65mph	65mph	645'	610'	60mph	Yes	Exist K = 166.7 < 193 (65mph)
Keystone	77.1	Vertical Clearance (Bridge Overpass)			16'	15'-2"		Yes	Existing condition acquired from posted sign
Keystone	77.1	Stopping Sight Distance (Crest Curve)	65mph	65mph	645'	635'	60mph	Yes	Exist K = 183.3 < 193 (65mph)
Keystone	77.3	Superelevation Rate	65mph	65mph	RC	NC	55mph	Yes	11,459.16' on 8% Max Super E Tables
Keystone	77.4	Stopping Sight Distance (Horizontal)	65mph	65mph	645'	538'	55mph	Yes	(WB) bridge approach guardrail
Keystone	77.4	Stopping Sight Distance (Crest Curve)	65mph	65mph	645'	569'	55mph	Yes	Exist K = 150 < 193 (65mph)
Keystone	77.5	Superelevation Rate	65mph	65mph	6.80%	4.80%	50mph	Yes	2,291.83' on 8% Max Super E Tables
Keystone	77.5	Shoulder Width (Inside)			10'	4'		Yes	5.7 miles, 3 lanes each direction
Keystone	78.5	Stopping Sight Distance (Crest Curve)	65mph	65mph	645'	590'	60mph	Yes	Exist K = 153.85 < 193 (65mph)
Keystone	79.0	Superelevation Rate	65mph	65mph	5.00%	3.90%	55mph	Yes	3,437.747' on 8% Max Super E Tables
Keystone	79.6	Superelevation Rate	65mph	65mph	5.00%	3.90%	55mph	Yes	3,437.747' on 8% Max Super E Tables
Keystone	79.7	Vertical Clearance (Bridge Overpass)			16'	14'-7"		Yes	Existing condition acquired from posted sign
Keystone	79.9	Superelevation Rate	65mph	65mph	5.00%	3.90%	55mph	Yes	3,437.747' on 8% Max Super E Tables
Keystone	80.5	Superelevation Rate	65mph	65mph	5.00%	3.90%	55mph	Yes	3,437.747' on 8% Max Super E Tables
Keystone	81.3	Vertical Clearance (Bridge Overpass)			16'	15'-1"		Yes	Existing condition acquired from posted sign
Keystone	81.5	Superelevation Rate	65mph	65mph	3.20%	2.20%	50mph	Yes	5,729.578' on 8% Max Super E Tables
Keystone	81.8	Vertical Clearance (Bridge Overpass)			16'	15'-1"		Yes	Existing condition acquired from posted sign
Keystone	81.9	Superelevation Rate	65mph	65mph	3.20%	2.20%	50mph	Yes	5,729.578' on 8% Max Super E Tables

Table C- 4: Keystone Identified Deficiencies

Segment	Mile Marker	Criteria Element	Target Design Speed	Existing Posted Speed	Target Design Value	Existing Condition Value	Speed Met by Existing Condition	Controlling Criteria?	Comments
Keystone	82.1	Superelevation Rate	65mph	65mph	7.60%	6.60%	55mph	Yes	1,909.859' on 8% Max Super E Tables
Keystone	82.3	Stopping Sight Distance (Crest Curve)	65mph	65mph	645'	591'	60mph	Yes	Exist K = 162 < 193 (65mph)
Keystone	82.5	Superelevation Rate	65mph	65mph	7.60%	6.60%	55mph	Yes	1,909.859' on 8% Max Super E Tables
Keystone	82.8	Stopping Sight Distance (Horizontal)	65mph	65mph	645'	570'	60mph	Yes	(WB) bridge end slope
Keystone	82.8	Vertical Clearance (Bridge Overpass)			16'	14'-11"		Yes	Existing condition acquired from posted sign
Keystone	82.9	Horizontal Curve Radius (Minimum)	65mph	65mph	1480'	1432.395'	55mph	Yes	7.6% super, Need 8% at 1480' to meet 65mph
Keystone	83.2	Stopping Sight Distance (Horizontal)	55mph	55mph	495'	424'	45mph	Yes	(WB) outside shoulder barrier
Keystone	83.2	Superelevation Rate	55mph	55mph	7.00%	5.00%	40mph	Yes	(WB) 1432.395' on 8% Max Super E Tables
Keystone	83.2	Superelevation Rate	55mph	55mph	4.60%	3.10%	40mph	Yes	(EB) 2,864.79' on 8% Max Super E Tables
Keystone	83.4	Curb Height			4"	6"		No	(EB) 6" sloped curb for 380' on outside
Keystone	83.4	Vertical Clearance (Bridge Overpass)			16'	15'-3"		Yes	EB lanes under ramp bridge. Existing condition acquired from posted sign.
Keystone	83.5	Stopping Sight Distance (Crest Curve)	55mph	55mph	495'	339'	40mph	Yes	(EB) Exist K = 53 < 114 (55mph)
Keystone	83.5	Vertical Clearance (Bridge Overpass)			16'	15'-1"		Yes	EB lanes over ramp. Existing condition acquired from posted sign.
Keystone	83.5	Stopping Sight Distance (Sag Curve)	55mph	55mph	495'	281'	50mph	No	(EB) Lighted, does not meet 55mph comfort
Keystone	83.6	Vertical Clearance (Bridge Overpass)			16'	15'-3"		Yes	EB lanes under ramp bridge. Existing condition acquired from posted sign.
Keystone	83.6	Stopping Sight Distance (Horizontal)	55mph	55mph	495'	241'	30mph	Yes	(WB) inside shoulder barrier
Keystone	83.6	Vertical Clearance (Bridge Overpass)			16'	15'-6"		Yes	WB lanes under ramp bridge. Existing condition acquired from posted sign.
Keystone	83.6	Horizontal Curve Radius (Minimum)	55mph	55mph	960'	716.2'	35mph	Yes	(WB, 6% super) Need 960' at 8% to meet
Keystone	83.6	Stopping Sight Distance (Horizontal)	55mph	55mph	495'	426'	50mph	Yes	(EB) outside shoulder barrier
Keystone	83.6	Superelevation Rate	55mph	55mph	7.20%	5.00%	40mph	Yes	(EB) 1432.395' on 8% Max Super E Tables
Keystone	83.6	Stopping Sight Distance (Crest Curve)	55mph	55mph	495'	332'	40mph	Yes	(EB) Exist K = 51 < 114 (55mph)
Keystone	83.6	Stopping Sight Distance (Crest Curve)	55mph	55mph	495'	384'	45mph	Yes	(WB) Exist K = 68 < 114 (55mph)

Table C- 5: Inola Identified Deficiencies

Segment	Mile Marker	Criteria Element	Target Design Speed	Existing Posted Speed	Target Design Value	Existing Condition Value	Speed Met by Existing Condition	Controlling Criteria	Comments
Inola	98.3	Median Width			50'	40'		No	40' median east for approximately 1.6 miles
Inola	98.7	Stopping Sight Distance (Sag Curve)	65mph	65mph	645'	508'	55mph	No	meets 65mph comfort, but not currently lit
Inola	99.5	Maximum Grade			3.00%	3.12%	55mph	Yes	Approximately 600' between crest and sag
Inola	101.6	Access Control						No	At-Grade Intersection
Inola	103.1	Access Control						No	At-Grade Intersection
Inola	104.1	Access Control						No	At-Grade Intersection
Inola	106.2	Access Control						No	At-Grade Intersection
Inola	107.2	Access Control						No	At-Grade Intersection
Inola	108.2	Access Control						No	At-Grade Intersection
Inola	109.2	Access Control						No	At-Grade Intersection
Inola	109.7	Access Control						No	At-Grade Intersection
Inola	110.2	Access Control						No	At-Grade Intersection
Inola	110.6	Maximum Grade			3.00%	3.45%	55mph	Yes	Instantaneous between reverse vertical
Inola	110.7	Superelevation Rate	70mph	65mph	2.60%	2.00%	60mph	Yes	8,594.367' on 8% Max Super E Tables
Inola	110.7	Stopping Sight Distance (Crest Curve)	70mph	65mph	730'	721'	65mph	Yes	K=241<247 (70mph)
Inola	111.2	Maximum Grade			3.00%	3.50%	55mph	Yes	Approximately 1300' between crest and sag
Inola	111.3	Maximum Grade			3.00%	3.35%	55mph	Yes	Approximately 1300' between crest and sag
Inola	111.7	Superelevation Rate	70mph	70mph	3.00%	2.00%	55mph	Yes	7,217.97' (WB) on 8% Max Super E Tables
Inola	111.7	Superelevation Rate	70mph	70mph	3.00%	2.00%	55mph	Yes	7,105.97' (EB) on 8% Max Super E Tables
Inola	112.4	Superelevation Rate	70mph	70mph	3.00%	2.00%	55mph	Yes	7,105.97' (WB) on 8% Max Super E Tables
Inola	112.4	Superelevation Rate	70mph	70mph	3.00%	2.00%	55mph	Yes	7,217.97' (EB) on 8% Max Super E Tables
Inola	112.8	Maximum Grade			3.00%	3.60%	55mph	Yes	Approximately 300' between crest and sag
Inola	113.1	Maximum Grade			3.00%	3.39%	55mph	Yes	Approximately 400' between crest and sag
Inola	113.3	Access Control						No	At-Grade Intersection
Inola	114.3	Access Control						No	At-Grade Intersection
Inola	115.3	Access Control						No	At-Grade Intersection
Inola	116.3	Access Control						No	At-Grade Intersection

Table C- 6: Inola Identified Deficiencies

Segment	Mile Marker	Criteria Element	Target Design Speed	Existing Posted Speed	Target Design Value	Existing Condition Value	Speed Met by Existing Condition	Controlling Criteria	Comments
Inola	117.3	Access Control						No	At-Grade Intersection
Inola	118.3	Access Control						No	At-Grade Intersection
Inola	119.3	Access Control						No	At-Grade Intersection
Inola	120.3	Access Control						No	At-Grade Intersection
Inola	121.3	Access Control						No	At-Grade Intersection
Inola	121.9	Access Control						No	At-Grade Intersection
Inola	122.2	Superelevation Rate	70mph	70mph	3.00%	RC**	55mph	Yes	7,161.97' (WB) on 8% Max Super E Tables
Inola	122.2	Superelevation Rate	70mph	70mph	3.00%	RC**	55mph	Yes	7,161.97' (EB) on 8% Max Super E Tables
Inola	122.4	Access Control						No	At-Grade Intersection
Inola	122.8	Superelevation Rate	70mph	70mph	RC	NC**	65mph	Yes	14,279.95' (WB) on 8% Max Super E Tables
Inola	122.8	Superelevation Rate	70mph	70mph	RC	NC**	65mph	Yes	14,367.95' (EB) on 8% Max Super E Tables
Inola	123.3	Access Control						No	At-Grade Intersection
Inola	123.5	Superelevation Rate	70mph	70mph	3.00%	RC**	55mph	Yes	7,205.97' (WB) on 8% Max Super E Tables
Inola	123.5	Superelevation Rate	70mph	70mph	3.00%	RC**	55mph	Yes	7,117.97' (EB) on 8% Max Super E Tables
Inola	123.9	Access Control						No	At-Grade Intersection
Inola	124.4	Access Control						No	At-Grade Intersection
Inola	125.0	Superelevation Rate	70mph	70mph	5.20%	4.10%	60mph	Yes	3,819.719' on 8% Max Super E Tables
Inola	125.0	Access Control						No	At-Grade Intersection
Inola	125.1	Number of Lanes						No	One Through-Traffic Lane EB

** Asumptions based on observations made in the field during site visit

Table C- 7: Cherokee Identified Deficiencies

Segment	Mile Marker	Criteria Element	Target Design Speed	Existing Posted Speed	Target Design Value	Existing Condition Value	Speed Met by Existing Condition	Controlling Criteria	Comments
Cherokee	125.3	Superelevation Rate	70mph	55mph	3.6%	2.9%	60mph	Yes	5,729.578' on 8% Max Super E Tables
Cherokee	125.5	Stopping Sight Distance (Horizontal)	70mph	55mph	730'	660.16'	65mph	Yes	Bridge Grading
Cherokee	125.5	Horizontal Curve Radius (Minimum)	70mph	55mph	1810'	1041.741'	55mph	Yes	55mph with 8.0% Super E
Cherokee	125.6	Number of Lanes						No	One Through-Traffic Lane WB
Cherokee	125.7	Horizontal Curve Radius (Minimum)	70mph	70mph	1810'	1432.395'	60mph	Yes	60mph with 7.8% Super E
Cherokee	125.7	Horizontal Curve Radius (Minimum)	70mph	55mph	1810'	1637.022'	55mph	Yes	55mph with 6.7% Super E
Cherokee	125.8	Median Width			50'	40'		No	No Median Barrier
Cherokee	126.1	Horizontal Curve Radius (Minimum)	75mph	75mph	1810'	1527.887'	65mph	Yes	65mph with 8.0% Super E
Cherokee	126.8	Superelevation Rate	75mph	75mph	7.3%	6.5%	70mph	Yes	2,864.789' on 8% Max Super E Tables
Cherokee	127.6	Horizontal Curve Radius (Minimum)	75mph	75mph	2210'	1909.859'	70mph	Yes	70mph with 8.0% Super E
Cherokee	127.9	Stopping Sight Distance (Sag Curve)	80mph	80mph	910'	640'	60mph	No	Exist K = 155 < 231 (80mph)
Cherokee	128.2	Stopping Sight Distance (Crest Curve)	80mph	80mph	910'	751'	70mph	Yes	Exist K = 261 < 384 (80mph)
Cherokee	129.2	Superelevation Rate	80mph	80mph	2.4%	2.0%	70mph	Yes	11,459.156' on 8% Max Super E Tables
Cherokee	129.9	Superelevation Rate	80mph	80mph	3.8%	2.8%	65mph	Yes	7,161.972' on 8% Max Super E Tables
Cherokee	130.5	Superelevation Rate	80mph	80mph	2.4%	2.0%	70mph	Yes	11,459.156' on 8% Max Super E Tables
Cherokee	131.0	Superelevation Rate	80mph	80mph	7.9%	6.5%	70mph	Yes	2,864.789' on 8% Max Super E Tables
Cherokee	131.4	Median Width			50'	40'		No	No Median Barrier
Cherokee	131.6	Stopping Sight Distance (Crest Curve)	80mph	80mph	910'	732'	70mph	Yes	Exist K = 248 < 384 (80mph)
Cherokee	131.8	Superelevation Rate	80mph	80mph	5.5%	4.4%	70mph	Yes	4,583.66' on 8% Max Super E Tables
Cherokee	132.4	Superelevation Rate	80mph	80mph	7.9%	6.5%	70mph	Yes	2,864.789' on 8% Max Super E Tables
Cherokee	132.7	Stopping Sight Distance (Crest Curve)	80mph	80mph	910'	808'	70mph	Yes	Exist K = 303 < 384 (80mph)
Cherokee	133.0	Stopping Sight Distance (Sag Curve)	80mph	80mph	910'	636'	60mph	No	Exist K = 154 < 231 (80mph)
Cherokee	133.1	Stopping Sight Distance (Crest Curve)	80mph	80mph	910'	827'	75mph	Yes	Exist K = 321 < 384 (80mph)
Cherokee	133.2	Superelevation Rate	80mph	80mph	7.9%	6.5%	70mph	Yes	2,864.789' on 8% Max Super E Tables
Cherokee	133.5	Superelevation Rate	80mph	80mph	7.4%	5.4%	65mph	Yes	3,274.05' on 8% Max Super E Tables
Cherokee	133.9	Horizontal Curve Radius (Minimum)	80mph	80mph	2,670'	2291.83'	70mph	Yes	70mph with 7.5% Super E
Cherokee	134.0	Stopping Sight Distance (Sag Curve)	80mph	80mph	910'	706'	65mph	No	Exist K = 174 < 231 (80mph)
Cherokee	134.3	Stopping Sight Distance (Crest Curve)	80mph	80mph	910'	729'	70mph	Yes	Exist K = 247 < 384 (80mph)
Cherokee	134.8	Stopping Sight Distance (Sag Curve)	80mph	80mph	910'	738'	70mph	No	Exist K = 182 < 231 (80mph)
Cherokee	135.7	Superelevation Rate	80mph	80mph	3.4%	2.8%	70mph	Yes	7,639.44' on 8% Max Super E Tables
Cherokee	136.3	Median Width			50'	40'		No	No Median Barrier
Cherokee	136.5	Stopping Sight Distance (Sag Curve)	80mph	80mph	910'	622'	60mph	No	Exist K = 150 < 231 (80mph)
Cherokee	136.8	Superelevation Rate	80mph	80mph	2.4%	2.0%	70mph	Yes	11,459.156' on 8% Max Super E Tables
Cherokee	139.3	Superelevation Rate	80mph	80mph	2.4%	2.0%	70mph	Yes	11,459.156' on 8% Max Super E Tables

Table C- 8: Cherokee Identified Deficiencies

Segment	Mile Marker	Criteria Element	Target Design Speed	Existing Posted Speed	Target Design Value	Existing Condition Value	Speed Met by Existing Condition	Controlling Criteria	Comments
Cherokee	140.0	Superelevation Rate	80mph	80mph	2.4%	2.0%	70mph	Yes	11,459.156' on 8% Max Super E Tables
Cherokee	140.6	Superelevation Rate	80mph	80mph	2.4%	2.0%	70mph	Yes	11,459.156' on 8% Max Super E Tables
Cherokee	141.5	Superelevation Rate	80mph	80mph	2.4%	2.0%	70mph	Yes	11,459.156' on 8% Max Super E Tables
Cherokee	142.2	Median Width			50'	40'		No	No Median Barrier
Cherokee	142.4	Stopping Sight Distance (Crest Curve)	80mph	80mph	910'	908'	75mph	Yes	Exist K = 376 < 384 (80mph)
Cherokee	142.6	Stopping Sight Distance (Crest Curve)	80mph	80mph	910'	885'	65mph	Yes	Exist K = 230 < 384 (80mph)
Cherokee	142.6	Shoulder Width (Outside)			10'	8'		Yes	8' Outside (Right) Shoulder
Cherokee	142.6	Shoulder Width (Outside)			10'	8'		Yes	8' Outside (Right) Shoulder
Cherokee	142.9	Stopping Sight Distance (Sag Curve)	80mph	80mph	910'	692'	65mph	No	Exist K = 167 < 231 (80mph)
Cherokee	142.9	Median Width			50'	40'		No	No Median Barrier
Cherokee	143.1	Stopping Sight Distance (Crest Curve)	80mph	80mph	910'	831'	75mph	Yes	Exist K = 320 < 384 (80mph)
Cherokee	143.2	Superelevation Rate	80mph	80mph	3.4%	2.8%	70mph	Yes	7,639.44' on 8% Max Super E Tables
Cherokee	143.5	Stopping Sight Distance (Sag Curve)	80mph	80mph	910'	622'	60mph	No	Exist K = 150 < 231 (80mph) EB
Cherokee	143.5	Stopping Sight Distance (Sag Curve)	80mph	80mph	910'	660'	65mph	No	Exist K = 161 < 231 (80mph) WB
Cherokee	143.6	Superelevation Rate	80mph	80mph	7.4%	5.8%	65mph	Yes	3,274.05' on 8% Max Super E Tables
Cherokee	143.6	Stopping Sight Distance (Horizontal)	80mph	80mph	910'	685.01'	65mph	Yes	Bridge Rail, vertical mitigates**
Cherokee	143.7	Stopping Sight Distance (Crest Curve)	80mph	80mph	910'	812'	70mph	Yes	Exist K = 305 < 384 (80mph) EB
Cherokee	143.8	Stopping Sight Distance (Crest Curve)	80mph	80mph	910'	869'	75mph	Yes	Exist K = 350 < 384 (80mph) WB
Cherokee	144.0	Superelevation Rate	80mph	80mph	3.4%	2.8%	70mph	Yes	7,639.44' on 8% Max Super E Tables
Cherokee	144.0	Superelevation Rate	80mph	80mph	4.5%	3.6%	70mph	Yes	5,729.578' on 8% Max Super E Tables
Cherokee	144.5	Superelevation Rate	80mph	80mph	4.5%	3.6%	70mph	Yes	5,729.578' on 8% Max Super E Tables
Cherokee	144.5	Superelevation Rate	80mph	80mph	4.5%	3.6%	70mph	Yes	5,729.578' on 8% Max Super E Tables
Cherokee	145.2	Superelevation Rate	80mph	80mph	2.4%	2.1%	75mph	Yes	11,459.156' on 8% Max Super E Tables
Cherokee	145.9	Superelevation Rate	80mph	80mph	4.5%	3.6%	70mph	Yes	5,729.578' on 8% Max Super E Tables
Cherokee	146.5	Stopping Sight Distance (Horizontal)	80mph	80mph	910'	522.53	55mph	Yes	Bridge Rail, vertical mitigates**
Cherokee	146.5	Stopping Sight Distance (Horizontal)	80mph	80mph	910'	699.95	65mph	Yes	Bridge Rail, vertical mitigates**
Cherokee	146.6	Superelevation Rate	80mph	80mph	7.1%	5.5%	65mph	Yes	3,437.75' on 8% Max Super E Tables
Cherokee	146.6	Stopping Sight Distance (Sag Curve)	80mph	80mph	910'	684'	65mph	No	Exist K = 165 < 231 (80mph)
Cherokee	147.3	Stopping Sight Distance (Crest Curve)	80mph	80mph	910'	891'	75mph	Yes	Exist K = 364 < 384 (80mph)
Cherokee	147.4	Superelevation Rate	80mph	80mph	4.5%	3.6%	70mph	Yes	5,729.578' on 8% Max Super E Tables
Cherokee	148.3	Median Width			50'	40'		No	No Median Barrier
Cherokee	149.2	Superelevation Rate	80mph	80mph	2.0%	-2.0%	75mph	Yes	16,370.223' on 8% Max Super E Tables
Cherokee	149.6	Superelevation Rate	80mph	80mph	3.4%	2.8%	70mph	Yes	7,813.061' on 8% Max Super E Tables
Cherokee	150.9	Superelevation Rate	80mph	80mph	3.4%	2.8%	70mph	Yes	7,639.44' on 8% Max Super E Tables

** Asumptions based on observations made in the field during site visit

Table C- 9: Cherokee Identified Deficiencies

Segment	Mile Marker	Criteria Element	Target Design Speed	Existing Posted Speed	Target Design Value	Existing Condition Value	Speed Met by Existing Condition	Controlling Criteria	Comments
Cherokee	151.2	Stopping Sight Distance (Sag Curve)	80mph	80mph	910'	806'	70mph	No	Exist K = 198 < 231 (80mph)
Cherokee	152.0	Superelevation Rate	80mph	80mph	4.5%	3.6%	70mph	Yes	5,729.578' on 8% Max Super E Tables
Cherokee	153.0	Superelevation Rate	80mph	80mph	4.5%	3.6%	70mph	Yes	5,729.578' on 8% Max Super E Tables
Cherokee	153.9	Median Width			50'	40'		No	No Median Barrier
Cherokee	154.1	Superelevation Rate	75mph	75mph	7.4%	6.5%	70mph	Yes	2,864.789' on 8% Max Super E Tables
Cherokee	154.7	Superelevation Rate	75mph	75mph	2.2%	2.0%	70mph	Yes	11,459.156' on 8% Max Super E Tables
Cherokee	155.2	Horizontal Curve Radius (Minimum)	75mph	75mph	2,210'	1909.858'	70mph	Yes	70mph with 8.0% Super E
Cherokee	155.6	Superelevation Rate	75mph	75mph	7.4%	6.5%	70mph	Yes	2,864.789' on 8% Max Super E Tables
Cherokee	156.0	Superelevation Rate	75mph	75mph	3.1%	2.8%	70mph	Yes	7,639.44' on 8% Max Super E Tables
Cherokee	156.4	Stopping Sight Distance (Horizontal)	75mph	75mph	820'	820.92'	75mph	Yes	Requires vegetation be trimmed
Cherokee	156.4	Superelevation Rate	75mph	75mph	6.6%	5.8%	65mph	Yes	2,864.789' on 8% Max Super E Tables
Cherokee	157.5	Superelevation Rate	75mph	75mph	8.0%	7.5%	70mph	Yes	2,291.832' on 8% Max Super E Tables
Cherokee	157.6	Stopping Sight Distance (Horizontal)	75mph	75mph	820'	829.04	75mph	Yes	Requires vegetation be trimmed
Cherokee	157.6	Stopping Sight Distance (Crest Curve)	75mph	75mph	820'	814'	70mph	Yes	Exist K = 307 < 312 (75mph)
Cherokee	157.8	Stopping Sight Distance (Sag Curve)	70mph	55mph	730'	550'	55mph	No	Exist K = 130 < 181 (70mph) WB
Cherokee	157.9	Stopping Sight Distance (Horizontal)	70mph	55mph	730'	578.56'	60mph	Yes	Bridge Rail, vertical mitigates**
Cherokee	157.9	Stopping Sight Distance (Crest Curve)	70mph	55mph	730'	457'	50mph	Yes	Exist K = 97 < 312 (75mph) WB
Cherokee	157.9	Horizontal Curve Radius (Minimum)	70mph	55mph	1,810'	1527.89	65mph	Yes	65mph with 8.0% Super E
Cherokee	158.0	Stopping Sight Distance (Horizontal)	70mph	55mph	730'	208.35'	30mph	Yes	Bridge Rail
Cherokee	158.0	Number of Lanes						No	One Through-Traffic Lane EB
Cherokee	158.0	Shoulder Width (Outside)			10'	6'		Yes	6' Outside (Right) Shoulder
Cherokee	158.0	Horizontal Curve Radius (Minimum)	70mph	55mph	1,810'	477.47	40mph	Yes	40mph with 8.0% Super E
Cherokee	158.0	Number of Lanes						No	One Through-Traffic Lane WB
Cherokee	158.0	Maximum Grade	70mph	55mph	4.0%	4.97%	55mph	Yes	Rural Rolling
Cherokee	158.1	Stopping Sight Distance (Sag Curve)	70mph	55mph	730'	300'	35mph	No	Exist K = 62 < 181 (70mph) WB
Cherokee	158.1	Horizontal Curve Radius (Minimum)	70mph	55mph	1,810'	763.94	50mph	Yes	50mph with 8.0% Super E

** Asumptions based on observations made in the field during site visit

Table C- 10: Siloam Springs Identified Deficiencies

Segment	Mile Marker	Criteria Element	Target Design Speed	Existing Posted Speed	Target Design Value	Existing Condition Value	Speed Met by Existing Condition	Exception Required	Comments
Siloam Springs	158.1	Median Width			50'	40'		No	No median barrier, about 1150'
Siloam Springs	158.3	Access Control						Yes	
Siloam Springs	158.5	Access Control						Yes	
Siloam Springs	158.7	Access Control						Yes	
Siloam Springs	158.8	Maximum Grade			4.00%	4.44%		Yes	WB lanes, rural rolling terrain
Siloam Springs	158.8	Access Control						Yes	Driveway (S side)
Siloam Springs	158.9	Horizontal Curve Radius (Minimum)	70mph	65mph	1810'	1432.39'	60mph	Yes	(WB, 7.8% super) Need 1810' at 8% to meet 70mph
Siloam Springs	159.0	Access Control						Yes	Driveway (EB pull-off)
Siloam Springs	159.2	Superelevation Rate	70mph	70mph	6.60%	5.10%	60mph	Yes	2864.79' (EB) on 8% Max Super E Tables
Siloam Springs	159.3	Maximum Grade			4.00%	5.86%		Yes	WB lanes, rural rolling terrain
Siloam Springs	159.3	Maximum Grade			4.00%	5.24%		Yes	EB lanes, rural rolling terrain
Siloam Springs	159.5	Access Control						Yes	
Siloam Springs	159.5	Superelevation Rate	70mph	70mph	6.60%	5.10%	60mph	Yes	2864.79' (WB) on 8% Max Super E Tables
Siloam Springs	159.5	Access Control						Yes	Driveway (WB pull-off)
Siloam Springs	159.7	Stopping Sight Distance (Crest Curve)	70mph	70mph	730'	717'	65mph	Yes	WB lanes, K=238 < 247 (70mph)
Siloam Springs	159.7	Stopping Sight Distance (Crest Curve)	70mph	55mph	730'	625'	60mph	Yes	EB lanes, K=181 < 247 (70mph)
Siloam Springs	159.8	Access Control						Yes	
Siloam Springs	160.0	Superelevation Rate	70mph	70mph	2.00%	1.04%	65mph	Yes	10,742.96' on 8% Max Super E Tables
Siloam Springs	160.0	Stopping Sight Distance (Sag Curve)	70mph	70mph	730'	673'	65mph	No	WB lanes, K=164 < 181 (70mph)
Siloam Springs	160.0	Stopping Sight Distance (Sag Curve)	70mph	70mph	730'	576'	60mph	No	EB lanes, K=137 < 181 (70mph)
Siloam Springs	160.1	Access Control						Yes	
Siloam Springs	160.4	Access Control						Yes	Driveway (S side)
Siloam Springs	160.5	Access Control						Yes	
Siloam Springs	160.7	Access Control						Yes	Driveway (N side)
Siloam Springs	160.7	Access Control						Yes	Driveway (S side)
Siloam Springs	160.9	Access Control						Yes	
Siloam Springs	161.1	Access Control						Yes	
Siloam Springs	161.5	Access Control						Yes	
Siloam Springs	161.6	Access Control						Yes	
Siloam Springs	161.8	Access Control						Yes	Driveway (S side)
Siloam Springs	161.9	Access Control						Yes	Driveway (S side)
Siloam Springs	162.0	Access Control						Yes	
Siloam Springs	162.2	Access Control						Yes	Driveway (S side)
Siloam Springs	162.2	Access Control						Yes	Driveway (S side)
Siloam Springs	162.3	Access Control						Yes	Driveway (N side)
Siloam Springs	162.3	Access Control						Yes	Driveway (N side)
Siloam Springs	162.4	Access Control						Yes	Driveway (N side)

Table C- 11: Siloam Springs Identified Deficiencies

Segment	Mile Marker	Criteria Element	Target Design Speed	Existing Posted Speed	Target Design Value	Existing Condition Value	Speed Met by Existing Condition	Exception Required	Comments
Siloam Springs	162.5	Access Control						Yes	
Siloam Springs	162.5	Access Control						Yes	Driveway (N side)
Siloam Springs	163.0	Access Control						Yes	
Siloam Springs	163.1	Access Control						Yes	Driveway (S side)
Siloam Springs	163.1	Access Control						Yes	Driveway (S side)
Siloam Springs	163.2	Access Control						Yes	
Siloam Springs	163.5	Access Control						Yes	
Siloam Springs	163.8	Access Control						Yes	
Siloam Springs	163.9	Access Control						Yes	Driveway (S side)
Siloam Springs	163.9	Access Control						Yes	
Siloam Springs	164.0	Access Control						Yes	Driveway (N side)
Siloam Springs	164.0	Access Control						Yes	
Siloam Springs	164.1	Access Control						Yes	Driveway (S side)
Siloam Springs	164.1	Access Control						Yes	Driveway (N side)
Siloam Springs	164.2	Access Control						Yes	Driveway (S side)
Siloam Springs	164.3	Access Control						Yes	
Siloam Springs	164.4	Access Control						Yes	Driveway (N side)
Siloam Springs	164.5	Access Control						Yes	
Siloam Springs	164.8	Access Control						Yes	Driveway (S side)
Siloam Springs	164.9	Access Control						Yes	Driveway (N side)
Siloam Springs	164.9	Access Control						Yes	Driveway (S side)
Siloam Springs	164.9	Access Control						Yes	Driveway (N side)
Siloam Springs	165.0	Access Control						Yes	
Siloam Springs	165.1	Access Control						Yes	
Siloam Springs	165.3	Shoulder Width (Inside)			4'	2'		Yes	EB, about 1800'
Siloam Springs	165.5	Access Control						Yes	
Siloam Springs	165.5	Stopping Sight Distance (Sag Curve)	50mph	45mph	820'	378'	45mph	No	WB lanes, K=83<96 (50mph)
Siloam Springs	165.5	Stopping Sight Distance (Sag Curve)	50mph	45mph	820'	373'	45mph	No	EB lanes, K=82<96 (50mph)
Siloam Springs	165.5	Median Type						No	Raised curbed median, no shoulder
Siloam Springs	165.5	Maximum Grade			4.00%	5.00%		Yes	exceeds 4% for approx. 300'
Siloam Springs	165.6	Superelevation Rate	50mph	45mph	2.80%	<2.8%**	45mph	Yes	4468.64' (WB) on 8% Max Super E Tables
Siloam Springs	165.6	Superelevation Rate	50mph	45mph	2.40%	<2.4%**	45mph	Yes	5255.34' (EB) on 8% Max Super E Tables
Siloam Springs	165.6	Access Control						Yes	
Siloam Springs	165.6	Maximum Grade			4.00%	6.64%		Yes	EB lanes exceed 4% for approx. 550'
Siloam Springs	165.6	Maximum Grade			4.00%	6.44%		Yes	WB lanes exceed 4% for approx. 550'

** Asumptions based on observations made in the field during site visit

Table C- 12: Springdale #1 Identified Deficiencies

Segment	Mile Marker	Criteria Element	Target Design Speed	Existing Posted Speed	Target Design Value	Existing Condition Value	Speed Met by Existing Condition	Exception Required	Comments
Springdale	4.8	Superelevation Rate	70mph	65mph	3.60%	2.9%**	60mph	Yes	5729.58' on 8% Max Super E Tables
Springdale	5.1	Access Control						No	
Springdale	5.6	Access Control						No	
Springdale	5.9	Superelevation Rate	70mph	65mph	5.20%	4.3%**	60mph	Yes	3819.72' on 8% Max Super E Tables
Springdale	6.1	Access Control						No	
Springdale	6.6	Access Control						No	
Springdale	7.0	Access Control						No	
Springdale	7.3	Superelevation Rate	70mph	65mph	2.80%	2.2%**	60mph	Yes	7639.44' on 8% Max Super E Tables
Springdale	7.4	Access Control						No	
Springdale	7.9	Access Control						No	
Springdale	8.6	Access Control						No	
Springdale	8.8	Superelevation Rate	70mph	65mph	3.60%	2.9%**	60mph	Yes	5729.58' on 8% Max Super E Tables
Springdale	9.2	Stopping Sight Distance (Crest Curve)	70mph	65mph	730'	<730' **		Yes	insufficient SSD based on field visit
Springdale	9.1	Access Control						No	
Springdale	9.4	Superelevation Rate	70mph	65mph	5.20%	4.3%**	60mph	Yes	3819.72' on 8% Max Super E Tables
Springdale	9.6	Stopping Sight Distance (Horizontal)	70mph	65mph	730'	609'	60mph	Yes	Bridge Rail - EB, sag vertical mitigates
Springdale	9.6	Stopping Sight Distance (Horizontal)	70mph	65mph	730'	695'	65mph	Yes	Bridge Rail - WB, sag vertical mitigates
Springdale	9.6	Access Control						No	
Springdale	9.9	Stopping Sight Distance (Crest Curve)	70mph	65mph	730'	<730' **		Yes	insufficient SSD based on field visit
Springdale	10.0	Access Control						No	
Springdale	10.4	Access Control						No	
Springdale	10.7	Superelevation Rate	70mph	65mph	5.20%	4.3%**	60mph	Yes	3819.72' on 8% Max Super E Tables
Springdale	11.2	Access Control						No	
Springdale	11.6	Stopping Sight Distance (Horizontal)	70mph	65mph	730'	609'	60mph	Yes	Bridge Rail - EB
Springdale	11.6	Stopping Sight Distance (Horizontal)	70mph	65mph	730'	695'	65mph	Yes	Bridge Rail - WB
Springdale	11.5	Superelevation Rate	70mph	65mph	5.20%	4.3%**	60mph	Yes	3819.72' on 8% Max Super E Tables
Springdale	12.0	Access Control						No	
Springdale	12.0	Stopping Sight Distance (Sag Curve)	70mph	65mph	730'	710'	65mph	Yes	k=175 which is good for 65mph
Springdale	12.1	Maximum Grade			4%	4.85%		Yes	Exceeds rural rolling terrain criteria for approx. 1700'
Springdale	12.6	Access Control						No	
Springdale	12.6	Superelevation Rate	70mph	65mph	5.20%	4.30%	60mph	Yes	3,820' on 8% Max Super E Tables
Springdale	13.1	Access Control						No	
Springdale	13.1	Superelevation Rate	70mph	65mph	5.20%	4.30%	60mph	Yes	3,820' on 8% Max Super E Tables
Springdale	13.5	Horizontal Curve Radius (Minimum)	70mph	65mph	1810'	1433'	60mph	Yes	9.3% super, need 8% at 1810' for 70mph
Springdale	13.6	Access Control						No	

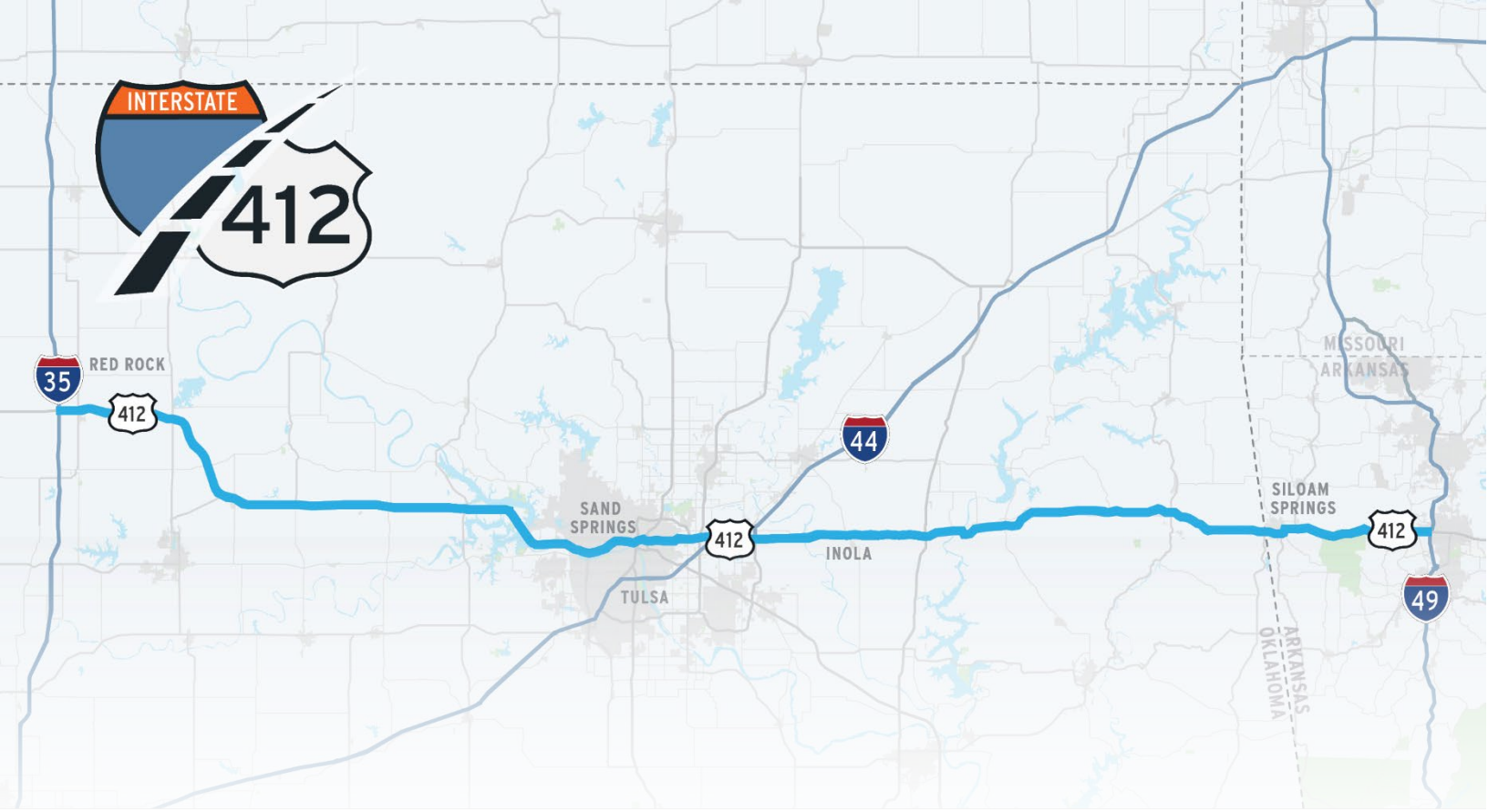
** Asumptions based on observations made in the field during site visit

s

Table C- 13: Springdale #1 Identified Deficiencies

Segment	Mile Marker	Criteria Element	Target Design Speed	Existing Posted Speed	Target Design Value	Existing Condition Value	Speed Met by Existing Condition	Exception Required	Comments
Springdale	13.9	Maximum Grade			4%	4.49%		Yes	Exceeds rural rolling terrain criteria for approx. 1100'
Springdale	14.2	Access Control						No	
Springdale	14.3	Stopping Sight Distance (Sag Curve)	70mph	65mph	730'	658'	65mph	Yes	K=160 which is good for 65mph
Springdale	14.8	Access Control						No	
Springdale	14.8	Maximum Grade			4%	4.61%		Yes	Exceeds rural rolling terrain criteria for approx. 1300'
Springdale	14.8	Superelevation Rate	70mph	65mph	7.20%	6.10%	60mph	Yes	2,547' on 8% Max Super E Tables
Springdale	15.5	Superelevation Rate	70mph	65mph	5.20%	4.30%	60mph	Yes	3,820' on 8% Max Super E Tables
Springdale	15.3	Access Control						No	
Springdale	15.6	Maximum Grade			4%	4.15%		Yes	Exceeds rural rolling terrain criteria for approx. 1500'
Springdale	15.8	Access Control						No	
Springdale	16.2	Access Control						No	
Springdale	16.2	Stopping Sight Distance (Crest Curve)	70mph	65mph	730'	725'	65mph	Yes	Exist K=243 < 247 (70mph)

** Asumptions based on observations made in the field during site visit



OKLAHOMA Transportation

ARDOT ARKANSAS DEPARTMENT OF TRANSPORTATION

OKLAHOMA Turnpike Authority

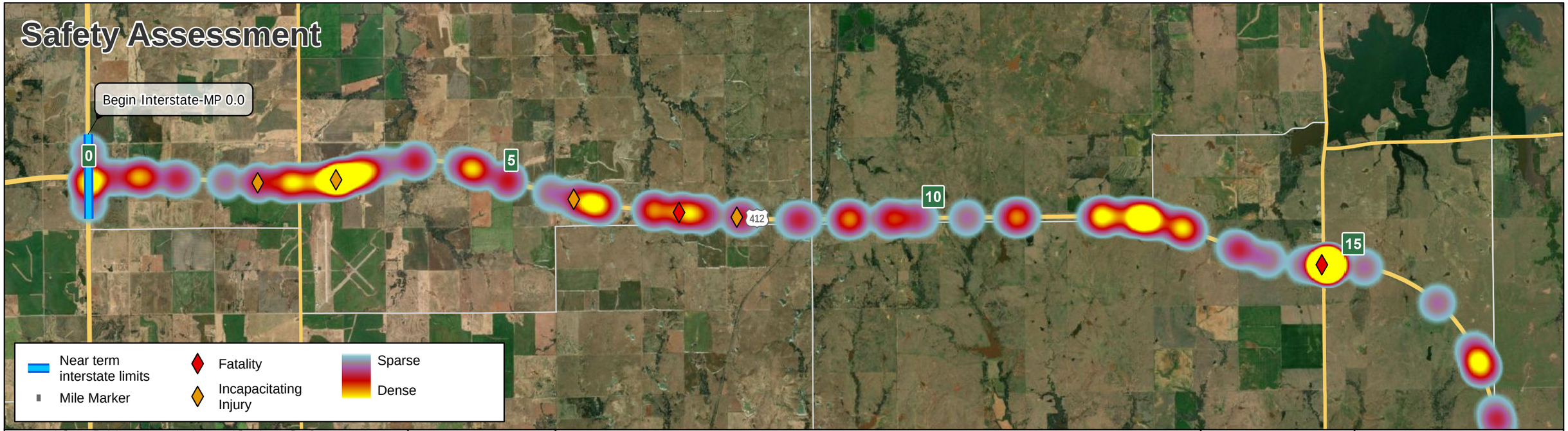
U.S. Department of Transportation Federal Highway Administration

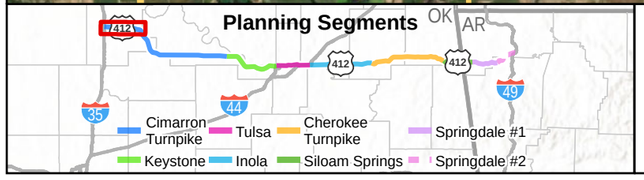
U.S. 412: from I-35 in Noble County, Oklahoma
to I-49 in Benton County, Arkansas

PEL Study

Traffic, Safety and Engineering Constraints Existing Conditions Report

Appendix D – Baseline Conditions Exhibits





U.S. 412 Corridor Study

Baseline Conditions

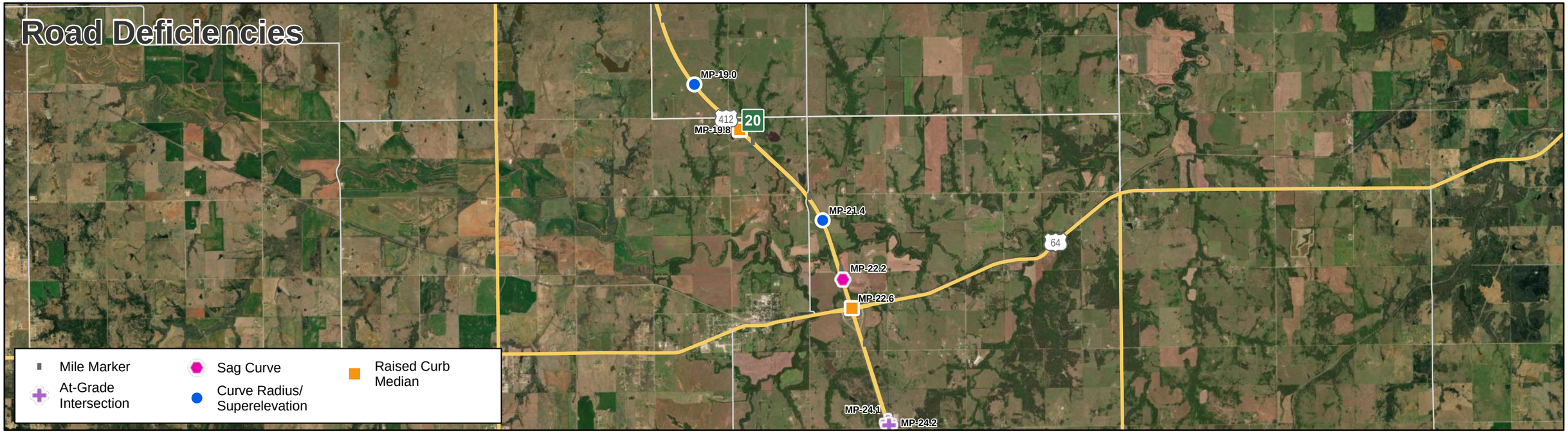
Figure 1

June 2023

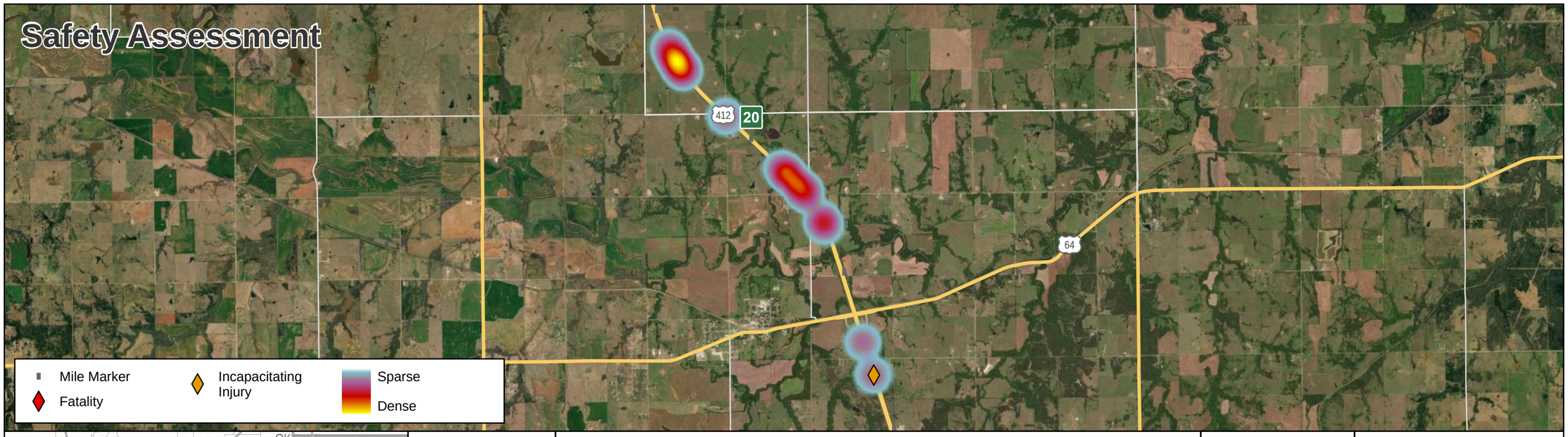
N

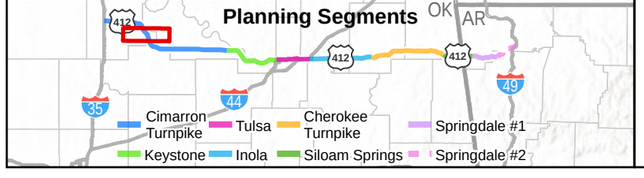
0 0.75 1.5 Mi

Road Deficiencies



Safety Assessment





INTERSTATE 412

U.S. 412 Corridor Study

Baseline Conditions

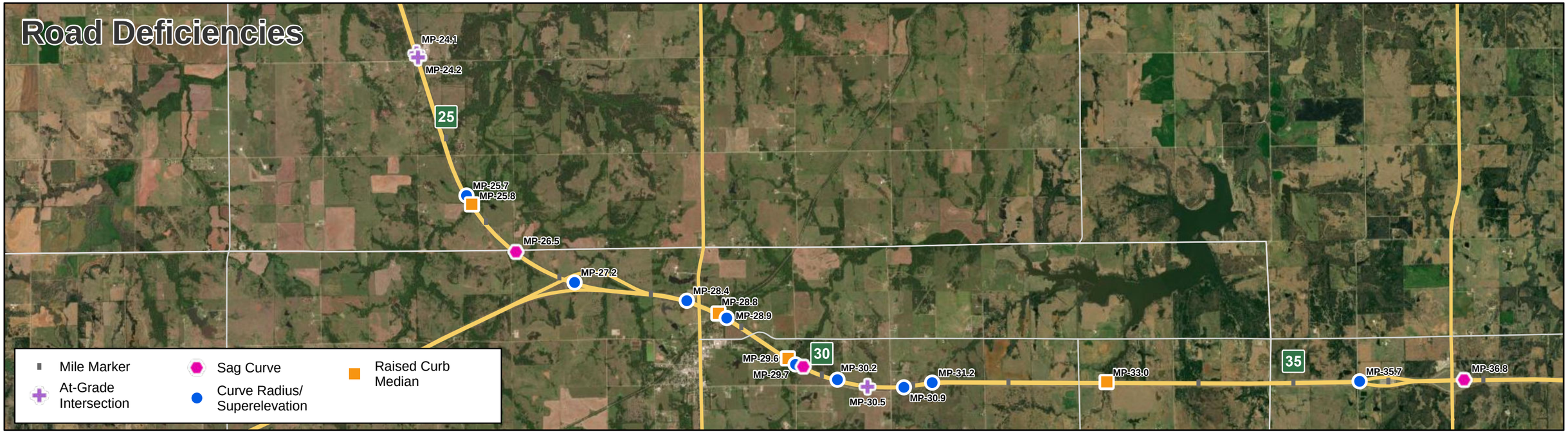
Figure 2

June 2023

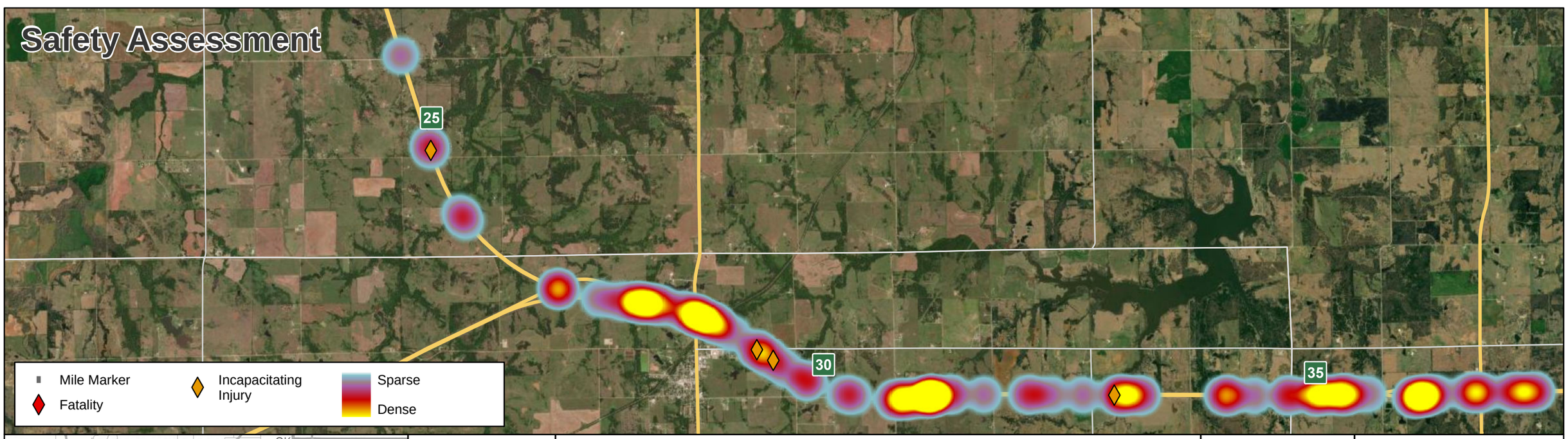
N

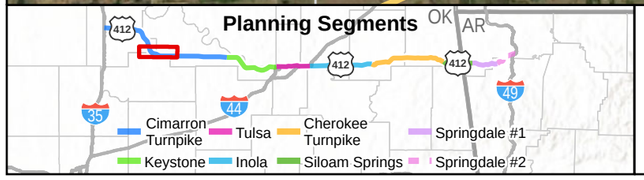
0 0.75 1.5 Mi

Road Deficiencies



Safety Assessment





INTERSTATE 412

U.S. 412 Corridor Study

Baseline Conditions

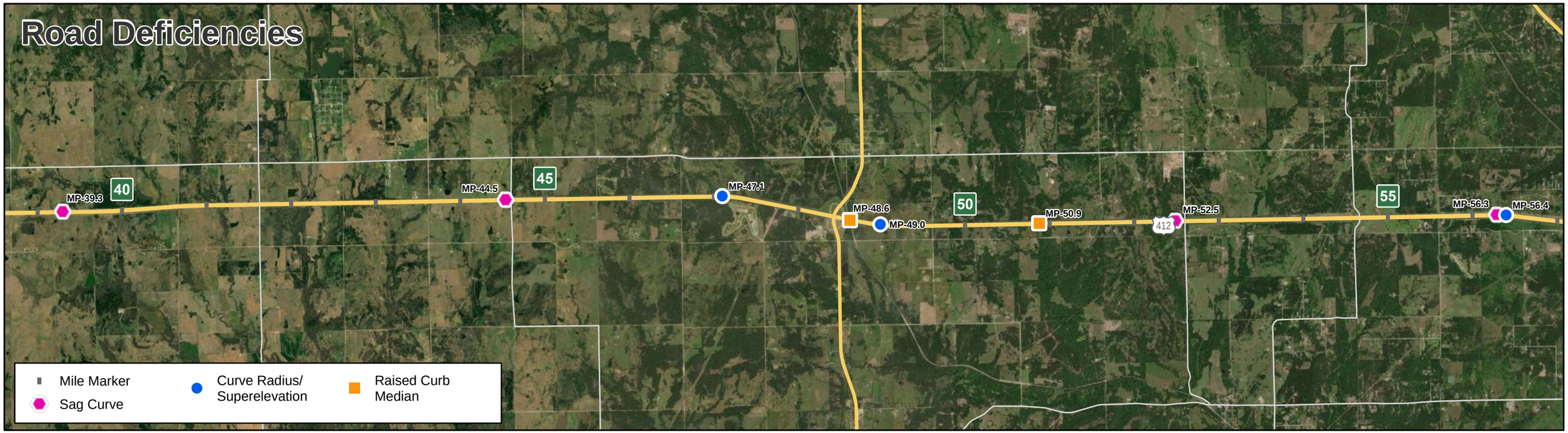
Figure 3

June 2023

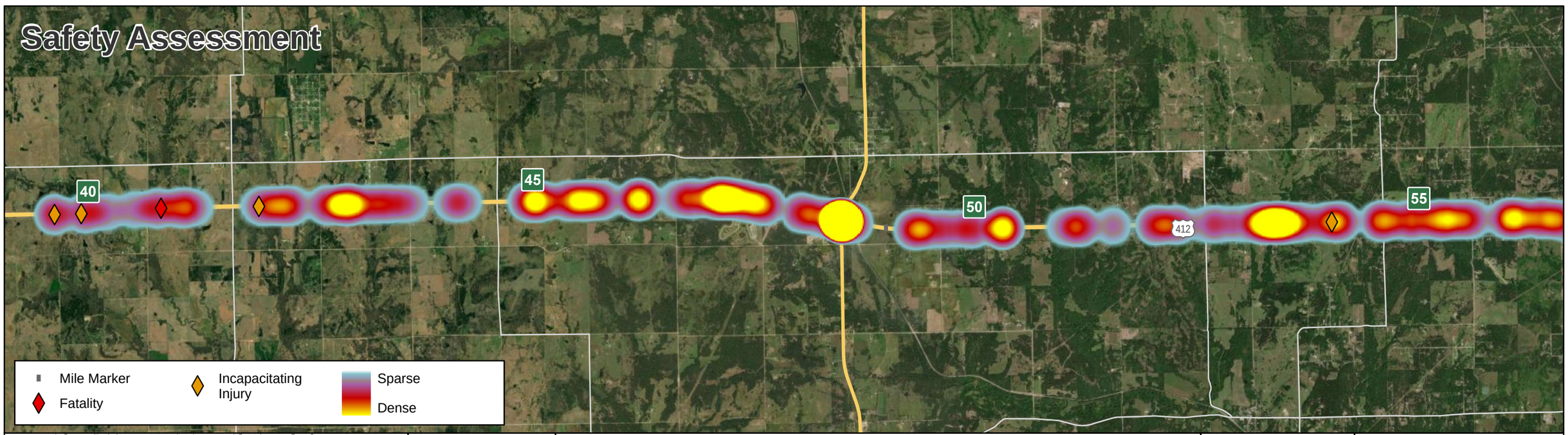
N

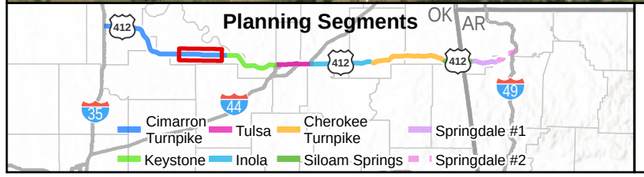
0 0.5 1 Mi

Road Deficiencies



Safety Assessment





U.S. 412 Corridor Study

Baseline Conditions

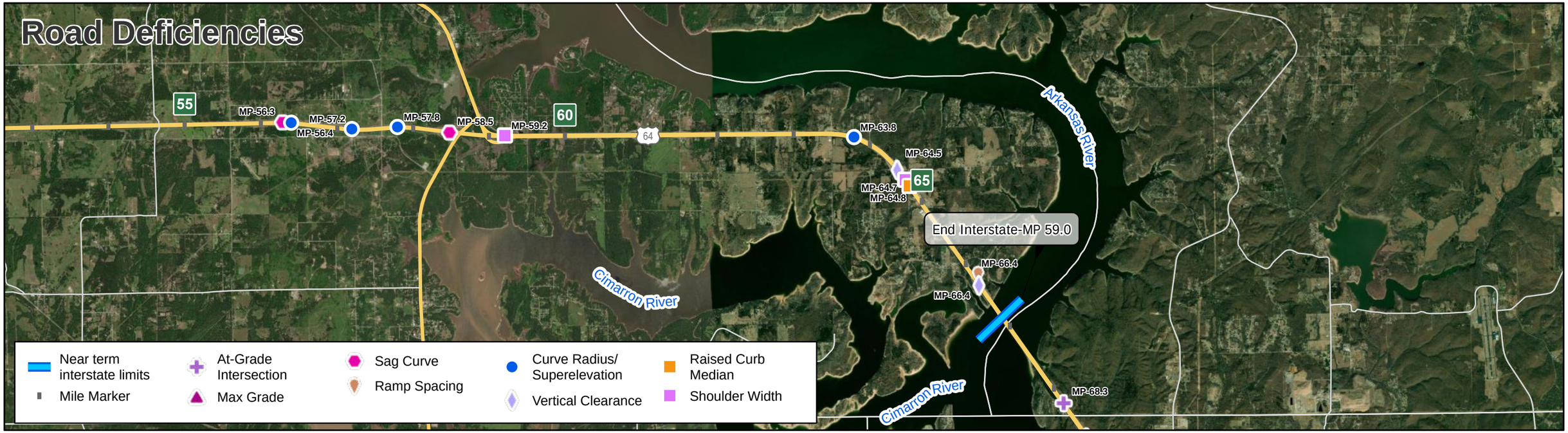
Figure 4

June 2023

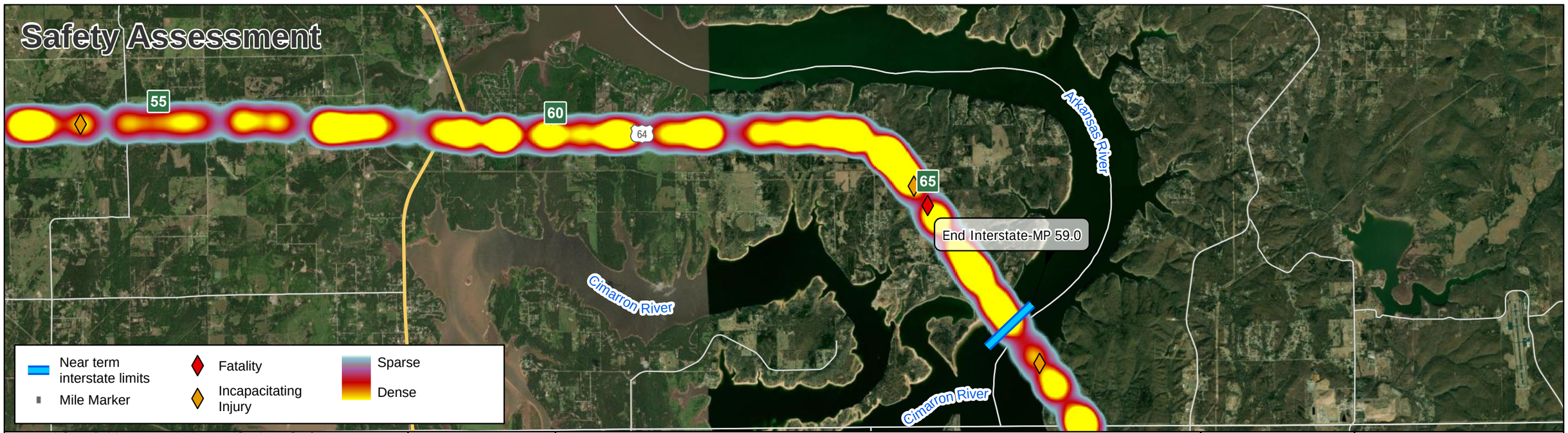
N

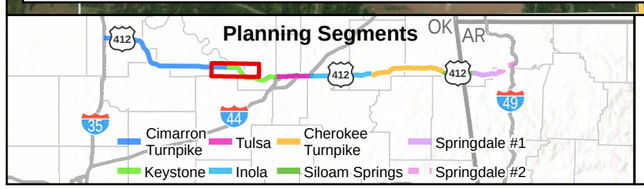
0 0.75 1.5 Mi

Road Deficiencies



Safety Assessment





U.S. 412 Corridor Study

Baseline Conditions

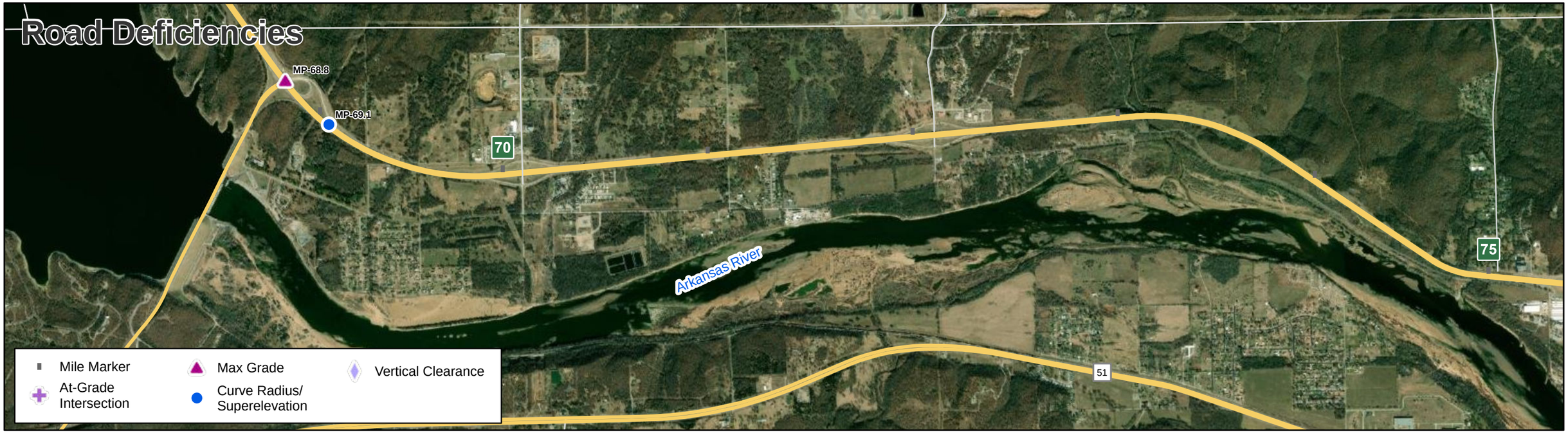
Figure 5

June 2023

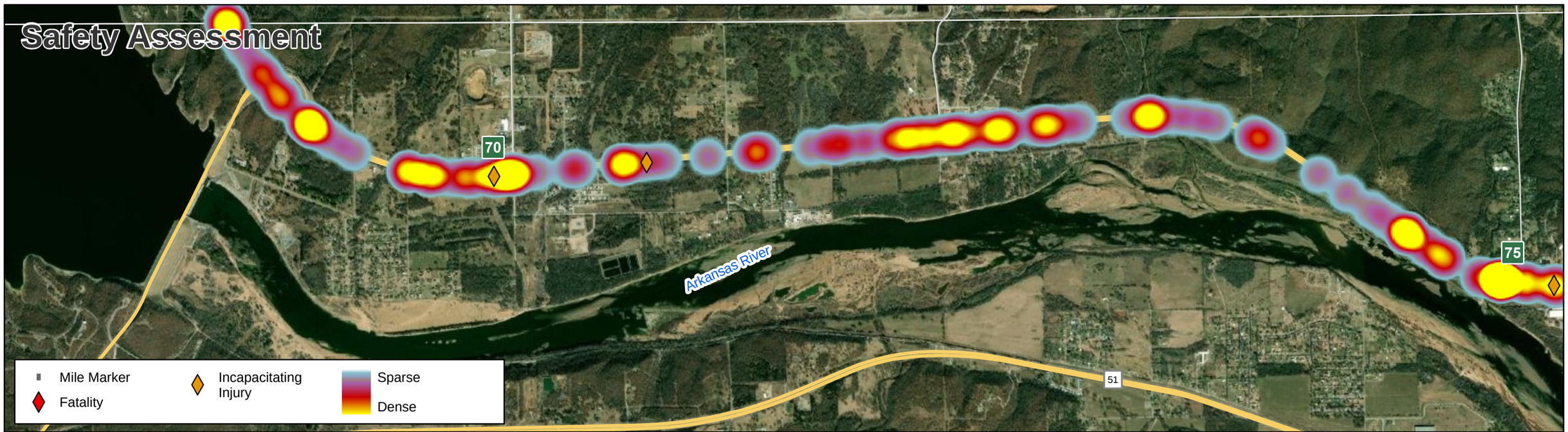
N

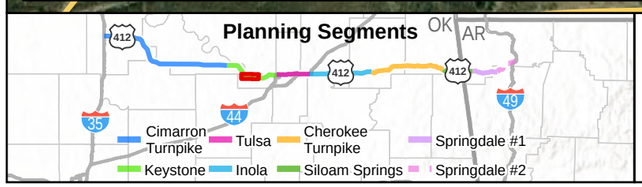
0 0.75 1.5 Mi

Road Deficiencies



Safety Assessment





INTERSTATE 412

U.S. 412 Corridor Study

Baseline Conditions

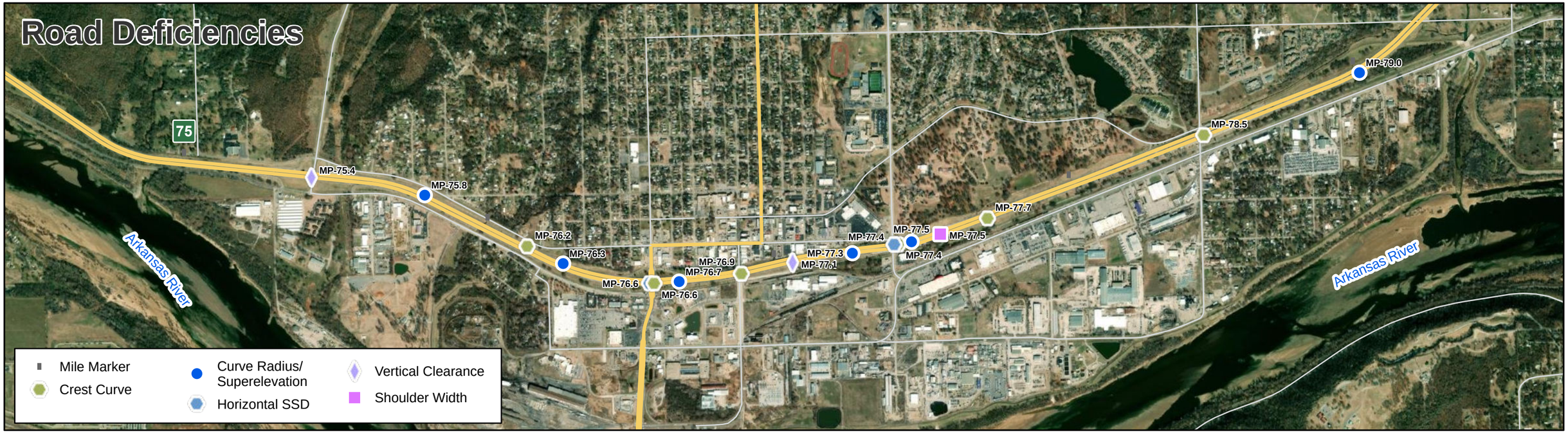
Figure 6

June 2023

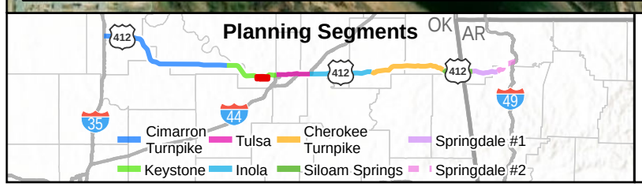
N

0 0.33 0.65 Mi

Road Deficiencies



Safety Assessment



INTERSTATE 412

U.S. 412 Corridor Study

Baseline Conditions

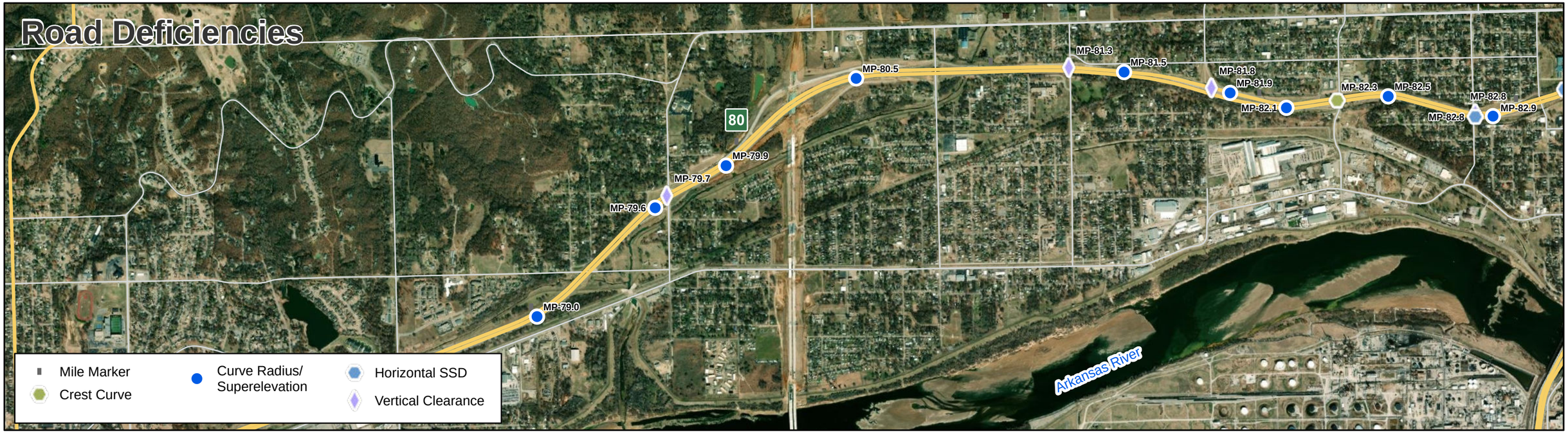
Figure 7

June 2023

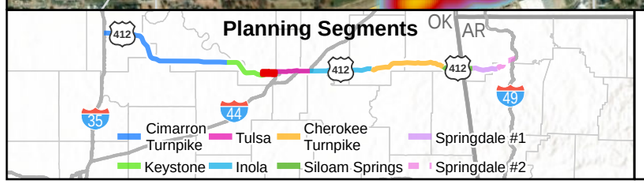
N

0 0.2 0.4 Mi

Road Deficiencies



Safety Assessment



INTERSTATE 412

U.S. 412 Corridor Study

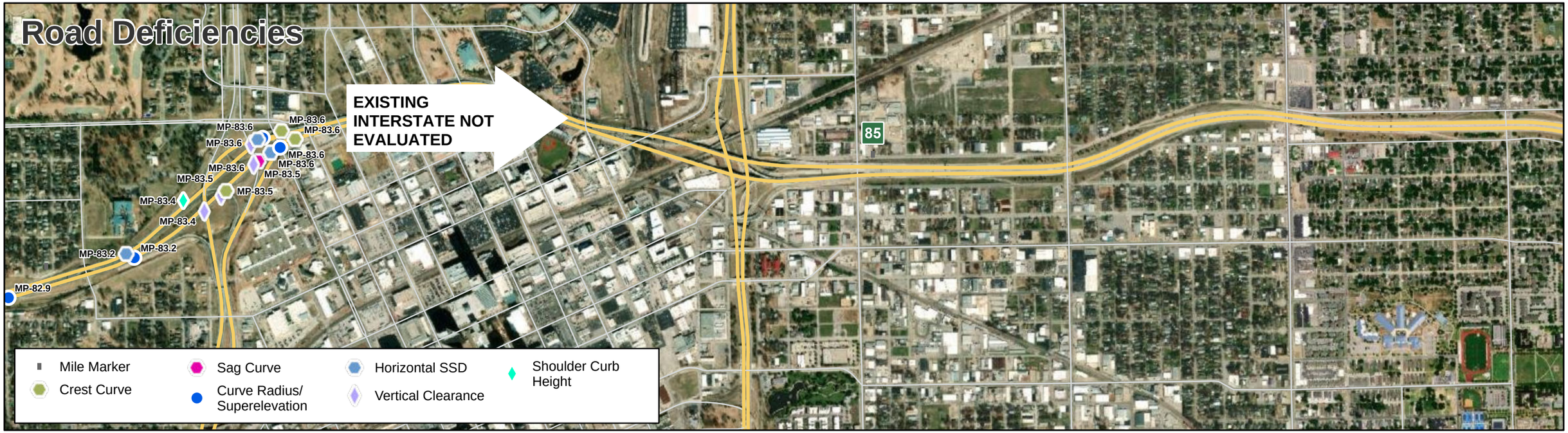
Baseline Conditions

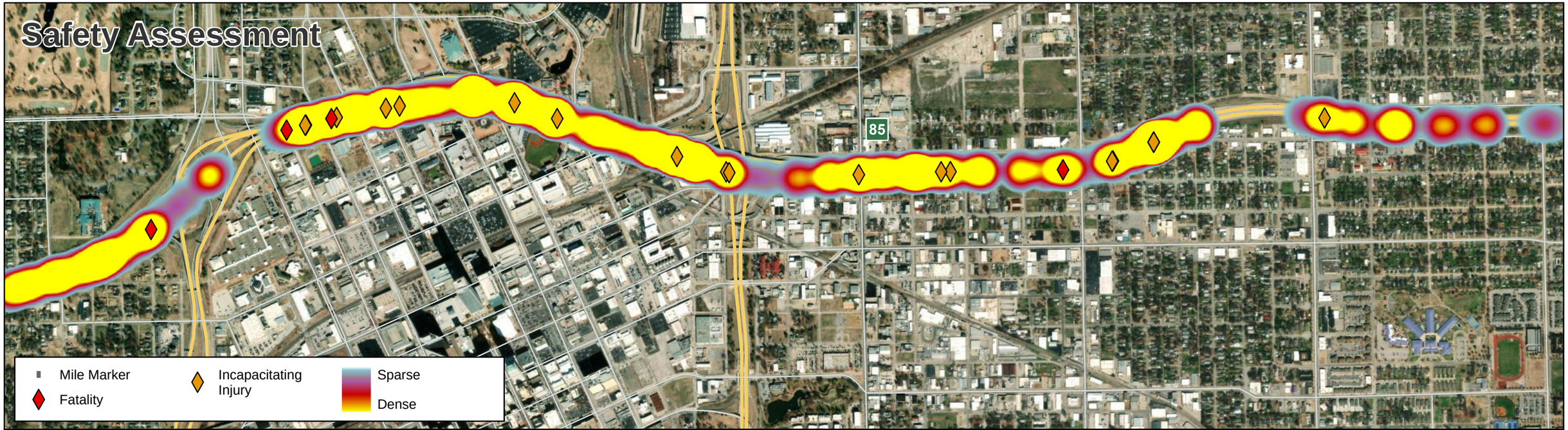
Figure 8

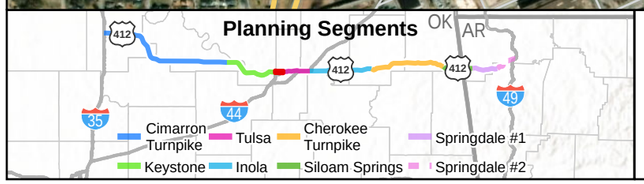
June 2023

N

0 0.25 0.5 Mi







INTERSTATE 412

U.S. 412 Corridor Study

Baseline Conditions

Figure 9

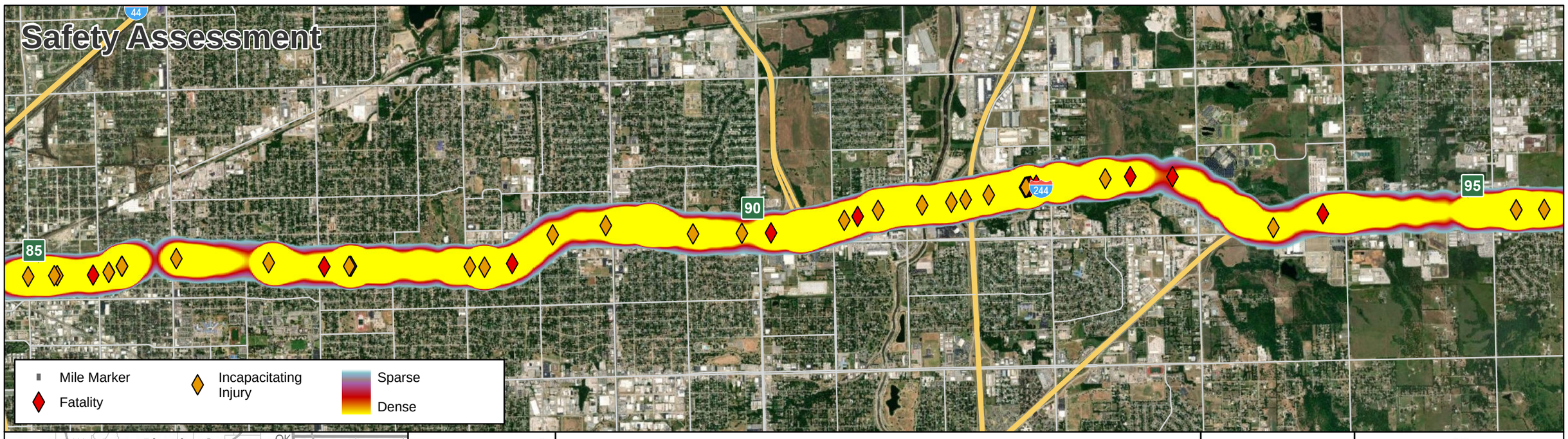
June 2023

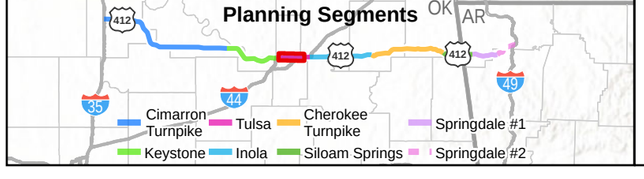
N

0 0.15 0.3 Mi

Road Deficiencies

Safety Assessment





INTERSTATE 412

U.S. 412 Corridor Study

Baseline Conditions

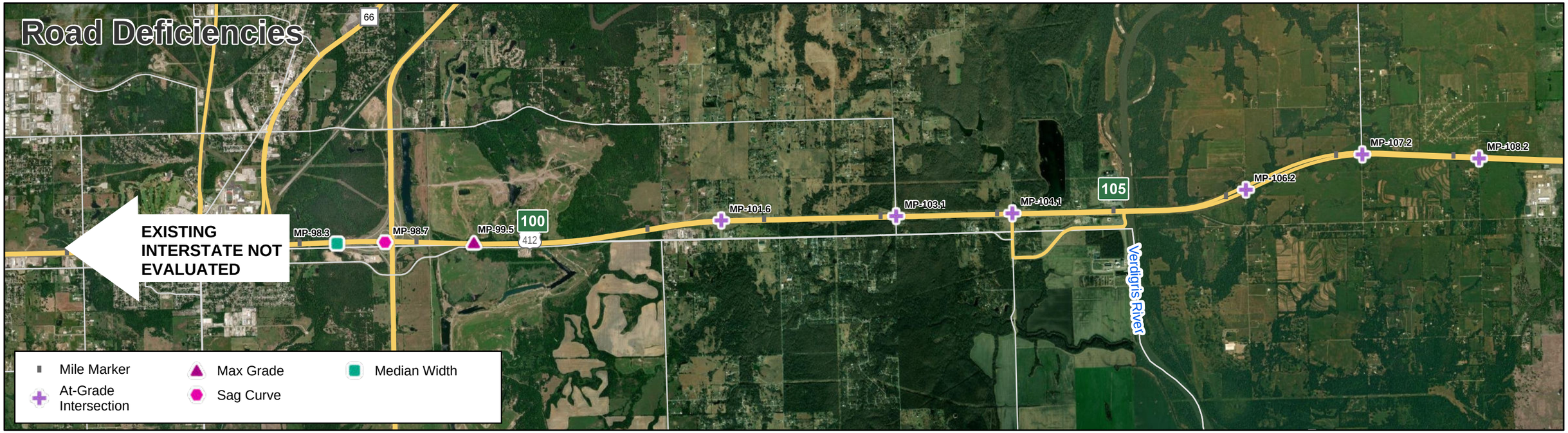
Figure 10

June 2023

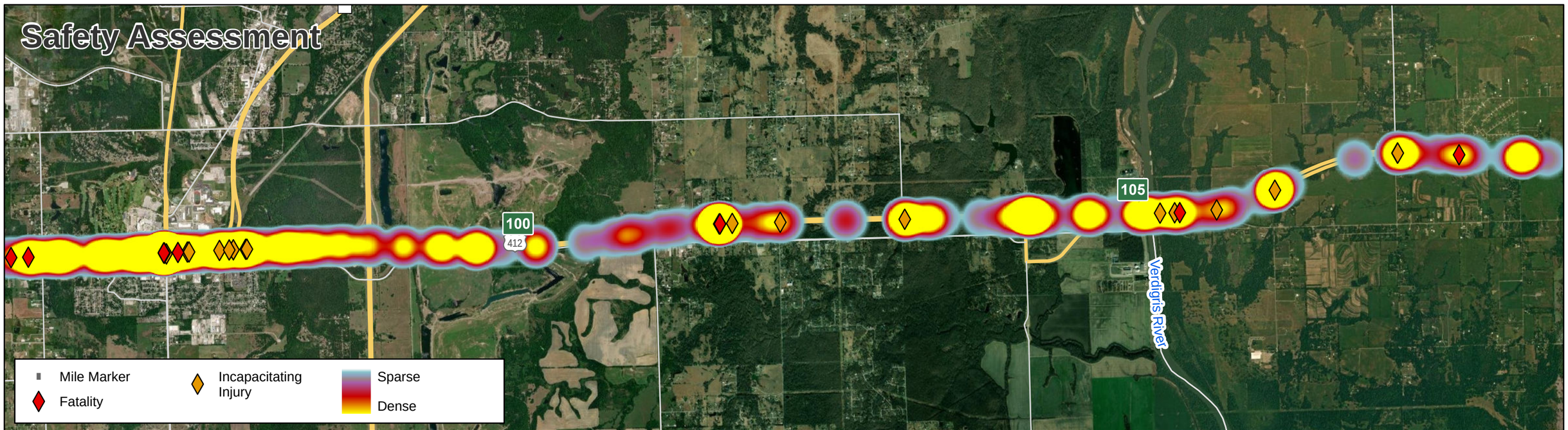
N

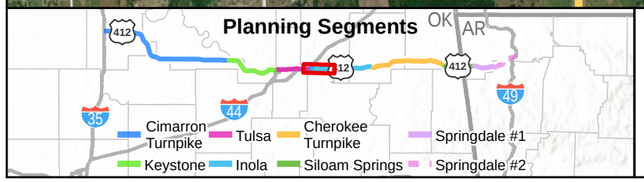
0 0.47 0.95 Mi

Road Deficiencies



Safety Assessment





INTERSTATE 412

U.S. 412 Corridor Study

Baseline Conditions

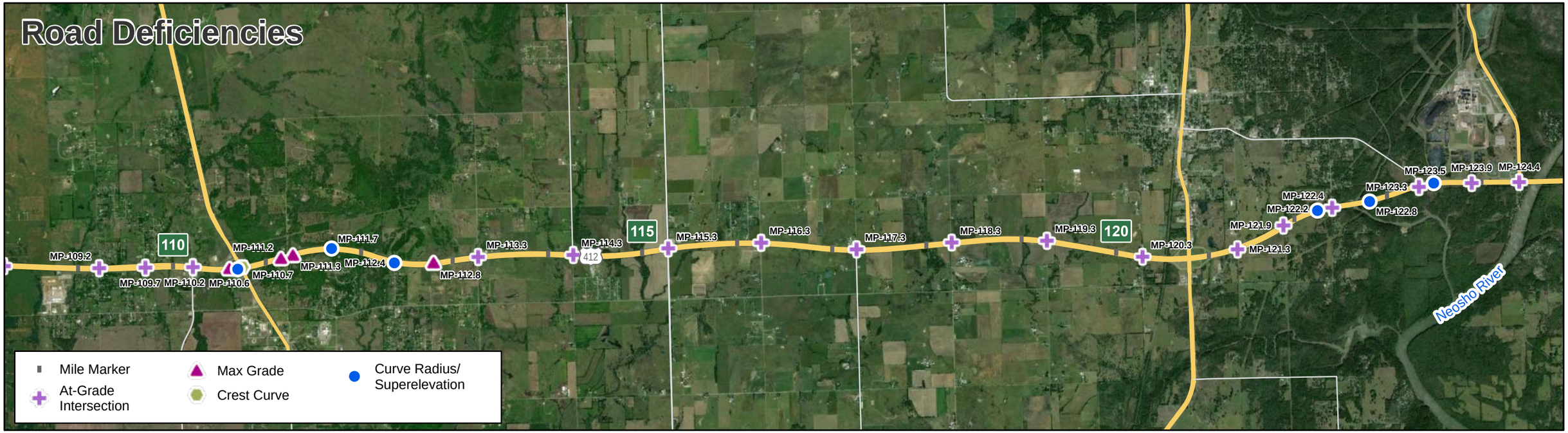
Figure 11

June 2023

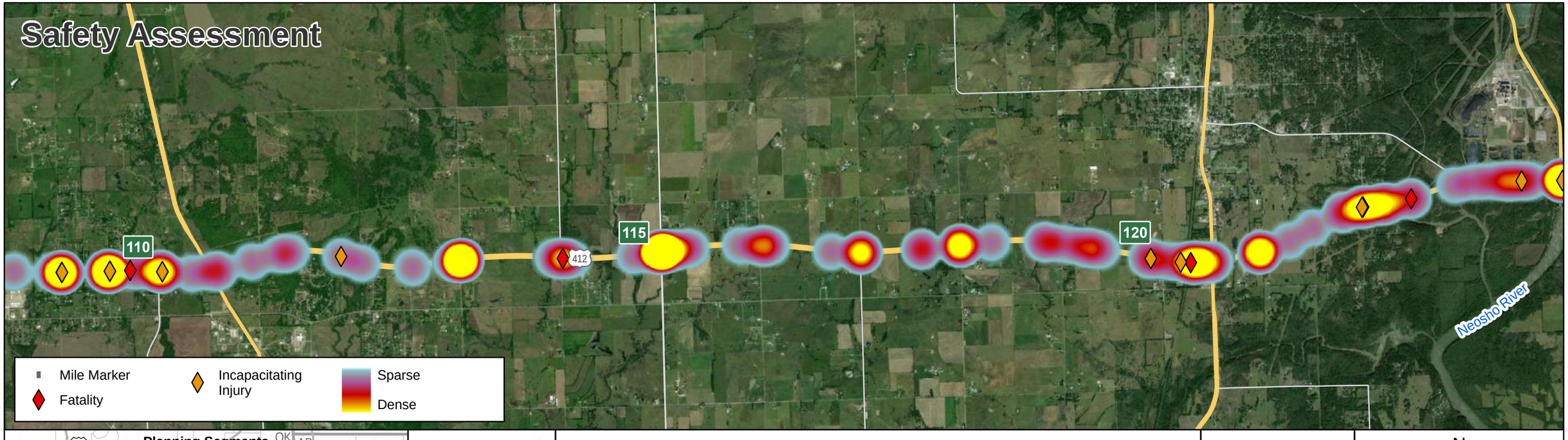
N

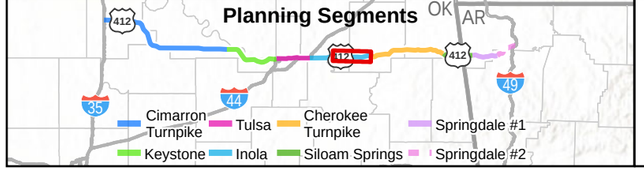
0 0.5 1 Mi

Road Deficiencies



Safety Assessment





INTERSTATE 412

U.S. 412 Corridor Study

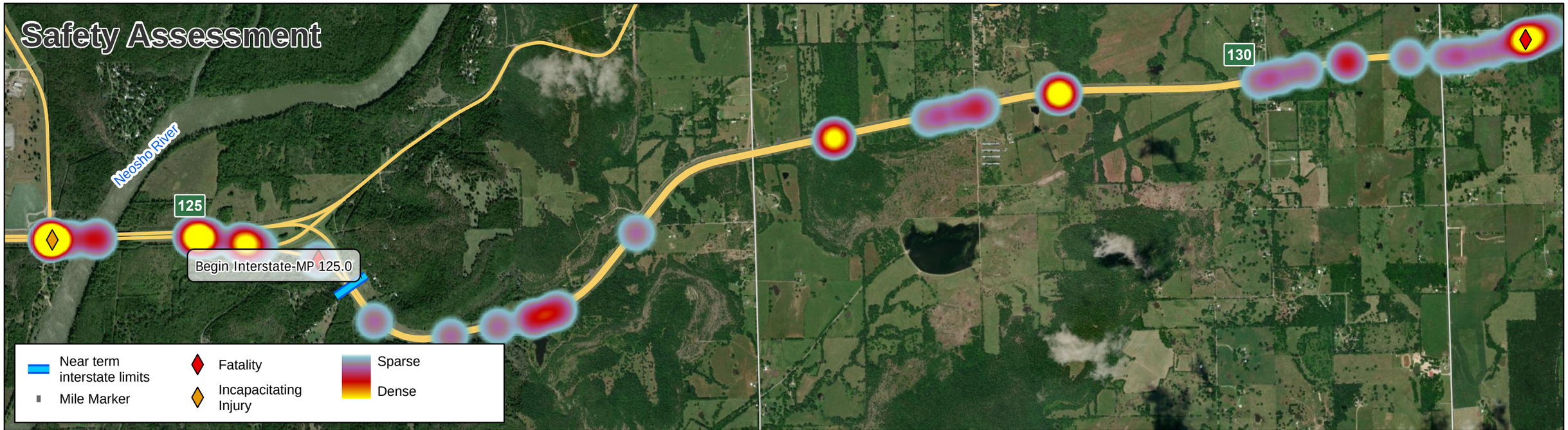
Baseline Conditions

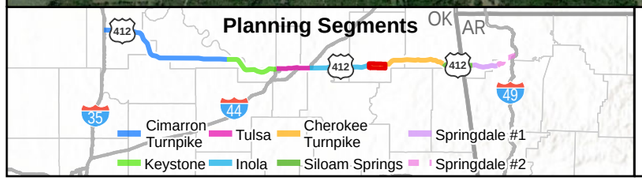
Figure 12

June 2023

N

0 0.5 1 Mi





INTERSTATE 412

U.S. 412 Corridor Study

Baseline Conditions

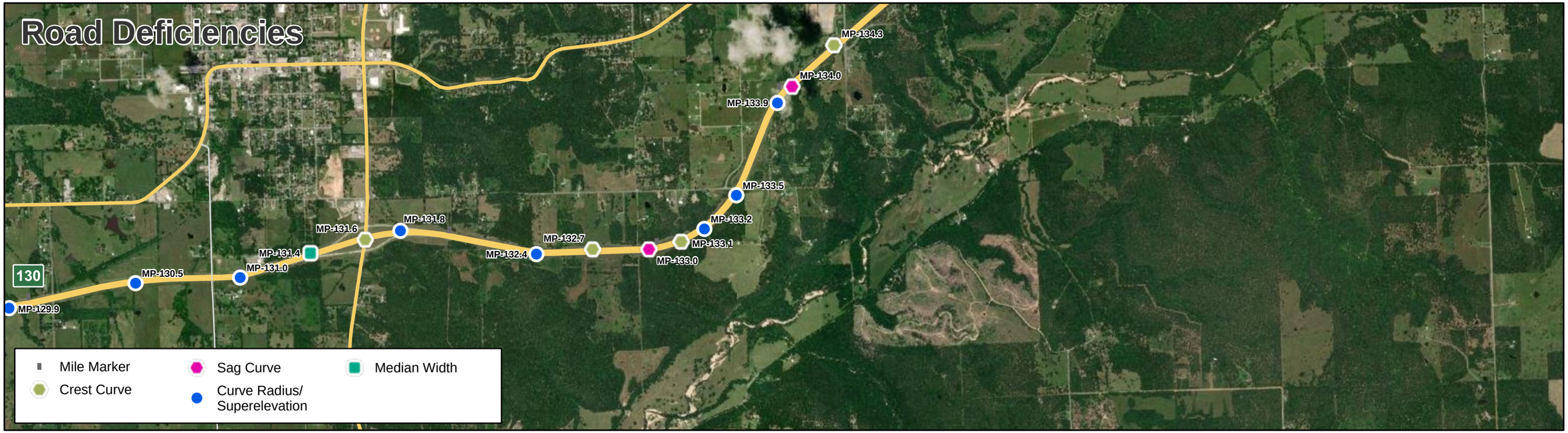
Figure 13

June 2023

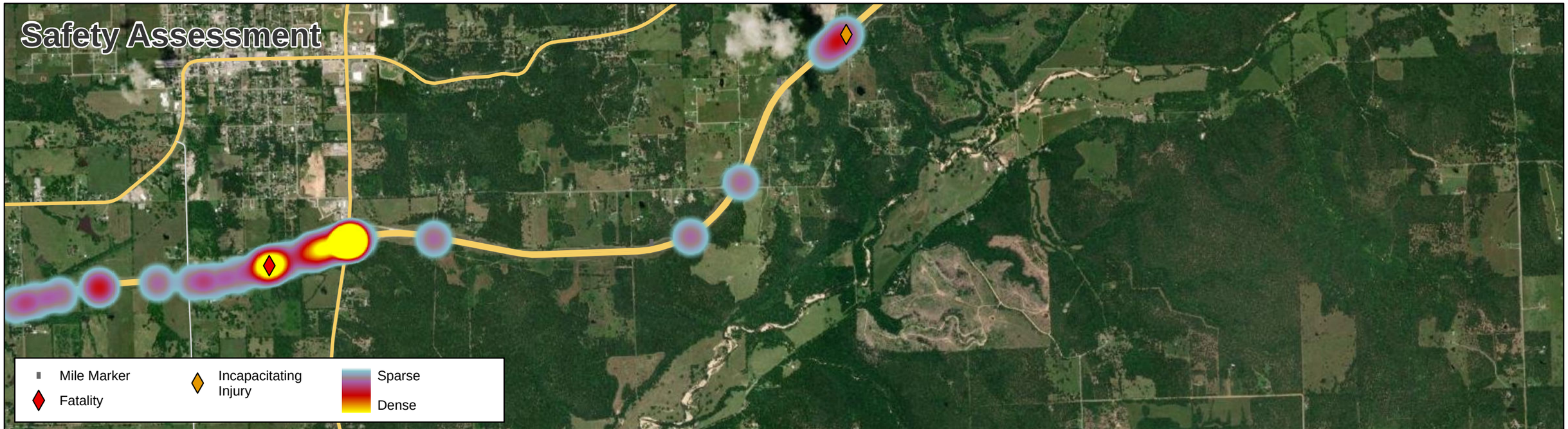
N

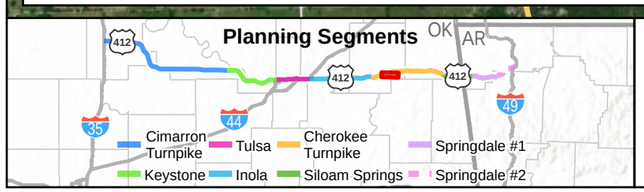
0 0.3 0.6 Mi

Road Deficiencies



Safety Assessment





U.S. 412 Corridor Study

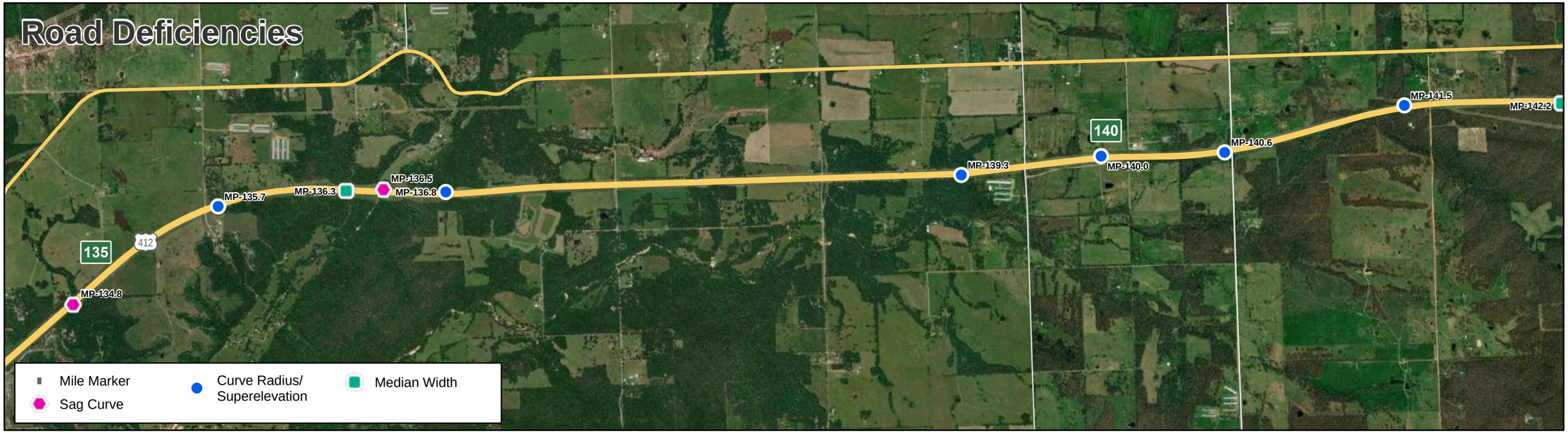
Baseline Conditions

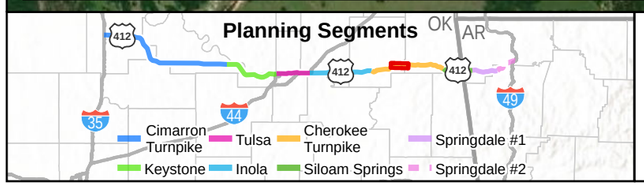
Figure 14

June 2023

N

0 0.3 0.6 Mi





U.S. 412 Corridor Study

Baseline Conditions

Figure 15

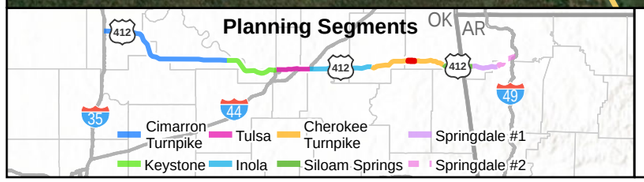
June 2023

N

0 0.33 0.65 Mi

Road Deficiencies

Safety Assessment



U.S. 412 Corridor Study

Baseline Conditions

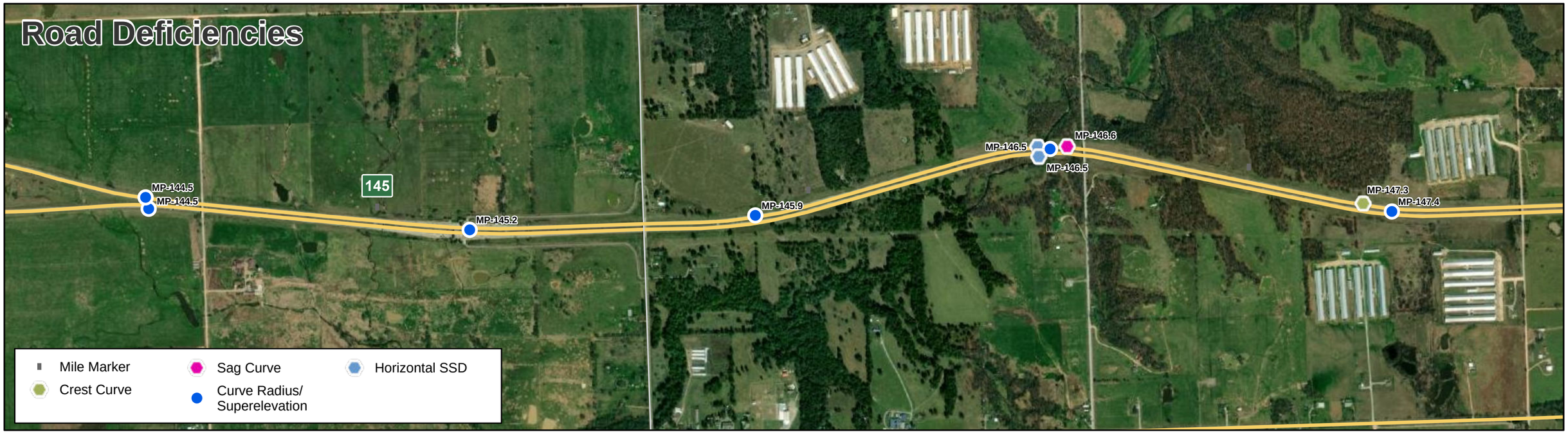
Figure 16

June 2023

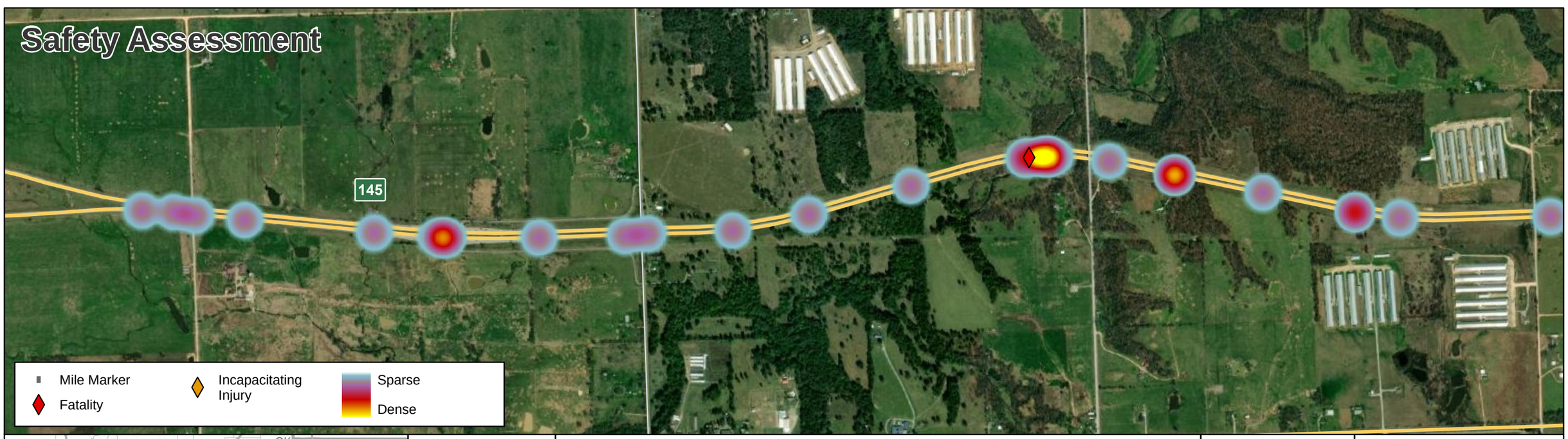
N

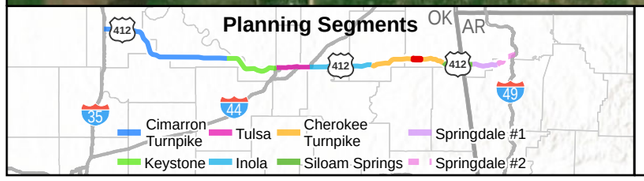
0 0.13 0.25 Mi

Road Deficiencies



Safety Assessment





INTERSTATE 412

U.S. 412 Corridor Study

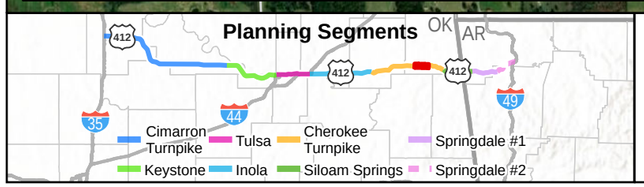
Baseline Conditions

Figure 17

June 2023

N

0 0.15 0.3 Mi



INTERSTATE 412

U.S. 412 Corridor Study

Baseline Conditions

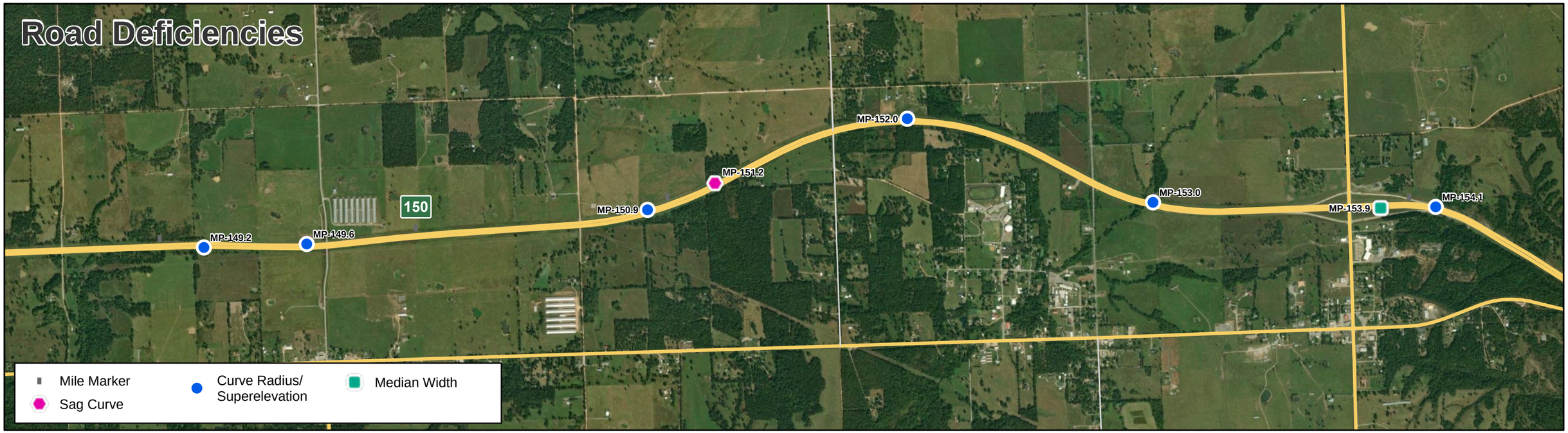
Figure 18

June 2023

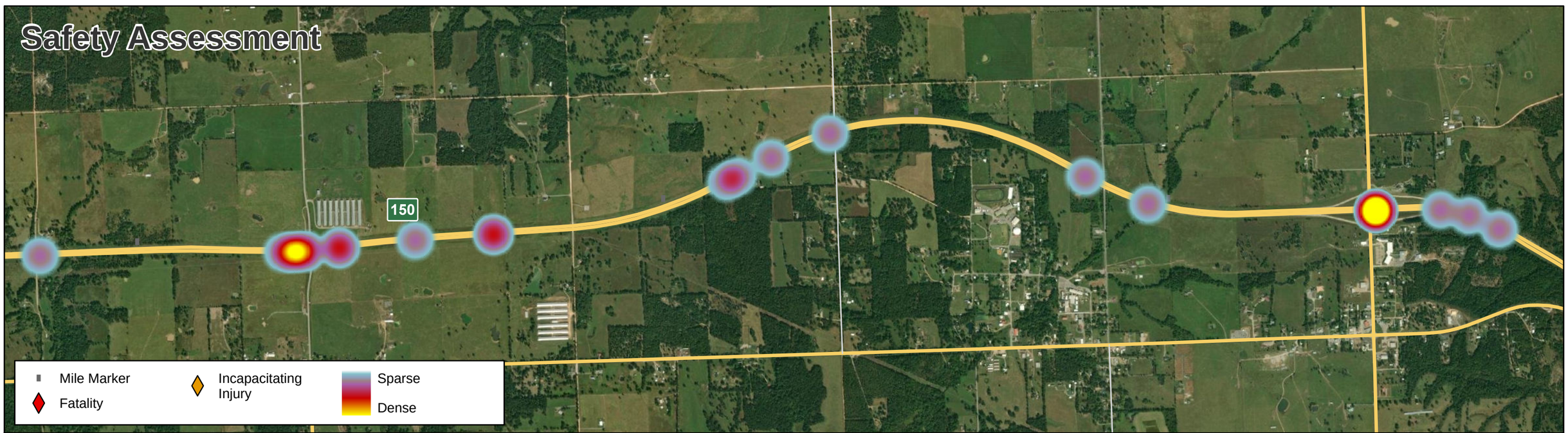
N

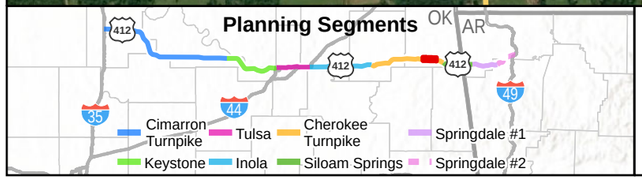
0 0.25 0.5 Mi

Road Deficiencies



Safety Assessment





U.S. 412 Corridor Study

Baseline Conditions

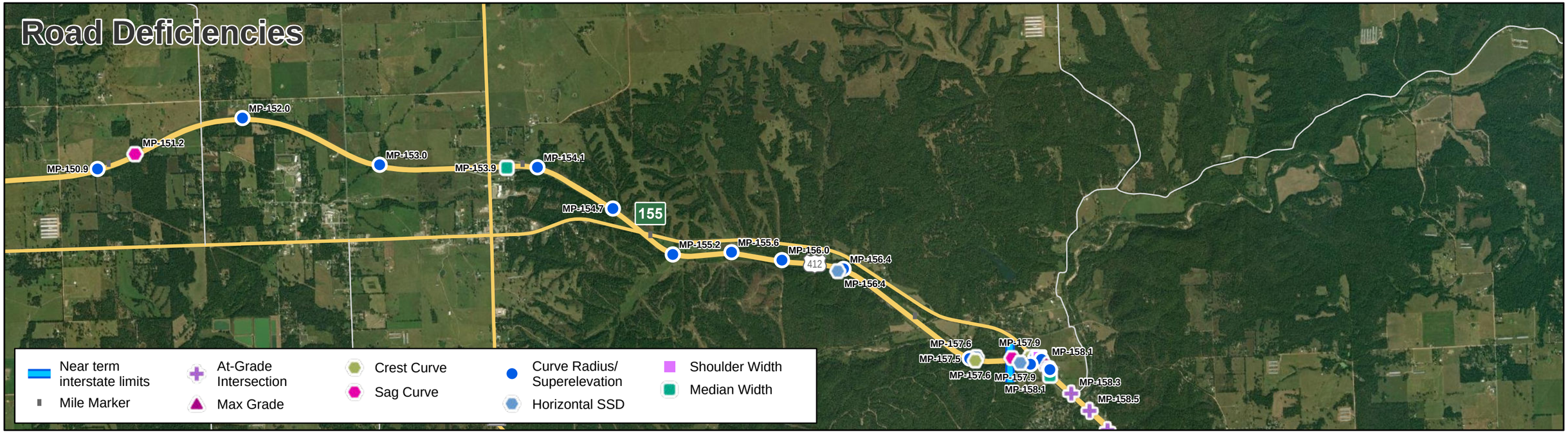
Figure 19

June 2023

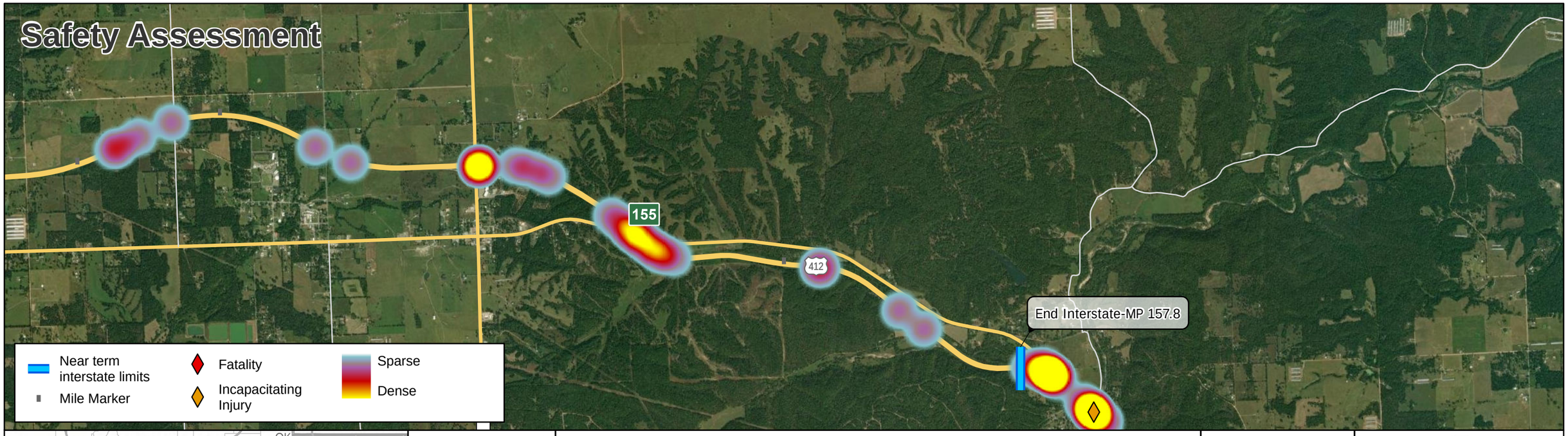
N

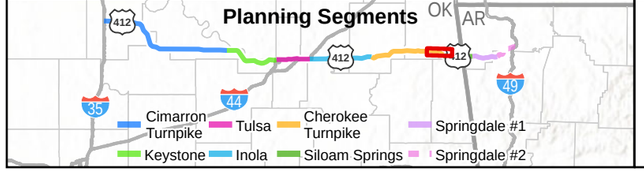
0 0.25 0.5 Mi

Road Deficiencies



Safety Assessment





INTERSTATE 412

U.S. 412 Corridor Study

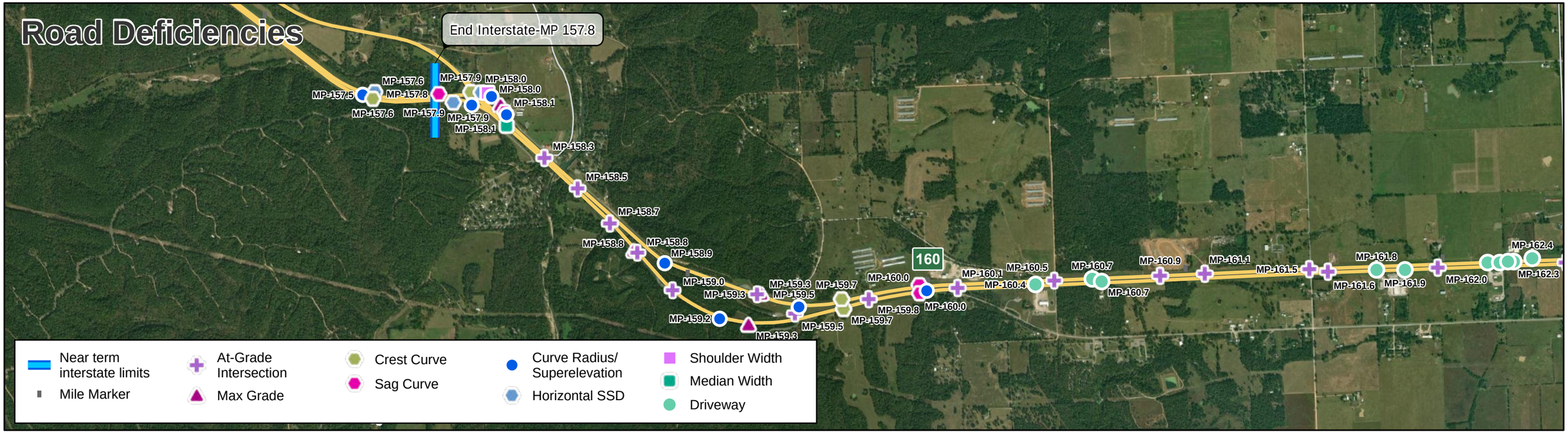
Baseline Conditions

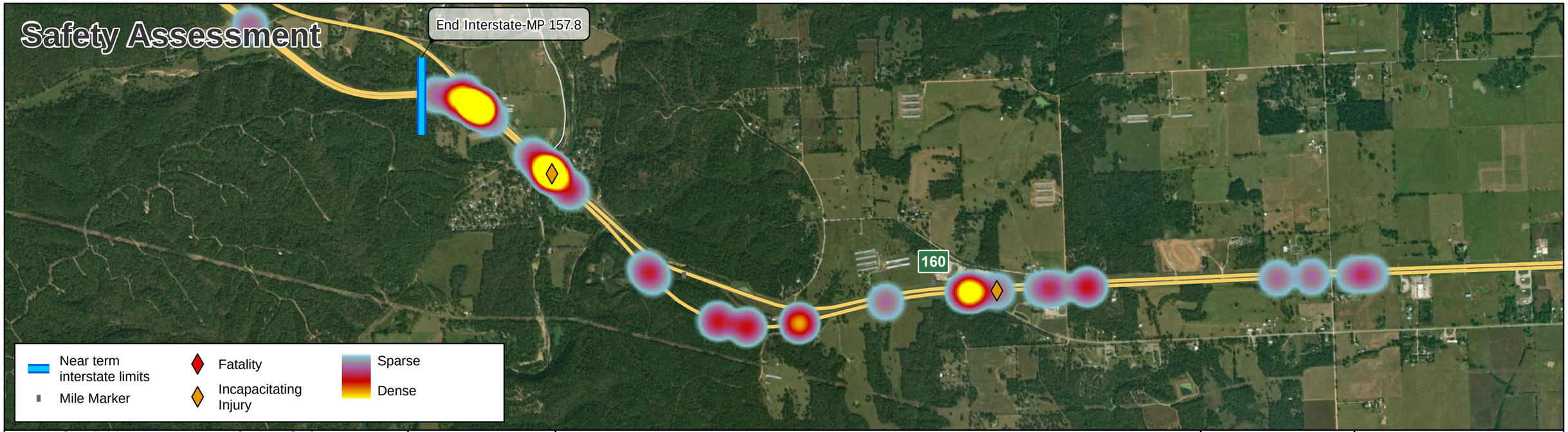
Figure 20

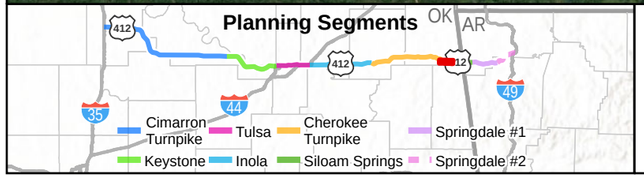
June 2023

N

0 0.45 0.9 Mi







U.S. 412 Corridor Study

Baseline Conditions

Figure 21

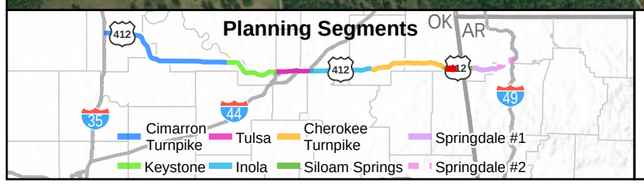
June 2023

N

0 0.25 0.5 Mi

Road Deficiencies

Safety Assessment



U.S. 412 Corridor Study

Baseline Conditions

Figure 22

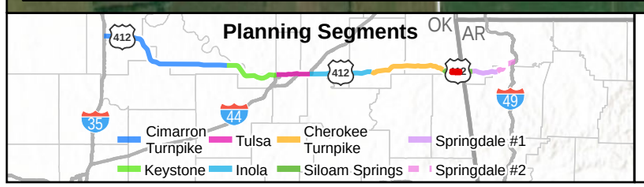
June 2023

N

0 0.13 0.25 Mi

Road Deficiencies

Safety Assessment



U.S. 412 Corridor Study

Baseline Conditions

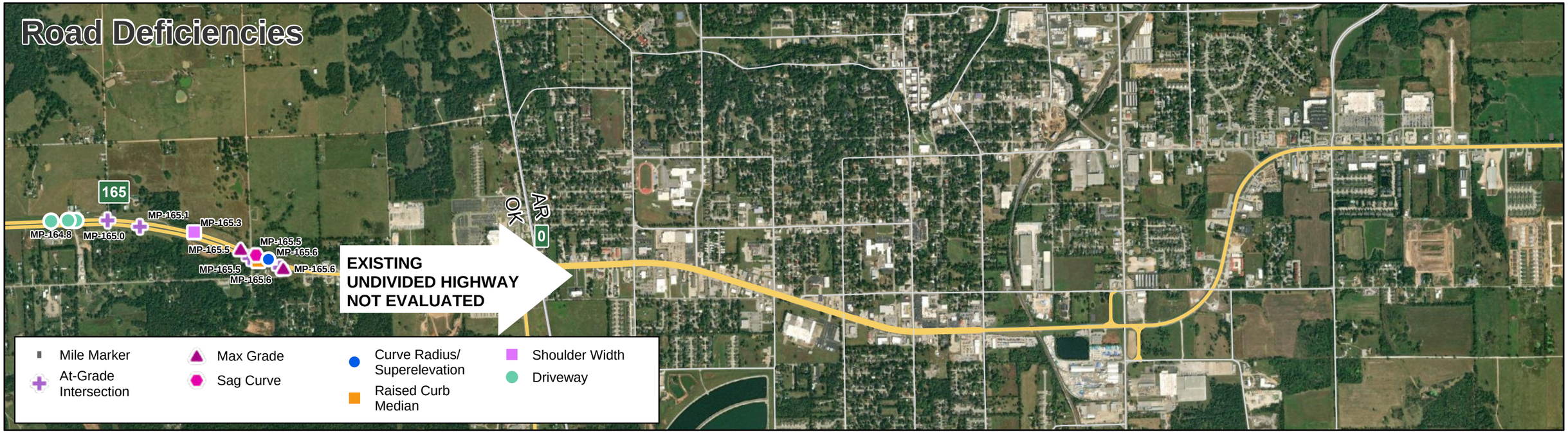
Figure 23

June 2023

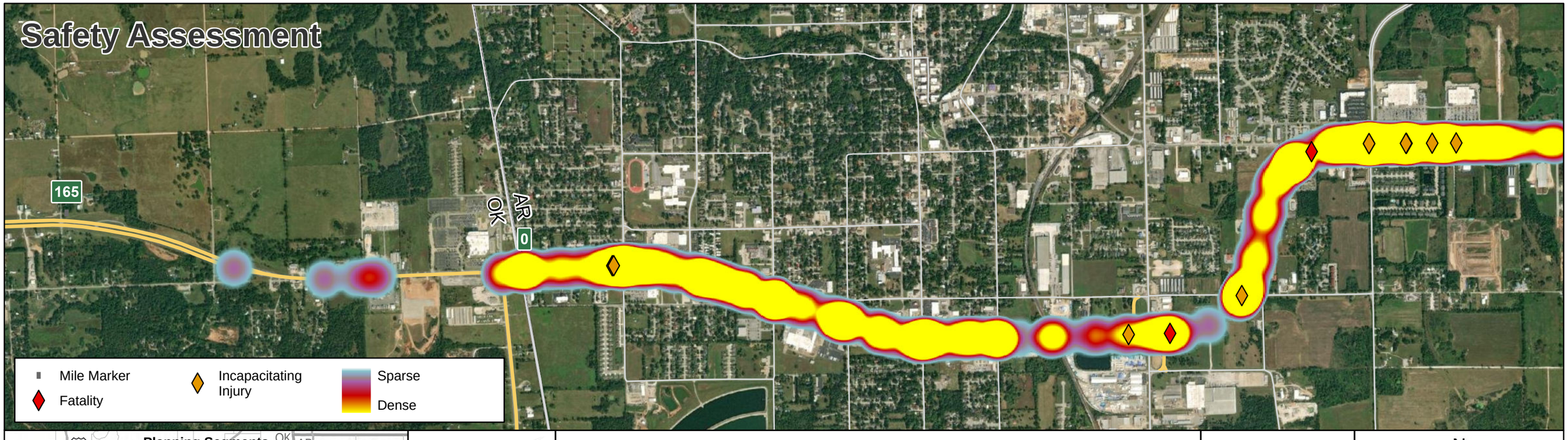
N

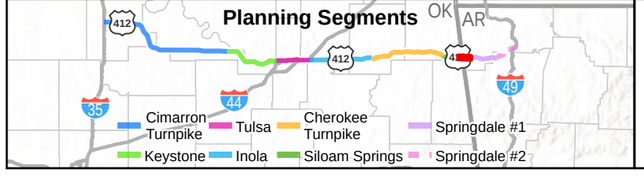
0 0.15 0.3 Mi

Road Deficiencies



Safety Assessment





INTERSTATE 412

U.S. 412 Corridor Study

Baseline Conditions

Figure 24

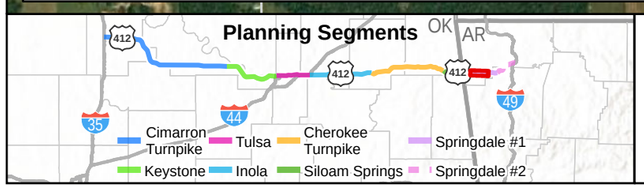
June 2023

N

0 0.23 0.45 Mi

Road Deficiencies

Safety Assessment



INTERSTATE 412

U.S. 412 Corridor Study

Baseline Conditions

Figure 25

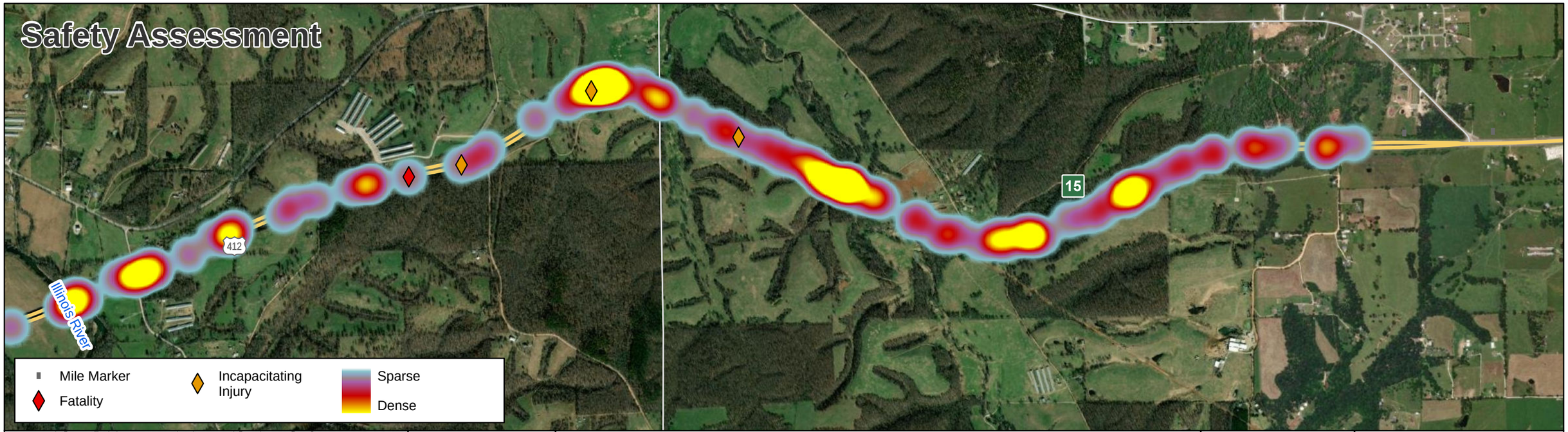
June 2023

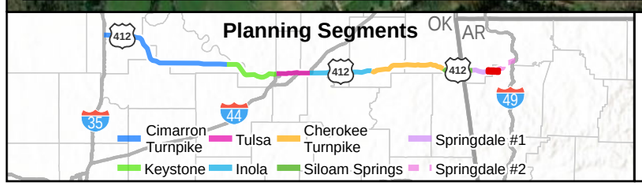
N

0 0.33 0.65 Mi

Road Deficiencies

Safety Assessment





U.S. 412 Corridor Study

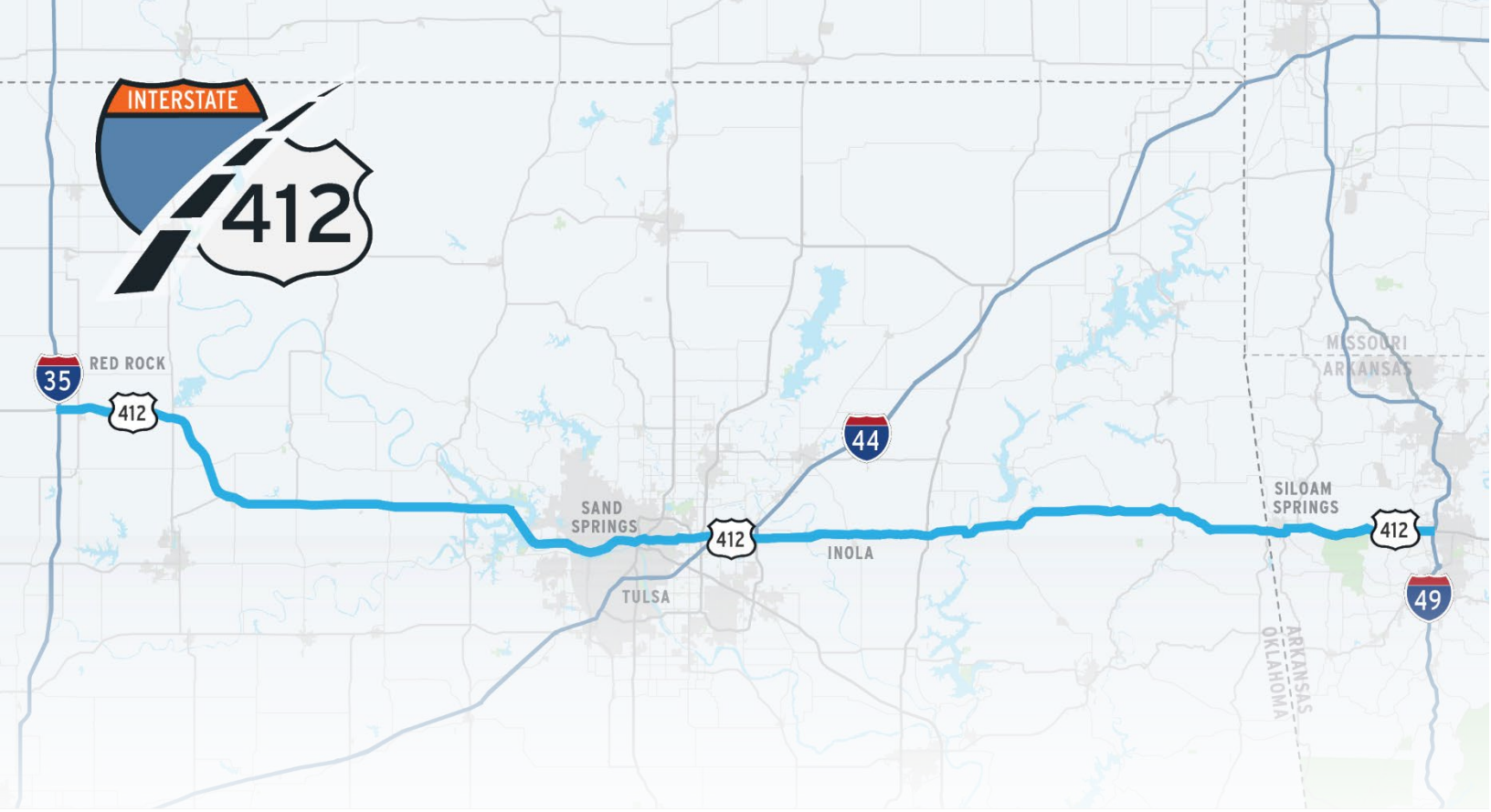
Baseline Conditions

Figure 26

June 2023

N

0 0.2 0.4 Mi



OKLAHOMA Transportation

ARDOT ARKANSAS DEPARTMENT OF TRANSPORTATION

OKLAHOMA Turnpike Authority

U.S. Department of Transportation Federal Highway Administration

U.S. 412: from I-35 in Noble County, Oklahoma
to I-49 in Benton County, Arkansas

PEL Study

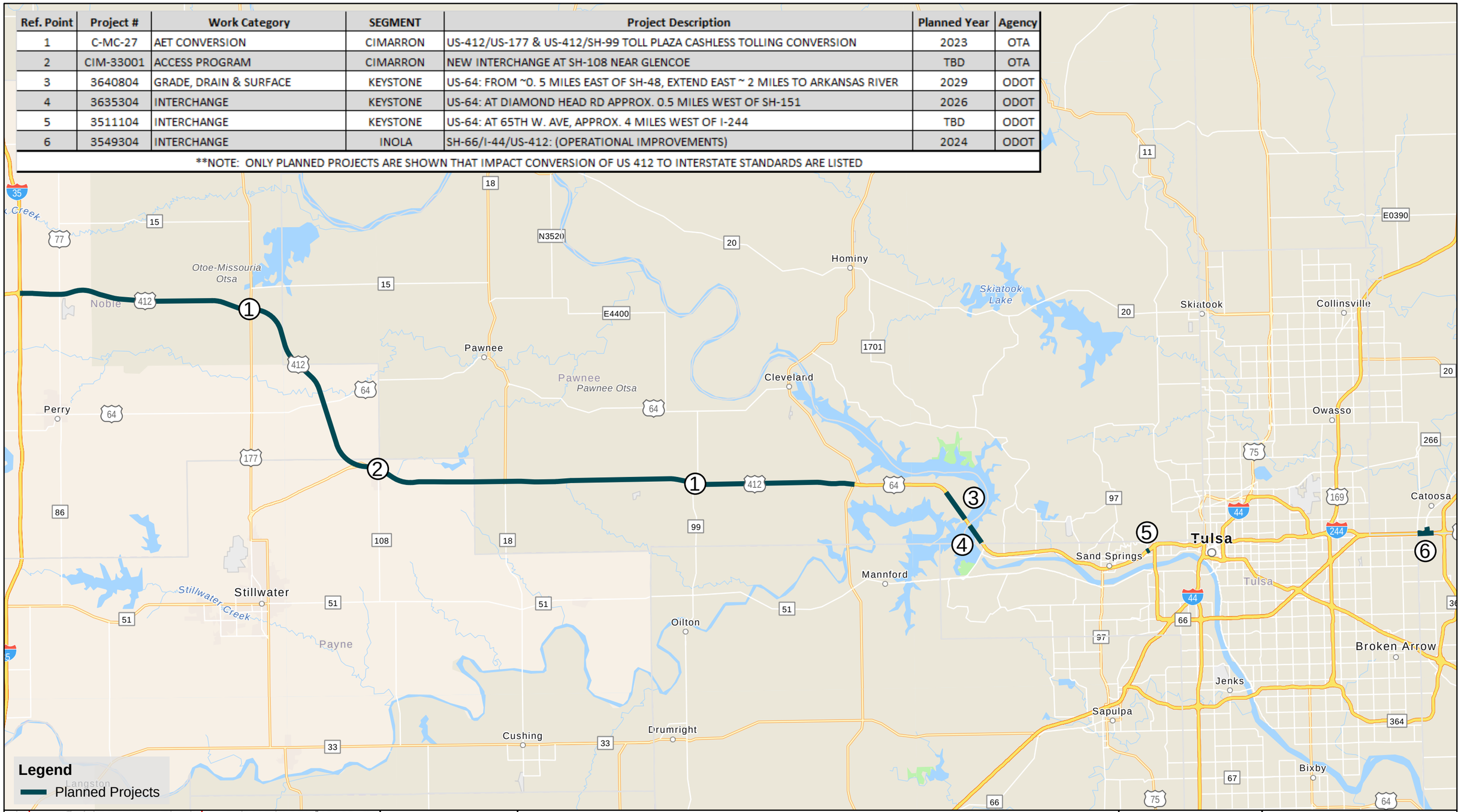
Traffic, Safety and Engineering Constraints Existing Conditions Report

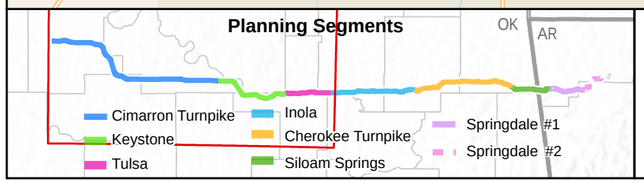
Appendix E – Planned Projects

Figure E-1: Planned Projects

Ref. Point	Project #	Work Category	SEGMENT	Project Description	Planned Year	Agency
1	C-MC-27	AET CONVERSION	CIMARRON	US-412/US-177 & US-412/SH-99 TOLL PLAZA CASHLESS TOLLING CONVERSION	2023	OTA
2	CIM-33001	ACCESS PROGRAM	CIMARRON	NEW INTERCHANGE AT SH-108 NEAR GLENCOE	TBD	OTA
3	3640804	GRADE, DRAIN & SURFACE	KEYSTONE	US-64: FROM ~0. 5 MILES EAST OF SH-48, EXTEND EAST ~ 2 MILES TO ARKANSAS RIVER	2029	ODOT
4	3635304	INTERCHANGE	KEYSTONE	US-64: AT DIAMOND HEAD RD APPROX. 0.5 MILES WEST OF SH-151	2026	ODOT
5	3511104	INTERCHANGE	KEYSTONE	US-64: AT 65TH W. AVE, APPROX. 4 MILES WEST OF I-244	TBD	ODOT
6	3549304	INTERCHANGE	INOLA	SH-66/I-44/US-412: (OPERATIONAL IMPROVEMENTS)	2024	ODOT

**NOTE: ONLY PLANNED PROJECTS ARE SHOWN THAT IMPACT CONVERSION OF US 412 TO INTERSTATE STANDARDS ARE LISTED





U.S. 412 Corridor Study

Planned Projects for Interstate Conversion

Figure E-1

May 2023

N

0 0.5 1 Mi

Ref. Point	Project #	Work Category	SEGMENT	Project Description	Planned Year	Agency
7	3109305	INTERCHANGE	INOLA	US-412: AT 265TH E AVE, APPROX. 2.8 MILES EAST OF I-44 JCT	2025	ODOT
8	3636904	BRIDGE & APPROACHES	INOLA	US-412: AT 289TH E AVE. APPROX. 4.3 MILES EAST OF I-44 JCT	2025	ODOT
9	1998311	INTERCHANGE	INOLA	SH-412P: INTERCHANGE AT US-412, 5.37 MI EAST OF I-44	2025	ODOT
10	3551007	INTERCHANGE	INOLA	US-412: AT 4170 RD	2024	ODOT
11	3640904	INTERCHANGE	INOLA	US-412: AT 4190 RD APPROX. 1.50 MILES WEST OF SH-88	2029	ODOT
12	3641004	INTERCHANGE	INOLA	US-412: AT 4240RD APPROX. 16.8 EAST OF I-44	2029	ODOT
13	3109104	GRADE,DRAIN,BRIDGE & SURFACE	INOLA	US 69: BEGIN AT MAYES/WAGONER CL AND EXTEND NORTH APPROX 6.7 MI SB	2024	ODOT
14	3505004	INTERCHANGE	INOLA	SH-412B: AT US-412 JUNCTION	2024	ODOT
15	3551005/06	RIGHT OF WAY /UTILITIES	INOLA	US-412: VERDIGRIS RIVER NAVIGATION CHANNEL EXTEND EAST 6.0 MILES TO SH-88	2028	ODOT
16	3632805/06	RIGHT OF WAY /UTILITIES	INOLA	US-412: FROM SH-88 EXTEND EAST APPROX 14 MILES TO CHEROKEE TURNPIKE	2029	ODOT
17	CHT-MC-11	POSITIVE BARRIER	CHEROKEE	CHEROKEE TURNPIKE: POSITIVE BARRIER MP 0-32	2023	OTA
18	090250	MAJOR WIDENING	SILOAM SPRINGS	WASHINGTON ST - EAST (HWY. 412) (SILOAM SPRINGS) (PROJECT DEVELOPMENT ONLY)	2025	ARDOT
19	012326	NEW LOCATION	SPRINGDALE	HWY. 412- HWY. 112 (SPRINGDALE BYPASS)	2025	ARDOT

**NOTE: ONLY PLANNED PROJECTS ARE SHOWN THAT IMPACT CONVERSION OF US 412 TO INTERSTATE STANDARDS ARE LISTED

Claremore
Pryor
Mayes
Cherokee OTSA
Saline Creek
Flint Creek
Snake Creek
Spring Creek
Bull Creek
Inola
Siloam Springs
Gravette
Noel
Gentry
Bentonville
Centerton
Benton
Rogers
Springda
Fayetteville
Westville
Prairie Grove
Washington
Lincoln
Wagoner
Coweta
Tahlequah
Adair
Baron Fork
Verdigris River

Legend
Planned Projects

Planning Segments
Cimarron Turnpike
Keystone
Tulsa
Inola
Cherokee Turnpike
Siloam Springs
Springdale #1
Springdale #2
OK
AR

U.S. 412 Corridor Study

Planned Projects for Interstate Conversion

Figure E-2

May 2023

N

0 0.5 1 Mi