ATKINS

Road Safety Audit:
State Route 196/Elma G. Miles Parkway

From Live Oak Church Road to Veterans Parkway

Hinesville, GA (Liberty County)

April 18, 2017

GDOT Georgia Department of Transportation

RSA

Executive Summary

The State Route 196/Elma G. Miles Parkway corridor from Live Oak Church Road to Veterans Parkway was identified as a site to be examined for a Road Safety Audit (RSA) by the Georgia Department of Transportation (GDOT). The Federal Highway Administration (FHWA) defines a RSA as a formal safety performance evaluation of an existing or future road or intersection by an independent audit team. The team is multidisciplinary and considers all road users during the safety audit. **Table 1**. shows the details of the RSA and **Table 2**. lists the top recommendations resulting from the RSA.

Table 1. RSA Details

Item	Details
Project Limits	State Route 196/Elma G. Miles Parkway from Live Oak Church Road to Veterans Parkway
Project Location	Hinesville, GA in Liberty County
Project Environment	Urban
Project Owner	GDOT
Date of the RSA	April 18, 2017
RSA Team	The RSA team included the following staff: • Jeffrey Bagdade (Atkins) – RSA Team Lead • Jonathan Kay (Atkins) – RSA Secretary • Michael Turpeau (GDOT TMC) • Kesha Wynn (GDOT TMC) • Greg Morris (FHWA) • Kenneth Cullens Jr. (GDOT District 5) • Bryan Hilllyard (GDOT District 5) • Tyler Vaughn (GDOT District 5) • Tracey E. Howard (Hinesville Police) • Donnie Boyd (GDOT District 5) • Joey Brown (Liberty County) • Jeff Ricketson (Liberty County Planning Commission) • Trent Long (Liberty County) • Keith Jenkins (Liberty County Sherriff's Office)

Table 2. Top Recommendations

#	Recommendations	Safety Benefit	Timeframe	Cost/Effort	Responsible Agency
1	Install sidewalks, where missing, including Americans with Disabilities Act (ADA) compliant crosswalks. Should be coordinated with planned Liberty County sidewalk installation project	High	Intermediate	Moderate	Liberty County
2	Consider implementing pedestrian hybrid beacon to allow controlled crossing along SR 196	High	Long	Moderate	GDOT
3	Consider implementing raised median along SR 196, including converting intersections to either RCUT, MUT, or other appropriate design in conjunction with median	High	Long	High	GDOT
4	Consider eliminating direct left-turn movements from Veterans Parkway intersection using MUT design	High	Long	High	GDOT
5	Install flashing yellow arrows, retroreflective backplates, and supplementary signal heads at Veterans Parkway intersection	Moderate	Intermediate	Low	GDOT

Table 3. Analysis Matrix

Safety Benefit	Timeframe	Cost/Effort
Low	**Short Term**	**Low**
Minimal safety impact for roadway users	4 to 6 months	$0 to $20,000; Expected to be completed by GDOT maintenance crews or local agencies
Moderate	**Intermediate**	**Moderate**
Some impact on safety for roadway users	7 to 24 months	S20,000 to $200,000; Likely to be utilized as a Quick Response Project by GDOT District office
High	**Long Term**	**High**
Offers great potential to improve safety for roadway users	longer than 24 months	Above $200,000; requires GDOT programmed project with full Plan Development Process (PDP)

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1. Introduction

On April 18, 2017, a field review of the State Route (SR) 196/Elma G. Miles Parkway corridor from Live Oak Church Road to Veterans Parkway was performed by an independent group of Georgia Department of Transportation (GDOT), Liberty County, Federal Highway Administration (FHWA), and Atkins traffic engineers. A representative of the Liberty County Sheriff's Department was also present for the field review. For a complete list of the participants, refer to **Appendix A.** The goal of the field review was to complete a Road Safety Audit (RSA) of the SR 196 corridor and proactively address safety concerns along the corridor within the study limits. This report will cover the existing corridor conditions, findings/observations from the field review, and recommendations to improve safety along the corridor.

1.1. What is a Road Safety Audit?

A RSA is a formal safety performance evaluation of an existing or future road or intersection by an independent and multidisciplinary team. RSAs provide GDOT with an innovative approach to analyze safety issues and collaboratively develop cost-effective solutions. Specifically, RSAs identify and address safety issues related to emphasis areas that include intersections, roadway departure, and non-motorized road users. Significant reductions in fatal and serious injury crashes can be achieved by addressing safety issues related to these emphasis areas and implementing proven safety countermeasures. ***Figure 1*** displays the typical eight-step process associated with a RSA.

Figure 1: The 8-Step RSA Process

SR 196/Elma G. Miles Parkway was identified as a location for a RSA due to the volume of traffic, crash history, and use as a principle arterial in Liberty County, Georgia. The corridor is approximately 1.7 miles long and has five lanes with the center lane serving as a two-way, left-turn lane. There are 17 intersections (1 signalized) and several entrances to various businesses along the corridor. The corridor serves approximately 25,000 drivers a day based on annual counts recorded by GDOT and an average of 105 crashes per year within the study limits were reported from 2012 to 2016 per the Georgia Electronic Accident Reporting System (GEARS).

A RSA team requires an independent group of qualified professionals and local citizens. GDOT selected Atkins to lead the RSA team in identifying practices and preparing recommendations to improve safety along SR 196. Atkins performed a nighttime inspection on April 17, 2017, to identify any safety issues present during low light conditions. The RSA team performed the formal daytime inspection on April 18, 2017, and a debriefing meeting was held after to discuss all findings and proposed recommendations. This report has been prepared to present these findings and recommendations so the maintaining agencies can develop projects to improve safety along the identified section of the SR 196 corridor.

2. Study Area

2.1. Background

SR 196 (Elma G. Miles Parkway) is a five-lane, minor arterial located southwest of downtown Hinesville, Georgia. This state route serves as an important connection between the City of Hinesville and the surrounding highway network. SR 196 also provides access to various commercial and residential developments along its length. It should be noted that SR 196 is co-routed with SR 119 along Elma G Miles Parkway, before SR 119 turns south at Airport Road. Given that the SR 196 is a key element of Hinesville's transportation network for both motorized and non-motorized road users, potential improvements to safety and mobility represent an important opportunity as the area continues to develop.

GDOT selected SR 196 from Live Oak Church Road to Veterans Parkway for a RSA. The location of the RSA study corridor in Liberty County, Georgia, is shown in **Figure 2** This corridor was selected based upon feedback from the Hinesville Area Metropolitan Planning Organization (HAMPO), GDOT District 5 staff, and a review of historical traffic and safety data.

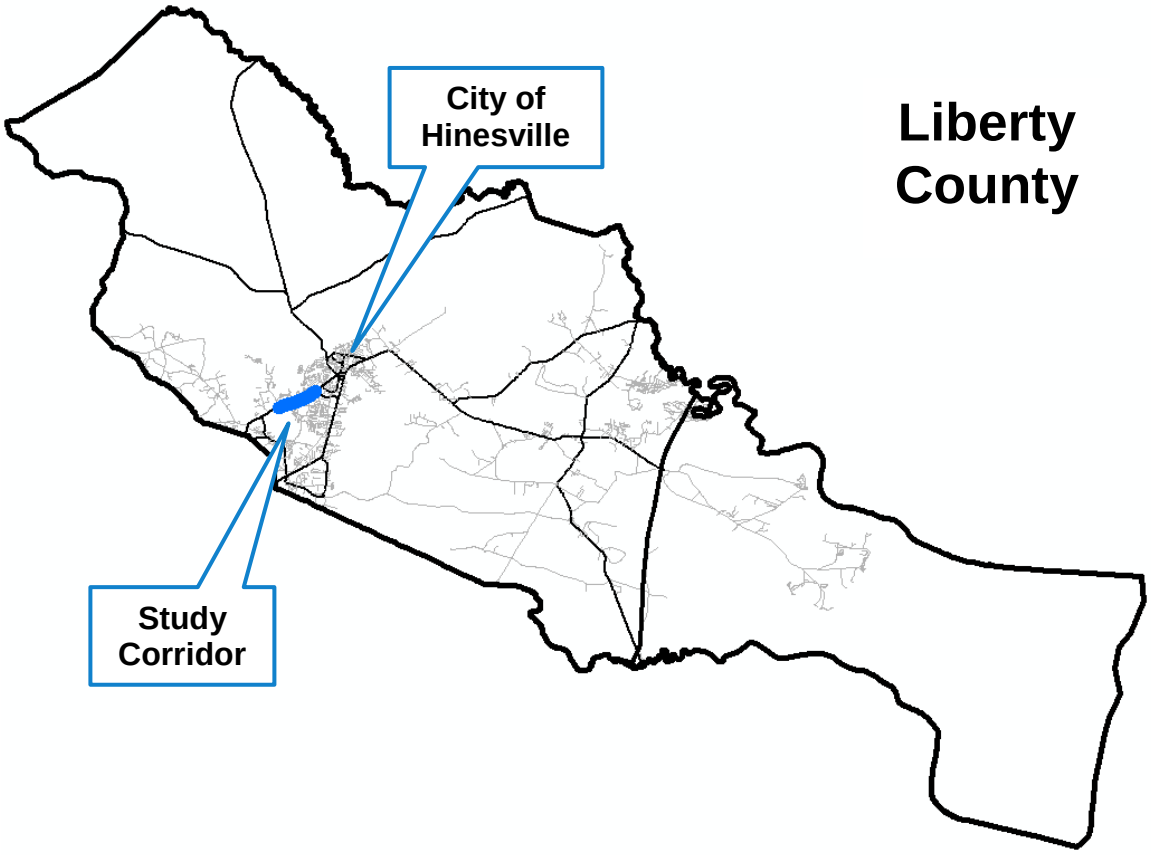


Figure 2: Map of RSA Study Corridor Location in Liberty County, Georgia

The SR 196 study corridor is located in central Liberty County, southwest of Hinesville, Georgia. SR 196 connects several state routes. Specifically, SR 196 provides an essential connection to Fort Stewart, a United States Army post with a population of more than 11,000 persons, located just north of the study area. Veterans Parkway, which represents the eastern end of the study corridor, is an important access point to Fort Stewart and has a significant impact on traffic patterns adjacent to SR 196 (shown in **Figure 3**). Veterans Parkway also provides a connection to the West Oglethorpe Highway to the east.

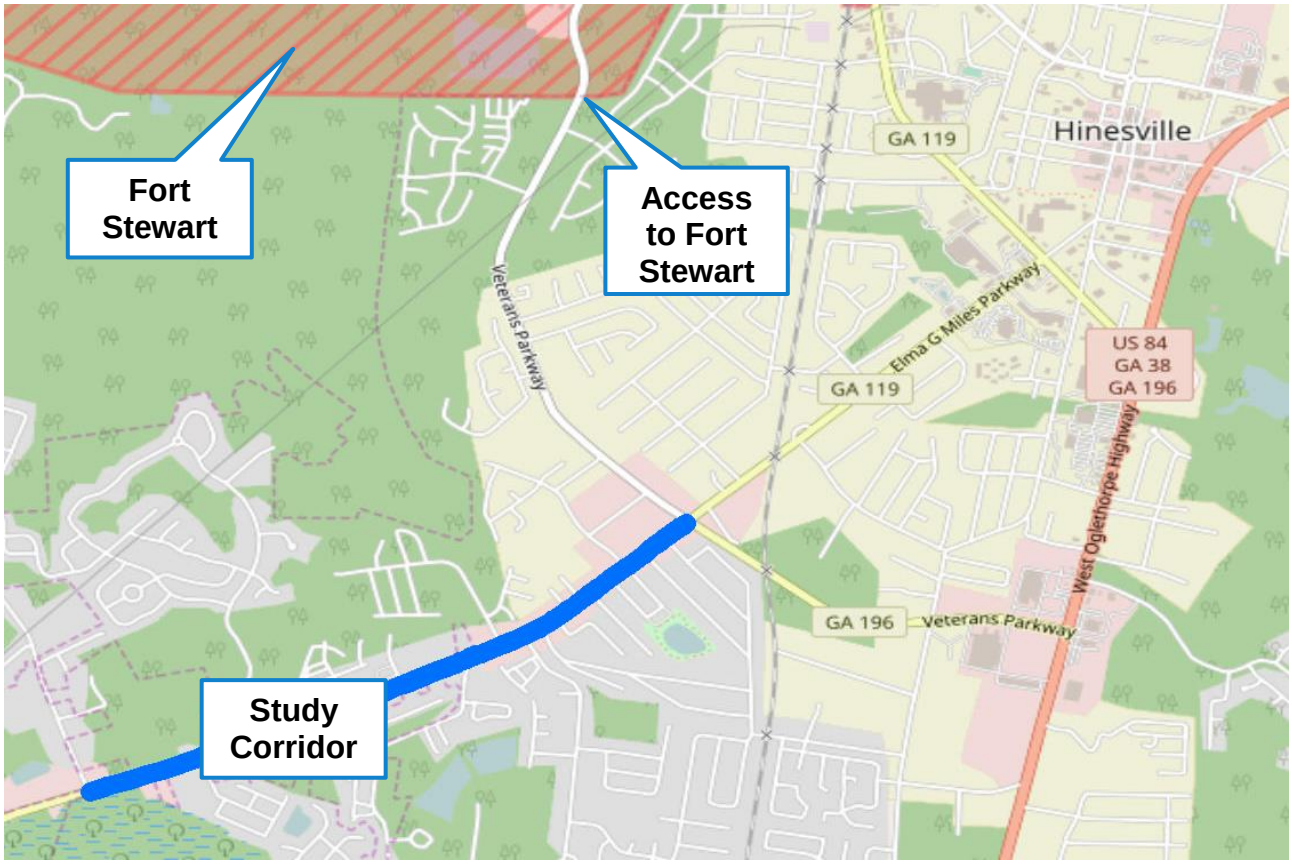


Figure 3: Map of SR 196 RSA Study Corridor and Surrounding Area

The 1.7 mile RSA study corridor includes 17 intersections, including one signalized intersection at the eastern boundary where Elma G. Miles Parkway intersects Veterans Parkway. The remaining intersections are minor route stop-controlled, and further SR 196 remains uncontrolled until it intersects Airport Road approximately 0.8 miles west of the study corridor.

HAMPO performed a traffic and speed study prior to the RSA study to provide additional information related to the operational characteristics of the study corridor. Annual average daily traffic (AADT) along the corridor was determined to be approximately 25,000 vehicles per day according to the traffic count data collected by HAMPO. This included approximately 3.8 percent heavy vehicles. The speed study indicated 85th percentile speeds were approximately 49 miles per hour (MPH), which is in general agreement with the 45 MPH posted speed limit. However, the posted speed limit reduces to 40 MPH on the eastern portion of the study corridor as vehicles enter the Hinesville city limits. A satellite view of the SR 196 study corridor is provided in **Figure 4**, including the intersections evaluated as a part of this study.

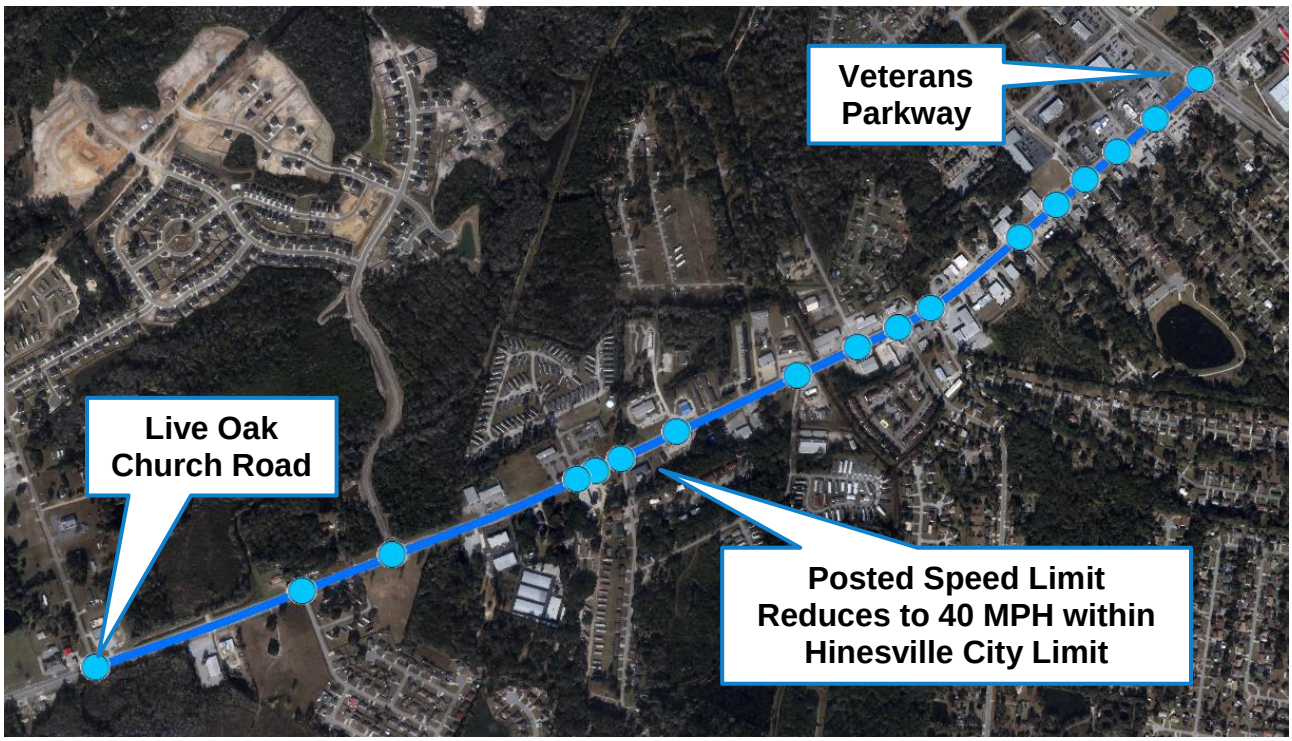


Figure 4: Satellite View of SR 196 (Elma G. Miles Parkway) Study Corridor

In this location, SR 196 is an urban minor arterial that includes a five-lane cross-section, with two through lanes in each direction and a center two-way, left-turn lane. A continuous exclusive right-turn lane is provided at select locations along the corridor to separate turning movements from the general traffic stream. Additionally, SR 196 maintains a typical urban curb and gutter design with no shoulder within the study area. Sidewalks are provided for the eastern portion of the corridor where adjacent commercial development is most prevalent; however, no sidewalks are provided west of Citation Boulevard. Access point density is relatively high along the corridor due to the adjacent commercial development, with 61 driveways located along the approximate 1.7 mile stretch, or approximately 36 access points per mile. A typical cross-section of the SR 196 study corridor is shown in **Figure 5**.

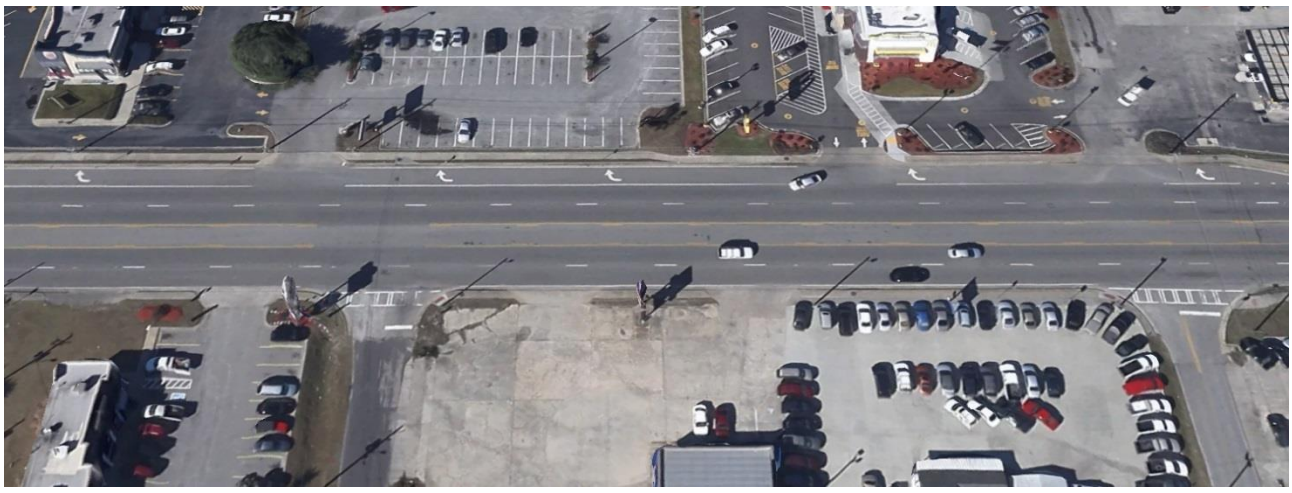


Figure 5: Typical Cross-section of SR 196 Study Corridor

2.2. GDOT Programmed Projects

The current programmed projects pulled from the GDOT GeoPI website are listed in **Table 4**.

Table 4. SR 196 Programmed Projects

Project ID	Program Year	Project Description
550600-	2014	The original concept report began at SR 119/EG Miles Parkway to North of SR 119/Hero Road, for a total of 2.7 miles. The project has been divided into two phases. Phase One PI #550600 will begin at SR 119/ EG Miles Parkway to the Fort Stewart access point, for a total of 1.61 miles. Phase Two of the project PI #0012859 will begin at the Fort Stewart access central point and extend to SR 119/Hero Rd for a total of 1.09 miles. (Project on Veteran's parkway but includes intersection with Elma G. Miles Parkway)

2.3. Existing Safety Features

GDOT and local agencies have already implemented several measures to improve safety and mobility along the study corridor, including:

- Raised reflective pavement markers are included along the striped lane pavement markings to provide additional lane delineation to drivers (**Figure 6**).

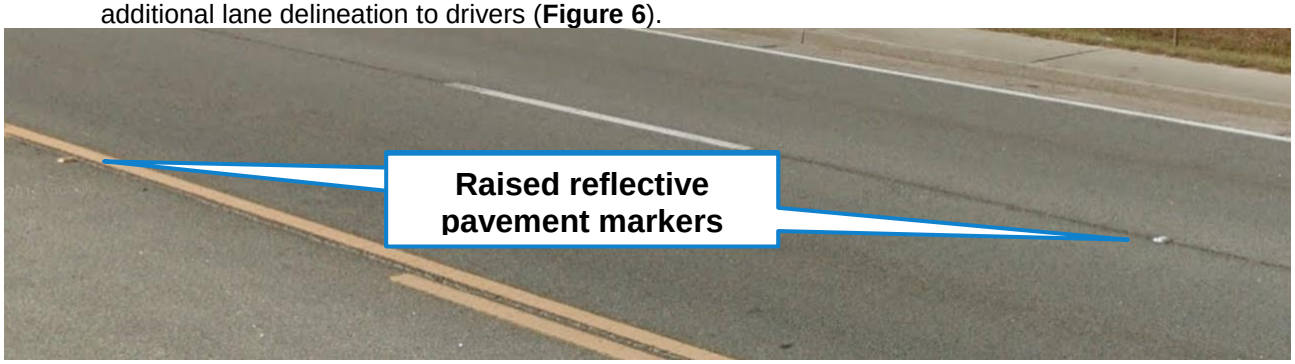


Figure 6: View of Raised Reflective Pavement Markers along SR 196

- Exclusive right-turn lanes in certain locations to separate vehicles making right-turning movements from the traffic stream (**Figure 7**).

Figure 7: View of Exclusive Right-Turn Lane along SR 196

- The signalized intersection at Veterans Parkway includes a variety of existing safety features. Raised concrete islands are included for three of the four quadrants, helping to channelize right-turning movements and providing refuge for pedestrians attempting to cross either SR 196 or Veterans Parkway (**Figure 8**). Additionally, this intersection incorporates Americans with Disabilities Act- (ADA) compliant pedestrian facilities, including striped crosswalks and pedestrian signal heads with push button actuation (**Figure 8**). Hatched pavement markings are included within the intersection to guide left-turning movements (**Figure 9**). Approaches to the intersection include overhead lane marking signs to provide guidance to drivers as well as W3-3 Signal Ahead warning signs (**Figure 10**). Overhead street name signs are also installed at the intersection to provide additional guidance to drivers. It should also be noted that Veterans Parkway maintains its divided nature on either side of SR 196.

Figure 8: View of Raised Concrete Islands and Pedestrian Facilities at Veterans Parkway Intersection

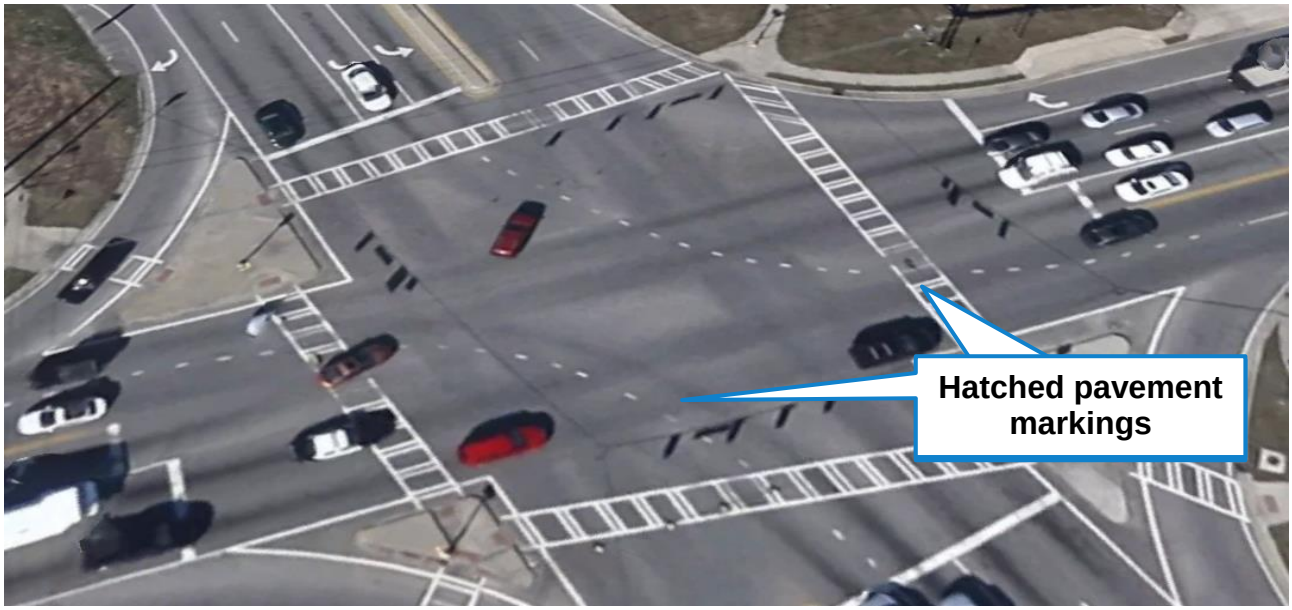


Figure 9: View of Hatched Pavement Markings to Guide Left-Turn Movements

Figure 10: View of Southbound Veterans Parkway Approaching SR

3. Crash Analysis

To supplement the findings obtained as a part of the RSA process, the Atkins team also performed a comprehensive historical crash analysis. First, a traditional crash data evaluation was performed, including an analysis of descriptive statistics and other historical crash patterns specific to the corridor. Additionally, a state-of-the-art analysis was performed using the Empirical Bayes (EB) method outlined in the American Association of State Highway Transportation Official's (AASHTO) *Highway Safety Manual* (HSM).

3.1. Traditional Crash Data Evaluation

To perform a comprehensive safety analysis, historical traffic crash data for the most recent five-year period (2012-2016) were collected from the GEARS. Crash data were mapped spatially in a geographic information system based upon the coordinates associated with each record, and each crash was ultimately allocated to the appropriate segment or intersection along the corridor based upon location. A summary of the crash data, including fatal, injury, and property damage only (PDO) crashes as well as non-motorized crashes specific to the SR 196 corridor are provided in **Table 5**.

Table 5. Summary of SR 196 Corridor Traffic Crash Data (2012-2016)

Location	Fatal	Injury	PDO	Total	Pedestrian	Bicycle
Segments	0	6	11	17	0	0
Intersections	2	166	341	509	6	7
Total Corridor	**2**	**172**	**352**	**526**	**6**	**7**

A total of 526 traffic crashes occurred during the five-year study period, including two fatal crashes; 172 crashes resulted in non-fatal injuries to crash-involved occupants. Additionally, six pedestrian crashes and seven bicycle crashes occurred during the five-year period, all in the functional area of intersections. The 172 injury crashes resulted in 24 severe injuries to crash-involved occupants. The location of crashes resulting in fatalities or severe injuries to crash involved-occupants is shown in **Figure 11.**

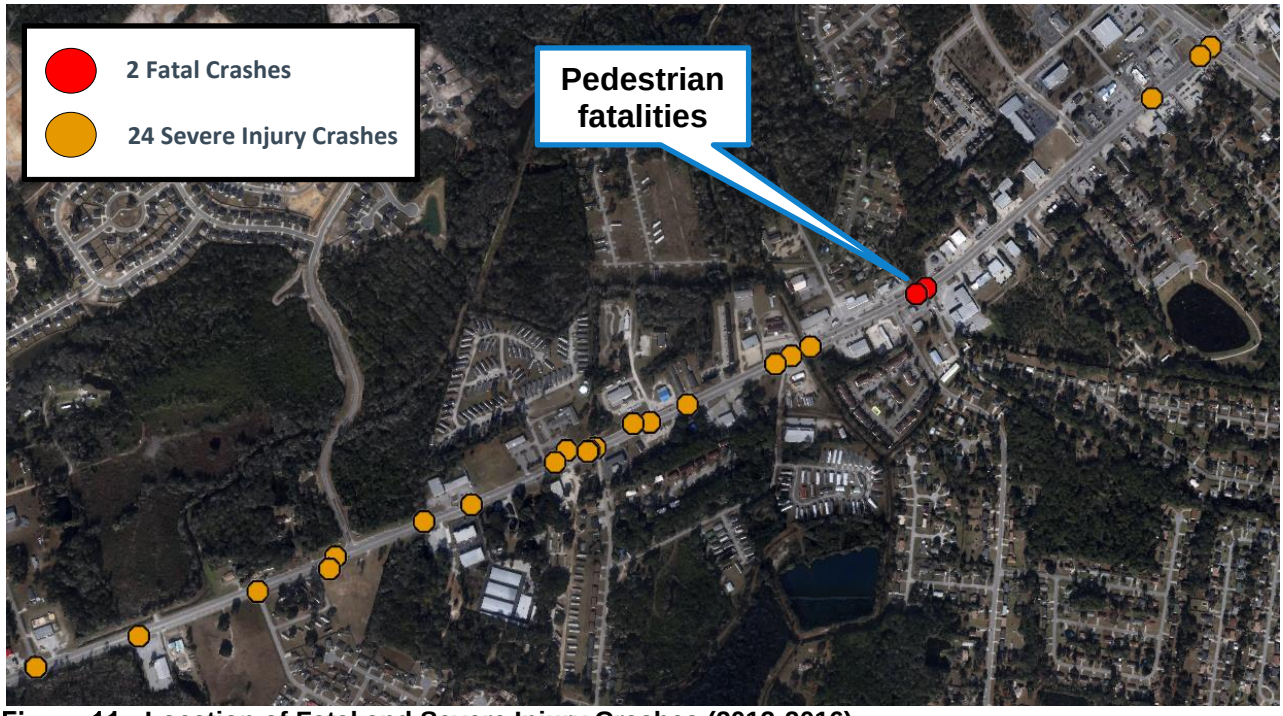


Figure 11: Location of Fatal and Severe Injury Crashes (2012-2016)

Both fatal collisions involved pedestrians attempting to cross SR 196 adjacent to Hearn Road at night. The first fatality occurred in May 2013 involving a vehicle traveling westbound along SR 196 and colliding with a pedestrian attempting to cross from north to south. The second fatality occurred in December 2016 involving a pedestrian attempting to cross SR 196 from south to north and being struck by an eastbound vehicle. A majority of severe crashes are distributed in the western portion of the corridor where vehicular speeds are higher. The location of pedestrian and bicycle crashes occurring along the study corridor during the five-year study period is shown in **Figure 12**.

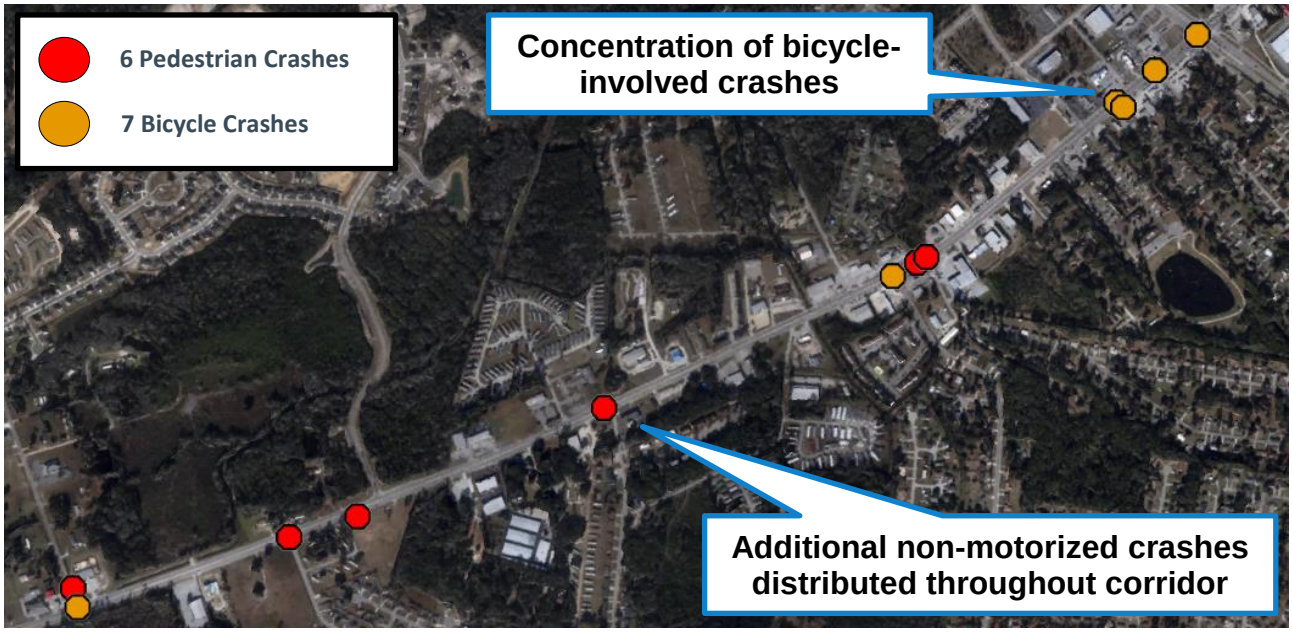


Figure 12: Location of Pedestrian and Bicycle Crashes (2012-2016)

As shown in **Figure 12**, a concentration of bicycle-involved crashes occurred at the eastern edge of the corridor. The confluence of adjacent restaurants and other destinations with the surrounding residential developments results in this portion of the corridor observing frequent bicycle traffic. The remaining non-motorized crashes are distributed through the study corridor, including the two fatalities and additional collisions due to non-motorized users attempting to cross SR 196 at uncontrolled locations. The fact that SR 196 remains uncontrolled for approximately 2.5 miles from Veterans Parkway to Airport Road represents a significant challenge to non-motorized users attempting to safely cross the five-lane arterial. A heat map of all crashes occurring during the five-year study period is presented in **Figure 13**.

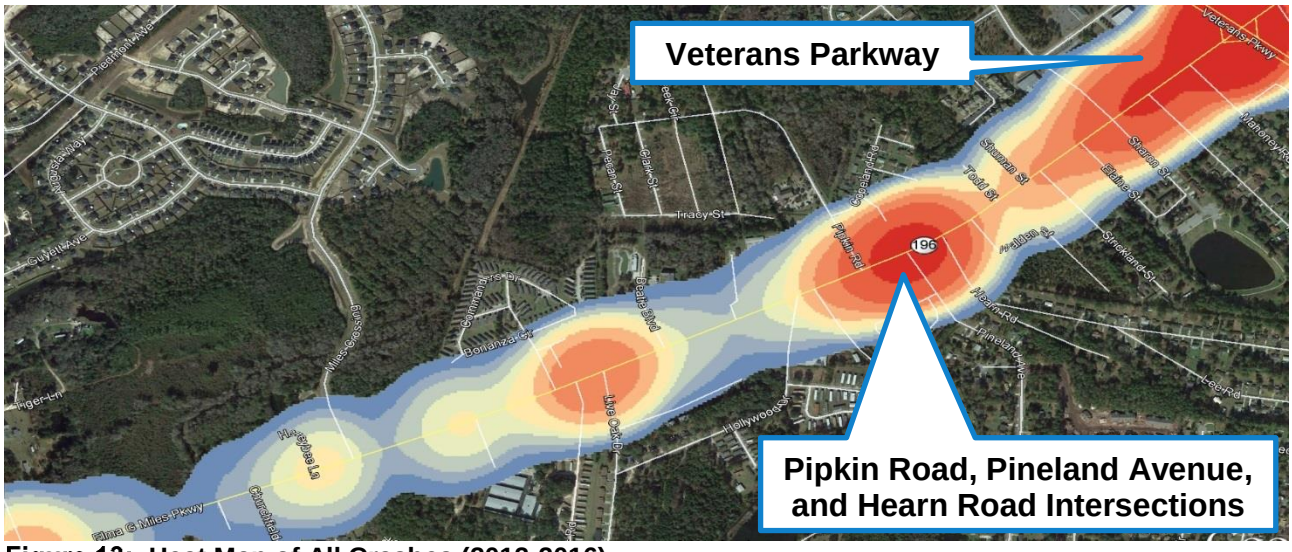


Figure 13: Heat Map of All Crashes (2012-2016)

The highest concentration of crashes occurred at the eastern end of the corridor adjacent to the signalized intersection with Veterans Parkway. This is due in part to the relatively high density of commercial driveways that serve significant entering and exiting traffic, and the presence of the signalized intersection. An additional hot spot is observed at the stretch where the minor approach stop-controlled intersections with Pipkin Road, Pineland Avenue, and Hearn Road are closely spaced along a gentle horizontal curve.

Tables 6 (segments) and 7 (intersections) summarize the crash data specific to each segment and intersection along the study corridor, including approximate traffic crash rates in addition to the number of fatal and injury (KABC) and PDO crashes. Approximate AADTs were applied to each segment and an approximation of the daily entering vehicles were assigned to each intersection based upon the traffic counts collected from HAMPO and the online GDOT database. It should be noted that minor approach volumes were estimated for intersections along the corridor where no counts were available to complete appropriate safety analyses. Further details regarding distribution of crash severity, type, time, pavement condition, and hazardous action are provided in the appendix. Additionally, crash diagrams specific to each location along the corridor are also provided in the appendix.

Table 6. Summary of SR 196 Corridor Segment Traffic Crash Data (2012-2016)

Segment Description					Traffic Crashes			Traffic Crash Rate*		
Name	**From**	**To**	**Length**	**AADT**	**KABC**	**PDO**	**Total**	**KABC**	**PDO**	**Total**
SR 196	Live Oak Church	Churchfield	0.29	25,000	2	3	5	15.12	22.67	37.79
SR 196	Churchfield	Miles Crossing	0.13	25,000	0	0	0	0.00	0.00	0.00
SR 196	Miles Crossing	Citation/Joyner	0.27	25,000	4	6	10	32.47	48.71	81.18
SR 196	Citation/Joyner	Live Oak	0.06	25,000	0	0	0	0.00	0.00	0.00
SR 196	Live Oak	Beatie Blvd	0.08	25,000	0	0	0	0.00	0.00	0.00
SR 196	Beatie	Hollywood	0.18	25,000	0	2	2	0.00	24.35	24.35
SR 196	Hollywood	Pipkin	0.08	25,000	0	0	0	0.00	0.00	0.00
SR 196	Pipkin	Pineland	0.06	25,000	0	0	0	0.00	0.00	0.00
SR 196	Pineland	Hearn	0.05	25,000	0	0	0	0.00	0.00	0.00
SR 196	Hearn	Strickland	0.15	25,000	0	0	0	0.00	0.00	0.00
SR 196	Strickland	Elaine	0.06	25,000	0	0	0	0.00	0.00	0.00
SR 196	Elaine	Sharon	0.05	25,000	0	0	0	0.00	0.00	0.00
SR 196	Sharon	McDowell	0.05	25,000	0	0	0	0.00	0.00	0.00
SR 196	McDowell	Mahoney	0.07	25,000	0	0	0	0.00	0.00	0.00
SR 196	Mahoney	Veterans Pkwy	0.08	25,000	0	0	0	0.00	0.00	0.00
All Corridor Segments			**1.66**	**25,000**	**6**	**11**	**17**	**7.92**	**14.52**	**22.45**

Table 7. Summary of SR 196 Corridor Intersection Traffic Crash Data (2012-2016)

Intersection Description		Traffic Volume		Traffic Crashes			Traffic Crash Rate*		
Minor	Signal	Major	Minor	KABC	PDO	Total	KABC	PDO	Total
Live Oak Church	No	25,000	1,250	8	10	18	0.17	0.21	0.38
Churchfield	No	25,000	1,250	1	2	3	0.02	0.04	0.06
Miles Crossing	No	25,000	1,250	5	5	10	0.10	0.10	0.21
Citation	No	25,000	1,250	4	5	9	0.08	0.10	0.19
Joyner	No	25,000	1,250	2	4	6	0.04	0.08	0.13
Live Oak	No	25,000	1,250	7	15	22	0.15	0.31	0.46
Beatie	No	25,000	1,250	4	2	6	0.08	0.04	0.13
Hollywood	No	25,000	1,250	3	4	7	0.06	0.08	0.15
Pipkin	No	25,000	1,250	15	14	29	0.31	0.29	0.61
Pineland	No	25,000	3,500	19	33	52	0.37	0.63	1.00
Hearn	No	25,000	1,250	14	16	30	0.29	0.33	0.63
Strickland	No	25,000	1,250	3	14	17	0.06	0.29	0.35
Elaine	No	25,000	1,250	1	9	10	0.02	0.19	0.21
Sharon	No	25,000	2,500	8	25	33	0.16	0.50	0.66
McDowell	No	25,000	1,250	9	22	31	0.19	0.46	0.65
Mahoney	No	25,000	1,250	11	28	39	0.23	0.58	0.81
Veterans Pkwy	Yes	25,000	8,940	54	133	187	0.87	2.15	3.02
All Corridor Intersections		**25,000**	**1,908**	**168**	**341**	**509**	**0.20**	**0.41**	**0.61**

**Traffic crash rates in crashes per 1M entering vehicles*

Traffic crashes were much more prevalent within the functional area of intersections along the corridor, in part due to the relatively high intersection density (approximately 10 per mile). Segment crashes occurred most frequently on the west end of the corridor where the intersection density is lower and travel speeds are higher with the 45 MPH posted speed limit. While a number of unsignalized intersections observed notable crash frequencies, the signalized intersection at Veterans Parkway experienced significantly more collisions than any other location along the corridor. A total of 187 crashes occurred at the intersection during the five-year study period, including 54 crashes resulting in an injury to crash-involved occupants.

3.2. Empirical Bayes Method Evaluation

Even though traditional safety analysis techniques provide an important contextual understanding of existing safety performance, there are several limitations related to using these methodologies alone. To address this concern, the AASHTO HSM outlines state-of-the-art EB methodology, which considers the impact of changing traffic volumes, regression-to-the-mean bias, and other factors that potentially affect the frequency of traffic crashes to occur. The EB-method combines a site's observed crash frequency with a predicted crash frequency developed using a statistical model, referred to as a safety performance function, to estimate an expected average crash frequency. Ultimately, the estimated predicted crash frequency is subtracted from the calculated expected crash frequency to determine excess expected crashes, or the number of expected crashes above or below crash frequencies for other similar facilities. An uncalibrated HSM analysis was performed by the Atkins team since GDOT currently does not maintain Georgia-specific calibration factors. **Table 9 and Figure 14** summarize the EB-method safety analysis results for the SR 196 corridor in terms of annual KABC, PDO, and total crash frequencies.

Table 8. Summary of EB-Method Safety Analysis – SR 196 Corridor (2012-2016)

Analysis Metric	KABC	PDO	TOTAL
Annual Observed Crashes	34.8	70.4	105.2
Annual Expected Crashes	29.7	67.8	99.7
Annual Predicted Crashes	17.9	38.1	55.7
Annual Excess Expected Crashes	**11.8**	**29.7**	**44.0**

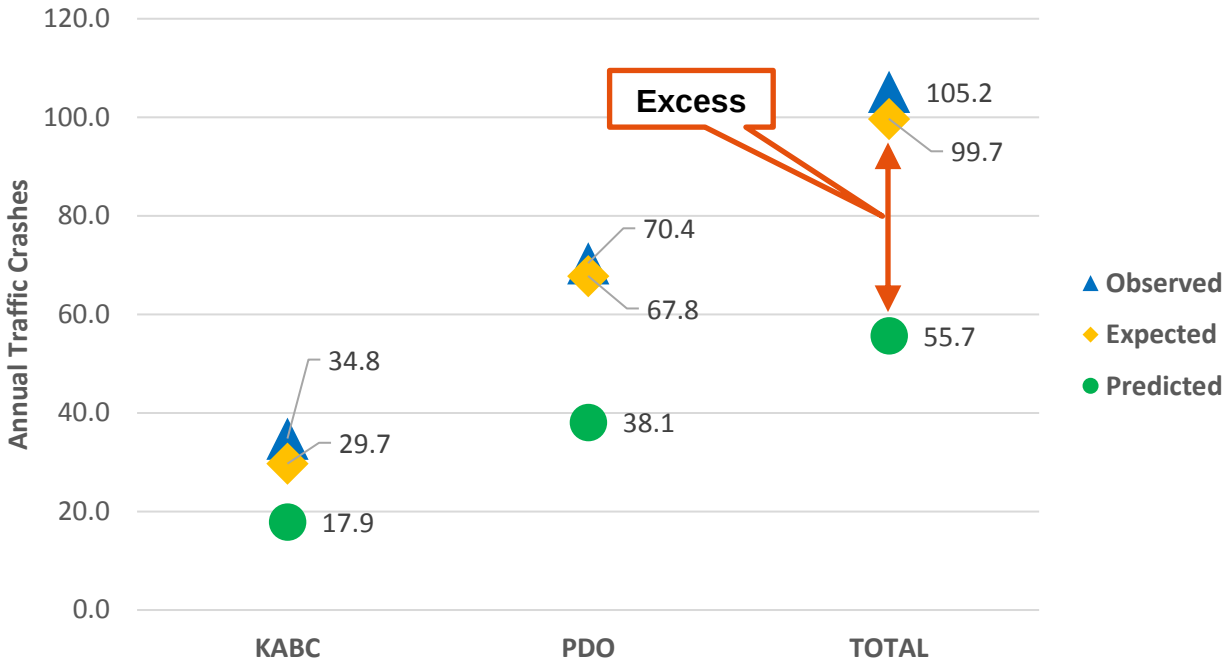


Figure 14: Summary of EB-Method Analysis Results – SR 196 Corridor (2012-2016)

The corridor observed an annual average of 105.2 crashes, including 34.8 crashes resulting in a fatality or injury to a crash-involved occupant. These values greatly exceed the predicted frequencies developed using the models in the HSM. After combining the observed and predicted frequencies using the EB-method, the corridor is expected to observe 29.7 KABC crashes and 99.7 total crashes annually. These values also greatly exceed the predicted values developed using the models in the HSM, demonstrating annual excesses of 11.8 KABC crashes and 44.0 total crashes. This suggests that there is significant opportunity to improve safety performance along the study corridor with appropriate treatments and countermeasures. The annual expected and predicted crashes for each corridor segment and intersection are presented in **Figures 15 (segments) and 16 (intersections).**

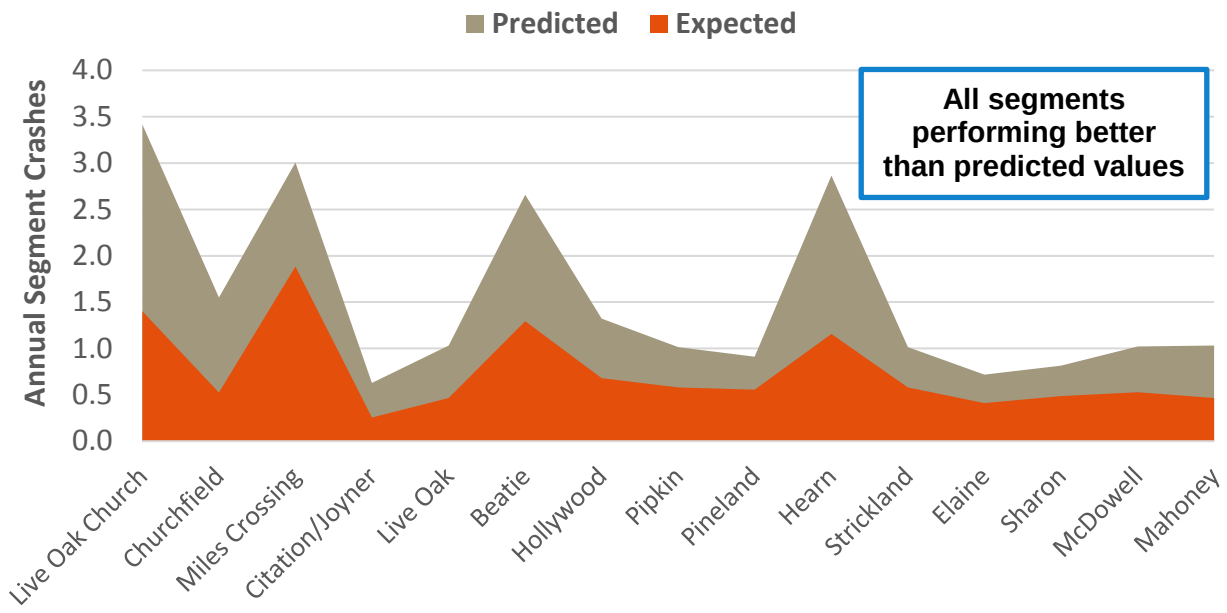


Figure 15: Summary of EB-Method Analysis Results – SR 196 Corridor Segments (2012-2016)

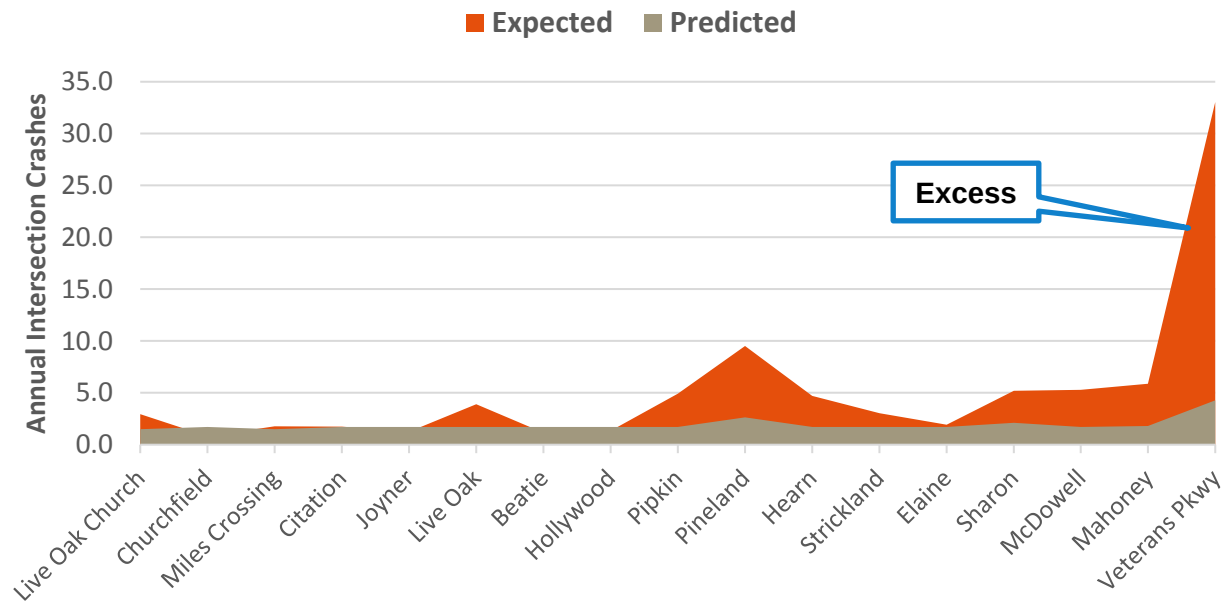


Figure 16: Summary of EB-Method Analysis Results – SR 196 Corridor Intersections (2012-2016)

4. Safety Findings/Recommendations

Given the RSA findings, as well as the review of the historical traffic and crash data, safety issues specific to the study corridor were identified.

The corridor was disaggregated into three distinct sections for the purpose of presenting safety issues and associated recommendations, shown in **Figure 17**. This includes the western portion of the SR 196 study corridor from Live Oak Church Road to Pipkin Road, the eastern portion of the study corridor from Pipkin Road to Veterans Parkway, and the signalized intersection at Veterans Parkway.

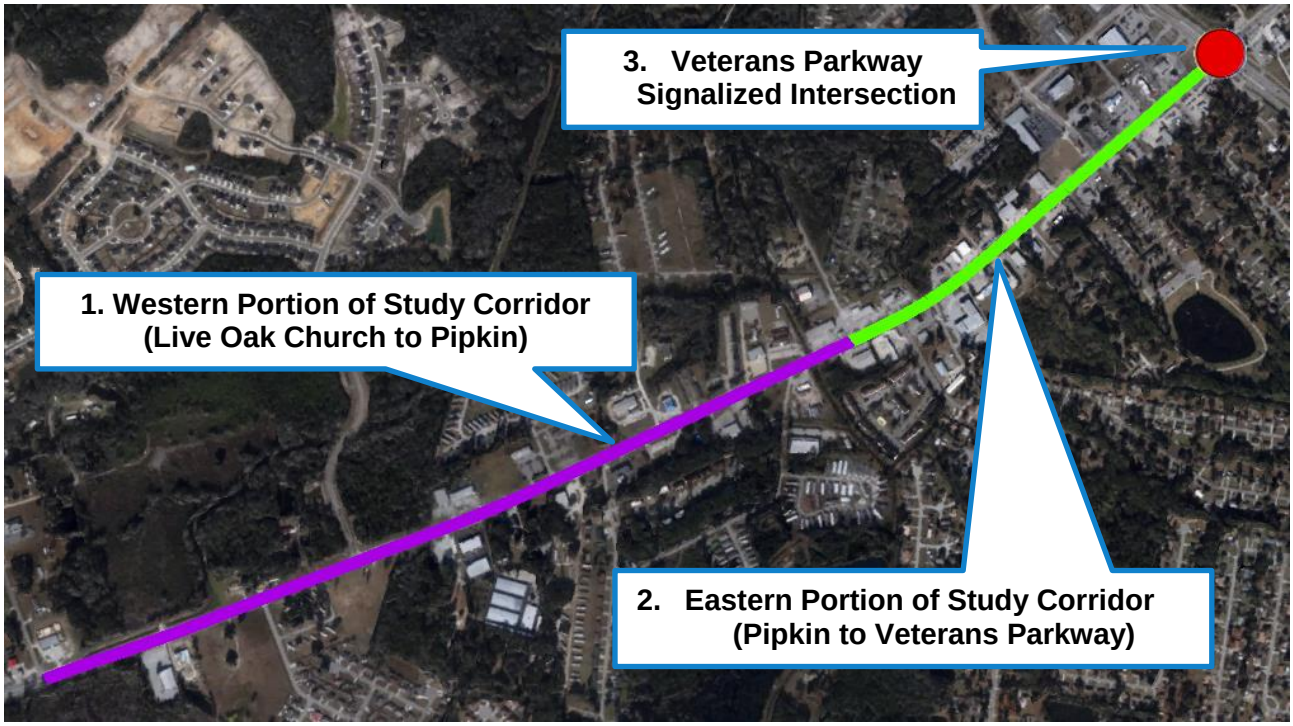


Figure 17: Map of Study Corridor – Three Sections for Safety Issues and Recommendations

4.1. Western Portion of Study Corridor

The western portion of the SR 196 study corridor is characterized by a slightly lower driveway density (26.6 access points per mile) compared to the overall corridor (36.7 access points per mile), the elevated 45 MPH posted speed limit (compared to 40 MPH in the eastern portion of the corridor), and a lack of ambient lighting. Existing sidewalks end at Citation Boulevard, creating a difficult environment for pedestrians that is further accentuated by poor lighting. While crashes in the eastern portion of the corridor all occur within the influence area of intersections, the western portion of the corridor experienced 17 segment-related traffic crashes during the five-year study period. Additionally, 21 out of the 24 crashes resulting in a severe injury to a crash-involved occupant occurred within this portion of the study corridor. **Table 10** summarizes the safety issues specific to the western portion of the study corridor identified as a part of this evaluation.

Table 9. Safety Findings for Western Portion of SR 196 Study Corridor

#	Location	Safety Findings/Comments
1	Western SR 196 Study Corridor	Lack of ambient lighting
2	Western SR 196 Study Corridor	Sidewalks missing west of Citation Boulevard and minor approach crosswalks are missing at several locations
3	Western SR 196 Study Corridor	No bicycle-specific facilities; bicycles have been observed using center two-way, left-turn lane
4	Western SR 196 Study Corridor	No existing non-motorized crossing of SR 196 within this area of the corridor
5	Western SR 196 Study Corridor	Difficult turning movements to and from minor street intersections and driveways along corridor
6	Western SR 196 Study Corridor	Relatively high travel speeds observed along SR 196 in this area of corridor, particularly where Hinesville city limit ends
7	Western SR 196 Study Corridor	Adjacent ditches running longitudinally along SR 196 complicate environment for non-motorized road users
8	SR 196 and Miles Crossing Intersection	Channelizing right turn island is provided with pavement markings only

The lack of ambient lighting is a primary concern along this portion of the corridor, potentially resulting in single vehicle run-off-the-road crashes and multiple vehicle collisions as well as crashes involving non-motorized road users. A view from a vehicle traveling westbound along SR 196 at night is shown in **Figure 18**.

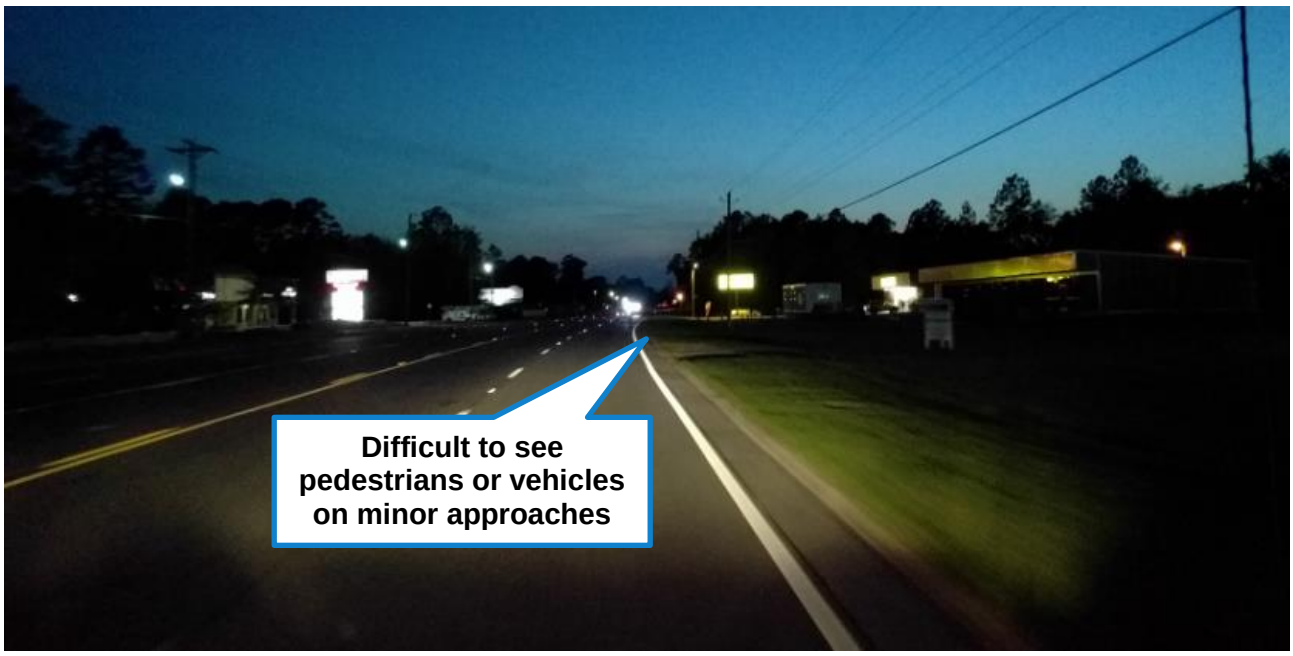


Figure 18: View from Vehicle Traveling Westbound on SR 196 at Night

These concerns are compounded by the fact that there are currently no sidewalks west of Citation Boulevard. It should be noted that there is a planned project by Liberty County to install sidewalks along the corridor, reaching west to 15th Street. Additionally, there are no bicycle-specific facilities included along SR 196, despite the presence of notable bicycle traffic. The ditches that run adjacent to SR 196 also make this a challenging environment for non-motorized road users. The lack of a marked crossing for non-motorized users also presents a challenge for pedestrians and bicyclists attempting to access developments located on either side of the high-speed, five-lane arterial.

The relatively high speeds observed along the corridor, evidenced by the 49 MPH 85th percentile speeds identified using the HAMPO data, represent a safety concern for all types of traffic crashes. This is an especially important consideration given the lack of ambient lighting. This combination, along with other site characteristics, results in particularly challenging turning movements in and out of minor street driveways and intersections along the this portion of the corridor. This has resulted in a significant number of angle-type crashes, which often result in severe injury outcomes to crash-involved occupants, as evidenced by the concentration of severe crashes in this area. Finally, the channelizing right-turn island at the intersection with Miles Crossing is implemented via pavement markings with a higher deflection angle (shown in **Figure 19**). More recent designs from GDOT include a raised concrete island with deflection angles that allow drivers to more easily identify conflicting vehicles while completing their right-turning movement.

Figure 19: Satellite View of SR 196 and Miles Crossing Intersection

Recommendations to address these safety issues are presented in **Table 10**, including the specific safety issue addressed by each countermeasure or treatment.

Table 10. Recommendations for Western Portion of SR 196 Study Corridor

#	Recommendation	Safety Benefit	Time Frame	Cost/Effort	Safety Issues Addressed
1	Install sidewalks where missing, including ADA-compliant crosswalks.*	High	Intermediate	Moderate	2, 7
2	Implement raised median along SR 196, including converting intersections to either restricted crossing u-turn (RCUT), median u-turn (MUT), or other appropriate design in conjunction with median.	High	Long	High	3, 4, 5, 6
3	Implement pedestrian hybrid beacon to allow controlled crossing along SR 196.	High	Long	Moderate	4
4	Implement multi-use path to accommodate bicyclists.*	Moderate	Intermediate	Moderate	3, 7
5	Install additional lighting	Moderate	Long	High	1
6	Protect or remove adjacent ditches along SR 196.*	Low	Short	Low	7
7	Replace painted channelizing island at Miles Crossing with raised concrete island.	Low	Short	Low	8

**Should be coordinated with planned Liberty County sidewalk installation project*

Several potential design configurations were discussed as a part of the RSA workshop specific to the western portion of the study corridor, including a road diet and the implementation of a raised median as well as other innovative highway designs to improve safety. Ultimately, given the existing traffic volumes, right-of-way limitations, and other site characteristics, a raised median was determined to be an appropriate alternative with additional operational analyses. The potential raised median would be implemented in conjunction with converting the minor approach stop-controlled intersections along SR 196 to either a RCUT or MUT design, providing a median opening, or otherwise consolidating access to SR 196. While several potential intersection

configurations at each location along the corridor may be appropriate based upon further study, RCUT conversions will be assumed for the purposes of performing alternatives analysis. The implementation of a raised median would also provide notable safety benefits to pedestrians along the corridor, providing refuge to allow a two-stage crossing of the five-lane arterial. Raised medians also provide several additional benefits according to the FHWA, including potentially decreasing vehicular delay, increasing capacity, and reducing vehicular speeds (which would directly address safety issue #6).

The installation of lighting along this area of the corridor would provide notable safety benefits, addressing all potential crash types occurring at night. This treatment is particularly important in improving the roadway environment for pedestrians and bicyclists, and would complement all the recommendations provided in **Table 10**.

Recommendations #11, #12, and #13 should be coordinated with the planned Liberty County sidewalk installation project to develop one comprehensive solution of non-motorized road users. The installation of a sidewalk represents a significant improvement over the existing condition, and a multi-use path would provide additional benefits for bicyclists. The installation of hand rails or otherwise protecting ditches along the corridor from accidental entry by pedestrians should also be completed in coordination with these pedestrian-focused treatments. The implementation of a controlled mid-block crossing treatment, such as a pedestrian hybrid beacon, would provide non-motorized road users with a safe opportunity to cross SR 196 (with or without the implementation of a raised median). This alternative would require further study to determine its feasibility and the appropriate location for implementation. Uncontrolled mid-block crossings are not recommended along this portion of the corridor given existing traffic volumes and the relatively high-speed nature of SR 196.

4.2. Eastern Portion of Study Corridor

The eastern portion of the corridor is characterized by slightly lower travel speeds due to the reduced 40 MPH posted speed limit, higher intersection and access point densities, and a higher (although still limited) level of ambient lighting due to the surrounding developments. Due to the higher intersection density, all traffic crashes occurring along this portion of the corridor fall within the functional area of an intersection. Additionally, crash rates (as presented in **Table 8**) and excess crashes (as presented in **Figure 16**), were much greater in this area when compared to the western section of the corridor. However, given the lower vehicular speeds associated with the reduced 40 MPH speed limit, far fewer severe crashes were experienced in the eastern end of the corridor. **Table 11** summarizes the safety issues specific to the eastern portion of the study corridor identified as a part of this evaluation.

Table 11. Safety Findings for Eastern Portion of SR 196 Study Corridor

#	Location	Safety Findings/Comments
9	Eastern SR 196 Study Corridor	Difficult turning movements to and from minor street intersections and driveways along corridor, particularly due to high density
10	Eastern SR 196 Study Corridor	No existing non-motorized crossing of SR 196 within this area of the corridor
11	Eastern SR 196 Study Corridor	Sidewalks or other pedestrian facilities need repair in several locations
12	Eastern SR 196 Study Corridor	Conflicts between pedestrians and bicyclists have been observed on sidewalks due to limited width, particularly adjacent to several minor approach crosswalks

#	Location	Safety Findings/Comments
13	Eastern SR 196 Study Corridor	No bicycle-specific facilities, bicycles have been observed using center two-way, left-turn lane
14	Eastern SR 196 Study Corridor	Lack of ambient lighting
15	Pipkin Road, Pineland Avenue, and Hearn Road Intersections with SR 196	Concentration of crashes occurs adjacent to closely spaced intersections along gentle horizontal curve
16	Eastern SR 196 Study Corridor	Excessively long exclusive right-turn lane on northern side of SR 196 creates potential traffic conflicts, and current downstream terminus creates potential traffic conflicts
17	Eastern SR 196 Study Corridor	State route guidance signs are misaligned

The relatively high density of minor approach stop-controlled intersections and commercial driveways along the eastern portion of the corridor create a challenging environment for both motorized and non-motorized road users. In particular, difficult left-turning movements in and out of both the intersections and driveways results in an elevated risk for angle-type crashes along this portion of the corridor. This is evidenced by the significant number of angle-type crashes that occurred along this portion of the corridor during the five-year study period. This included 113 angle-type crashes out of the 241 total crashes (or 47 percent) that occurred on this portion of the corridor; **Figure 20** shows their locations.

Figure 20: Location of Angle-Type Crashes Occurring on Eastern Portion of Study Corridor

As can be seen from **Figure 20**, angle-type crashes are distributed throughout the eastern portion of the corridor and are most prominent adjacent to intersections and commercial access points. Treatments and countermeasures to improve safety specific to this portion of the study corridor should particularly address this crash pattern.

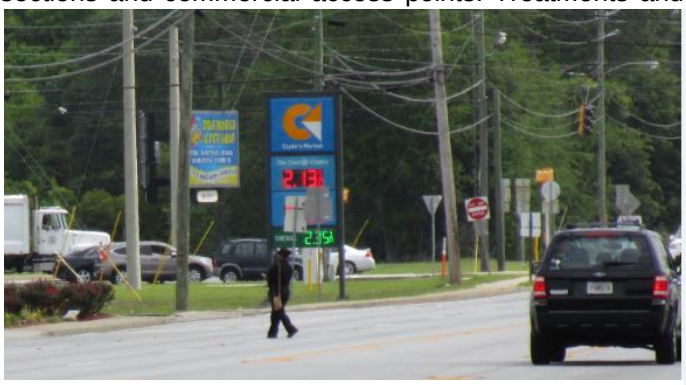


Figure 21: Pedestrian Crossing SR 196 during RSA

Similar to the western portion of the corridor, the eastern portion of the corridor also does not provide any controlled crossing locations for non-motorized users until the signalized intersection with Veterans Parkway to the east. The confluence of commercial access points, along with the surrounding residential developments, results in a facility that is heavily travelled by non-motorized road users. Additionally, non-motorized road users need to reach destinations

on either side of SR 196 and both pedestrians and bicyclists have been observed crossing SR 196 at unmarked locations (**Figure 21**).

This is also evidenced by the two pedestrian fatalities that occurred adjacent to Hearn Road, along with the concentration of bicycle-involved crashes that occurred just west of the signalized intersection with Veterans Parkway. Sidewalks along this portion of the corridor are also in need of repair, such as the location on the north side of SR 196 adjacent to the McDonalds Restaurant shown in **Figure 22**.

Figure 22: View of Sidewalk Needing Repair along Eastern Portion of SR 196 Study Corridor

Conflicts between pedestrians and bicyclists have also been observed due to the limited available sidewalk width, particularly at minor street intersection approaches (**Figure 23**).

Figure 23: View of Crosswalk along SR 196 with Limited Width

While the level of ambient lighting is significantly higher along the eastern portion of the corridor due to the presence of the adjacent commercial developments (**Figure 24**), lighting remains a concern, particularly in relation to non-motorized road users.

Figure 24: View of Westbound SR 196 at Night

The exclusive right-turn lane located on the north side of SR 196 on the eastern edge of the corridor spans more than 1,000 feet and incorporates three commercial driveways and a stop-controlled intersection. As a result, traffic conflicts were observed during the RSA field visit related to vehicles entering the exclusive right-turn lane well before their intended destination. Additionally, the existing downstream terminus, which extends approximately 275 feet beyond the intersection with Sharon Street, results in drivers using this lane as an acceleration lane to merge with westbound SR 196 traffic (**Figure 25**).

Figure 25: View of Exclusive Right-Turn Lane on North Side of SR 196

State route guidance signs located on the north side of SR 196 and west of Veterans Parkway appeared to be previously struck by a vehicle and are misaligned (**Figure 26**).

Figure 26: View of Misaligned State Route Guidance Signs on North Side of SR 196

Recommendations to address these safety issues are presented in **Table 12**, including the specific safety issue addressed by each countermeasure or treatment.

Table 12. Recommendations for Eastern Portion of SR 196 Study Corridor

#	Recommendation	Safety Benefit	Time Frame	Cost/Effort	Safety Issues Addressed
8	Implement raised median including appropriate intersection conversions or potential bicycle lanes along SR 196.	High	Long	High	9,10,12,13,15,16
9	Install additional lighting.	Moderate	Long	High	14
10	Repair damaged sidewalks.	Moderate	Short	Low	11
11	Ensure sufficient width available for non-motorized road users along existing sidewalks.	Moderate	Short	Low	11,12
12	Repair misaligned state route guidance signs.	Low	Short	Low	17
13	Evaluate excessively long exclusive right-turn lane on SR 196 and consider geometric changes to reduce traffic conflicts.	Low	Intermediate	Moderate	16

Several potential design configurations were discussed as a part of the RSA workshop specific to the eastern portion of the study corridor, including a road diet in combination with bicycle lanes, the implementation of a raised median, and other innovative highway designs to improve safety. Ultimately, given the existing traffic volumes, right-of-way limitations, and other site characteristics, it was determined that either the implementation of bicycle lanes or implementation of a raised median may be an appropriate alternative with additional operational analyses.

Implementing bicycle lanes would include the reduction of existing through and center left-turn lane widths to accommodate a bicycle lane of adequate width along SR 196. This also would likely involve reducing the posted speed limit to 35 MPH in this portion of SR 196 to better fit within the context of the modified highway, reducing the risk of crashes between vehicles and non-motorized road users. This alternative would specifically address several safety issues identified in **Table 11**. Additionally, potential changes to the exclusive right-turn lane, as identified in safety issue #8, could be implemented in conjunction with bicycle lanes. While this alternative would directly help to address bicycle-related safety concerns along the corridor, right-of-way limitations and operational impacts may result in this alternative not being feasible at this location. Despite these concerns, the implementation of bicycle lanes merits further study.

The potential raised median would be implemented in conjunction with converting the minor approach stop-controlled intersections along SR 196 to either a RCUT or MUT design, providing a median opening, or otherwise consolidating access to SR 196. While several potential intersection configurations at each location along the corridor may be appropriate based upon further study, RCUT conversions will be assumed for the purposes of performing alternatives analysis. The implementation of a raised median would also provide notable safety benefits to pedestrians along the corridor, providing refuge to allow a two-stage crossing of the five-lane arterial. Raised medians also provide several additional benefits according to the FHWA, including potentially decreasing vehicular delay, increasing capacity, and reducing vehicular speeds.

Installing lighting along this section of the corridor would provide notable safety benefits, addressing all potential crash types occurring at night. This treatment is particularly important in improving the roadway environment for pedestrians and bicyclists, and would complement all the recommendations provided in **Table 12**. Repairing the damaged sidewalks along the corridor and ensuring adequate width would support non-motorized road users, representing low-cost, short-term improvements that can provide moderate safety benefits.

4.3. Intersection with Veterans Parkway

The signalized intersection with Veterans Parkway at the eastern end of the corridor represents the connection of two urban minor arterials, serving almost 34,000 total vehicles per day. SR 196 maintains its five-lane configuration on either side of Veterans Parkway; however, exclusive right-turn lanes are provided at the intersection. Veterans Parkway is a four-lane, divided highway on either side of SR 129; however, dual exclusive left-turn lanes and exclusive right-turn lanes are provided at the intersection. The 187 total crashes that occurred during the five-year study period represents nearly 36 percent of all crashes along the study corridor, demonstrating that enhancements to this urban signalized intersection provide a substantial opportunity to improve safety performance. In fact, the 28.8 annual excess crashes estimated by the EB-method analysis represents more than 65 percent of all excess crashes along the corridor. **Table 13** summarizes the safety issues specific to the intersection of SR 196 and Veterans Parkway identified as a part of this evaluation.

Table 13. Safety Findings for Elma G. Miles and Veterans Parkway Intersection

#	Location	Safety Findings/Comments
18	Veterans Parkway Intersection	Relatively high approach speeds at intersection and complex visual environment for drivers
19	Veterans Parkway Intersection	Signal heads lack retroreflective backplates; supplementary signal heads are not present

#	Location	Safety Findings/Comments
20	Veterans Parkway Intersection	Eastbound and Westbound signal heads do not have flashing yellow arrows
21	Veterans Parkway Intersection	Significant queues were observed along several approaches
22	Veterans Parkway Intersection	Channelizing islands require drivers to look over their shoulder to view cross traffic
23	Veterans Parkway Intersection	Pedestrian signals missing count down signal heads
24	Veterans Parkway Intersection	Driveways within functional area of intersection
25	Veterans Parkway Intersection	W3-3 Signal Ahead warning signs are placed too far upstream and have lost retro reflectivity

Approach speeds to the intersection were noted to be relatively high during the RSA process, a concern that is evidenced by the fact that 140 of the 187 crashes that occurred at this location were rear end in nature. The combination of the relatively high approach speeds with the queues that form during the peak hours at this location (shown in **Figure 27**) compound this concern, leading the noted pattern of rear end crashes.

Figure 27: View of Westbound SR 196 at Veterans Parkway Intersection

The existing traffic signal heads at the intersection do not include retroreflective backplates (shown in **Figure 28**). Additionally, four-level flashing yellow arrow signal heads are not included for the eastbound and westbound left-turn movements, as the existing signal heads employ the dog-house design. Supplementary signal heads are also not present, which may help to provide additional guidance to drivers attempting to complete left-turn movements.

Figure 28: View of Eastbound Signal Heads at Veterans Parkway Intersection

The existing raised concrete channelizing islands were implemented with a higher deflection angle that can result in drivers having to look over their shoulder to observe conflicting traffic. As a result, a pattern of rear end crashes within the channelized right-turns was observed during the five-year study period (**Figure 29**).

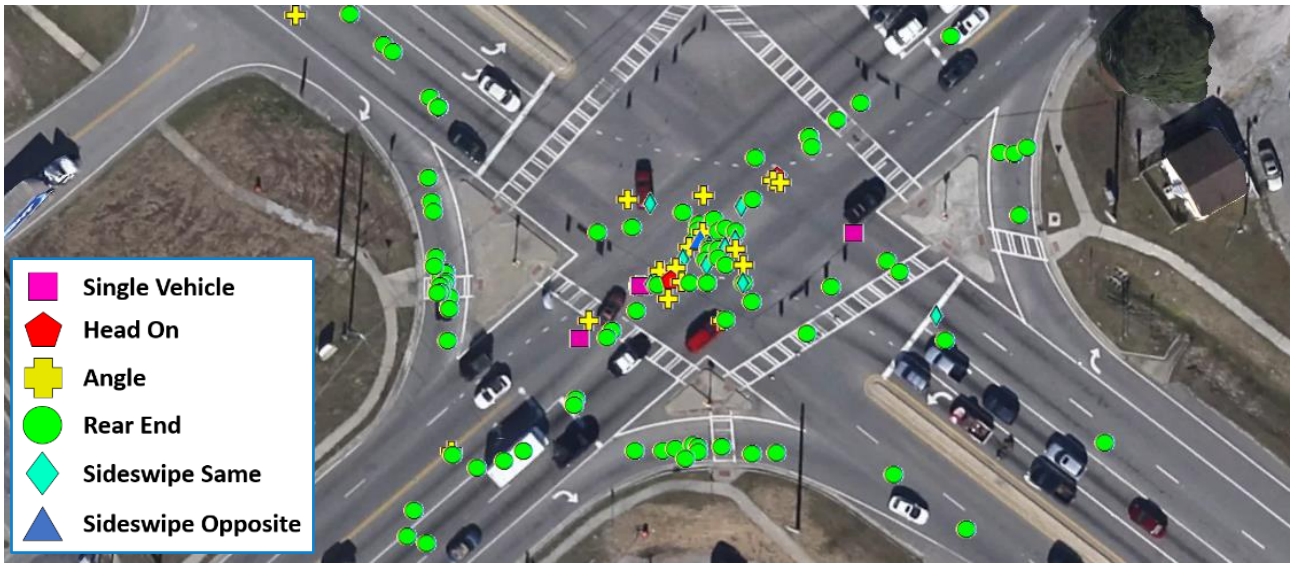


Figure 29: Pattern of Rear End Crashes in Channelized Right-Turn Lanes (2012-2016)

While pedestrian signal heads and push button actuation are present at this location, pedestrian count down signal heads have not been included (**Figure 30**). The RSA team determined the crosswalks and ADA-complaint ramps present at this location are in good condition.

Figure 30: View of Pedestrian Signal Head and Push Button Actuation

Due to the relatively high access point density present along this portion of SR 196, there are driveways located within the functional area of the signalized intersection. In particular, the gas station driveways located on the north leg of the intersection represent a potential safety concern. This is evidenced by the fact that four angle-type crashes occurred during the five-year study period involving vehicles entering or exiting these driveways (shown in **Figure 31**).

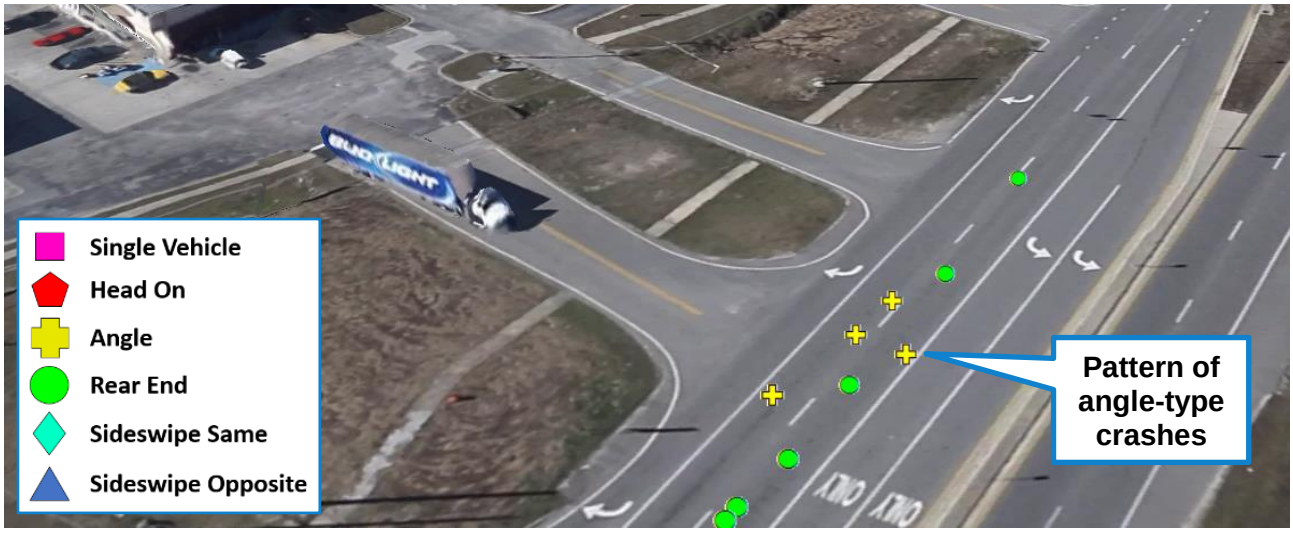


Figure 31: View of Northern Leg of Elma G. Miles and Veterans Parkway Intersection

While the W3-3 Signal Ahead warning signs are placed along each approach to the intersection, these devices are past their useful service life and are not providing appropriate retro-reflectively (**Figure 32**). Additionally, these devices are located too far downstream to provide the necessary warning to drivers of the upcoming intersection, especially considering the queues often observed during the peak hour (an example of vehicles queued beyond the W3-3 sign is shown in **Figure 27**).

Figure 32: View of Westbound SR 196 at Veterans Parkway Intersection

Recommendations to address these safety issues are presented in **Table 14**, including the specific safety issue addressed by each countermeasure or treatment.

Table 14. Recommendations for Elma G. Miles and Veterans Parkway Intersection

#	Recommendation	Safety Benefit	Time Frame	Cost/Effort	Safety Issues Addressed
14	Replace existing channelizing islands with updated 30-60-90 degree raised concrete channelizing islands.	High	Intermediate	Moderate	22
15	Eliminate direct left-turn movements from Veterans Parkway using MUT design.	High	Long	High	18
16	Replace and relocate W3-3 Signal Ahead warning signs farther upstream.	Moderate	Short	Low	18,21,25
17	Perform signal timing study to potentially reduce queueing.	Moderate	Short	Low	21
18	Install pedestrian count down signal heads.	Moderate	Intermediate	Moderate	23
19	Install flashing yellow arrows for left-turn signal heads on eastbound and westbound approaches.	Moderate	Intermediate	Low	18,20
20	Install retroflective backplates.	Moderate	Intermediate	Low	18,19
21	Install supplementary signal heads.	Moderate	Intermediate	Low	18,19
22	Consider implementation of dual left-turn lanes for SR 196 approaches.	Low	Intermediate	High	21
23	Consolidate driveways in functional area of intersection.	Low	Intermediate	Low	24

Given the presence of significant non-motorized traffic at this location, treatments to improve pedestrian and bicycle safety performance are a critical element of this RSA. Pedestrian count down signal heads have been shown to improve non-motorized safety performance, and replacing the existing pedestrian signal heads with

count down heads would provide additional guidance to pedestrians attempting to cross this complex urban intersection.

The existing W3-3 Signal Ahead warning signs are beyond their useful service life; replacing these signs would greatly improve their conspicuity, especially under dark conditions. Further, relocating these devices farther upstream would provide additional guidance to drivers of the upcoming signalized intersection. This would directly help to address safety issues #18, #21 and #25. It should be noted that the bicycle lane alternative identified for the eastern portion of the SR 196 corridor would also help to address safety issue #18 related to high approach speeds on the western leg.

The installation of retroreflective backplates, supplementary signal heads, and flashing yellow arrows for the eastbound and westbound left-turn signal heads would also help to improve traffic signal conspicuity, providing additional guidance to drivers in this complex visual environment. It should be noted that the recommended signal treatments may not be appropriate in combination with recommendations #21 and #23. A review of the existing signal timing may also identify opportunities to reduce queuing to address safety issue #21.

The implementation of 30-60-90 degree raised concrete channelizing islands would represent a significant improvement over the existing condition, helping to address the pattern of rear end-type crashes shown in **Figure 29.** Consolidating driveways within the functional area of the intersection, specifically the gas station driveways located on the northern leg, would directly help to address the crash pattern shown in **Figure 31**.

Altering the SR 196 approaches to include dual left-turn lanes may help to address queueing observed during the peak hour. This is particularly relevant given the presence of Fort Stewart north of the intersection, as army post traffic frequently uses SR 196 to access Fort Stewart from Veterans Parkway. An additional alternative would be to eliminate direct left-turn movements from Veterans Parkway, and implement a MUT design, which would require left-turn movements to use a cross-over downstream along Veterans Parkway before making a right-turn movement at the signalized intersection to complete the left-turn. While these alternatives would require additional study to determine feasibility, geometric improvements to this signalized intersection represent a significant opportunity to improve safety performance.

5. Conclusions

The SR 196/Elma G. Miles Parkway corridor represents an important component of the central Liberty County transportation system, providing a connection between various state routes as well as access to adjacent residential and urban developments. The corridor also serves considerable non-motorized traffic due to the surrounding land use. Despite several safety measures already in place, the SR 196/Elma G. Miles Parkway corridor experienced an annual average of more than 105 crashes during the last five years. In particular, the high-speed uncontrolled nature of SR 196 in this area, combined with relatively high driveway densities, a lack of ambient lighting, and incomplete non-motorized facilities, results in a corridor that exhibits an increased risk for crashes with injuries to crash-involved occupants. The signalized intersection located at Veterans Parkway also represents an elevated risk for traffic crashes, particularly due to frequent queueing, relatively high approach speeds, and right-turn channelizing islands implemented with an older deflection angle design.

This report formally summarizes the findings and recommendations of the audit team. A complete list of recommendations is provided in **Appendix D**.

The short-term recommendations include:

- Repairing damaged sidewalk and signage along the corridor,
- Ensuring that sufficient width is available along existing sidewalks,
- Replacing a painted channelizing island at Miles Crossing,
- Relocating W3-3 Signal Ahead warning signs at Veterans Parkway farther upstream, and
- Performing a signal timing study to reduce queueing at Veterans Parkway.

Intermediate-term recommendations include:

- Installing sidewalks along the corridor consistent with the planned Liberty County sidewalk project,
- Implementing a multi-use path,
- Evaluating the excessively long exclusive right-turn lane on SR 196,
- Upgrading the traffic signals and right-turn channelizing islands at the Veterans Parkway signalized intersection,
- Closing driveways within the functional area of the Veterans Parkway intersection, and
- Implementing dual left-turn lanes at the Veterans Parkway intersection.

Long-term recommendations include:

- Implementing a raised median along SR 196,
- Implementing a pedestrian hybrid beacon along SR 196,
- Installing additional lighting, and
- Eliminating direct left-turns at the Veterans Parkway intersection by converting to a MUT design.

The RSA team suggests that the recommendations stated in this report be implemented as resources become available. The responsible agency(s) should document any decisions to modify or eliminate recommendations based on engineering judgement or lack of feasibility.

Appendix A – RSA Invite/Attendees

SR 196 / Elma G Miles Parkway RSA
Live Oak Church Road to Veterans Parkway
Sign-In Sheet

4/18/2017

Name	Organization	Phone	Email
Michael Turpeau Jr.	GDOT		mturpeau@dot.ga.gov
Greg Morris	FHWA		greg.morris@dot.gov
Kesha Wynn	GDOT		kwynn@dot.ga.gov
Kenneth Cullens Jr.	GDOT /DSTO		kcullens@dot.ga.gov
Bryan Hillyard	GDOT /DSTO		bhillyard@dot.ga.gov
Tyler Vaughn	GDOT /DSTO		tvaughn@dot.ga.gov
Tracey E. Howard	Hinesville Police		thoward@cityofhinesville.org
Donnie Boyd	GDOT		dboyd@dot.ga.gov
Joey Brown	LCBOC		Joey.Brown@libertycounty.ga.gov
Jeff Ricketson	LCPC		jricketson@thelcpc.org
Trent Long	Liberty Co.		trlong@trlongeng.com
Keith Jenkins	LCSO		jenkinskarate@comcast.net
Jeff Bagdade	Atkins		Jeff.Bagdade@atkinsglobal.com
Jonathan Kay	Atkins		Jonathan.Kay@atkinsglobal.com

Appendix B – Crash Data

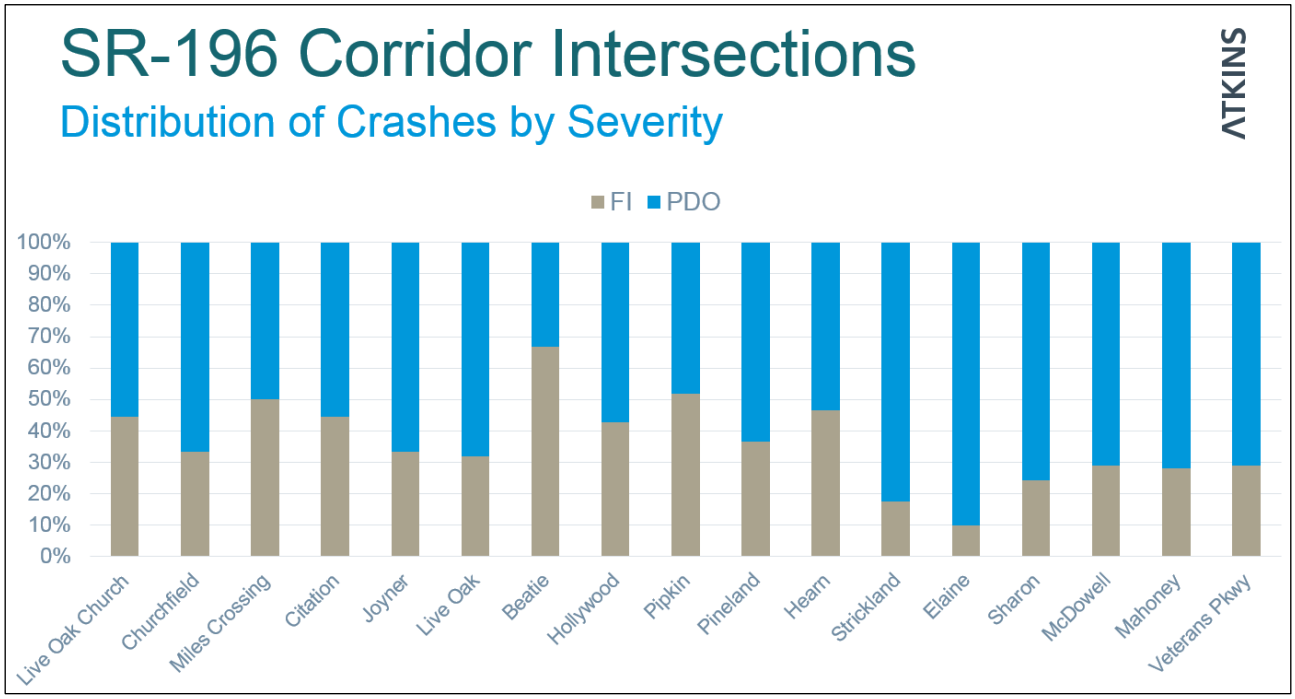


Figure A-1 Distribution of Intersection Crashes by Severity

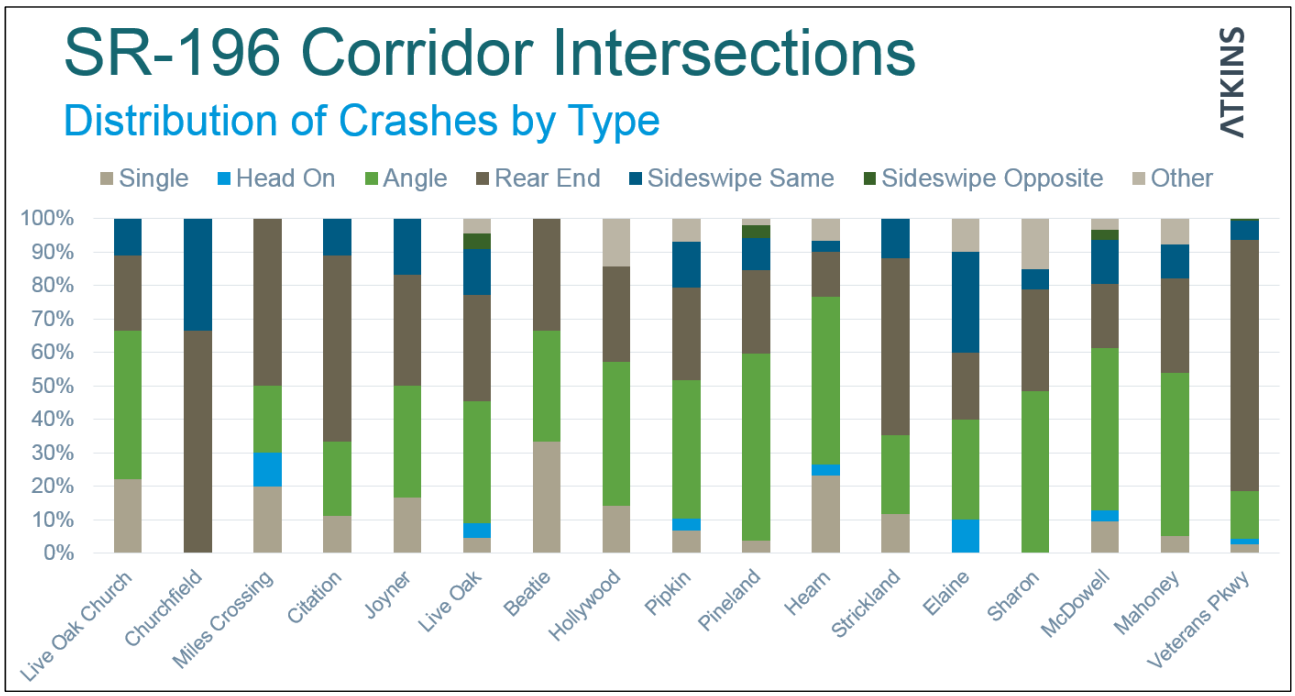


Figure A-2 Distribution of Intersection Crashes by Type

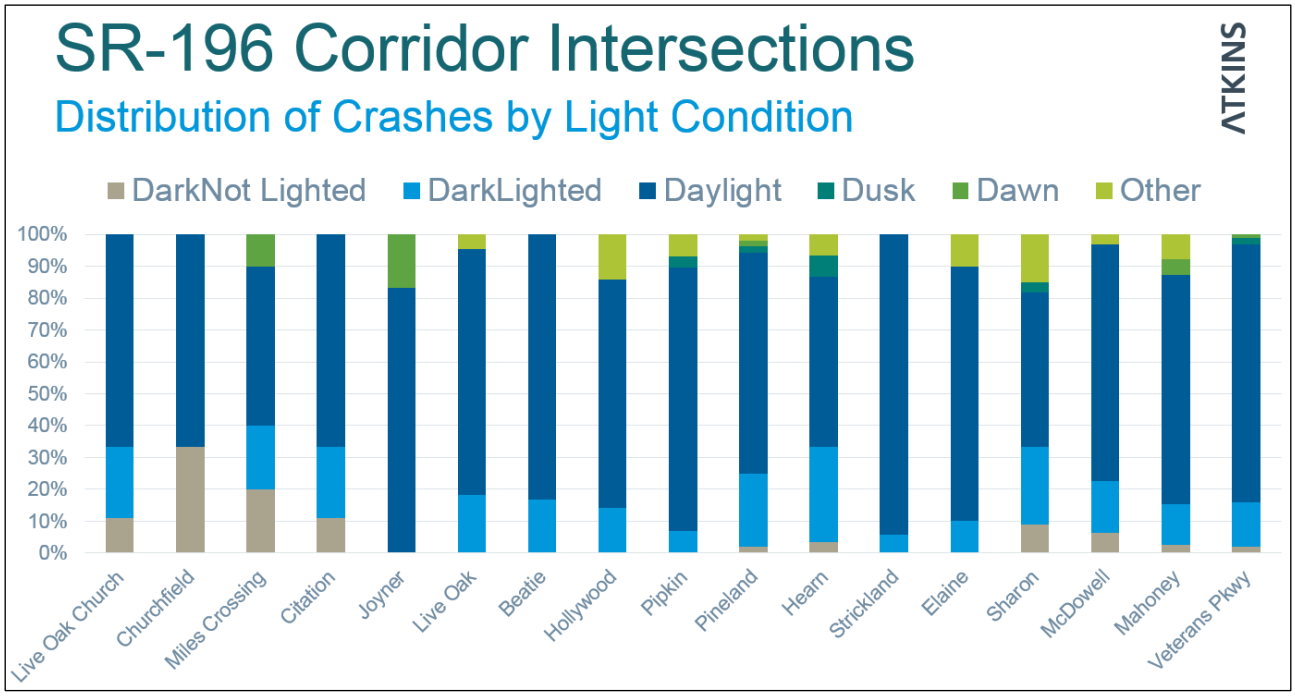


Figure A-3 Distribution of Intersection Crashes by Light Condition

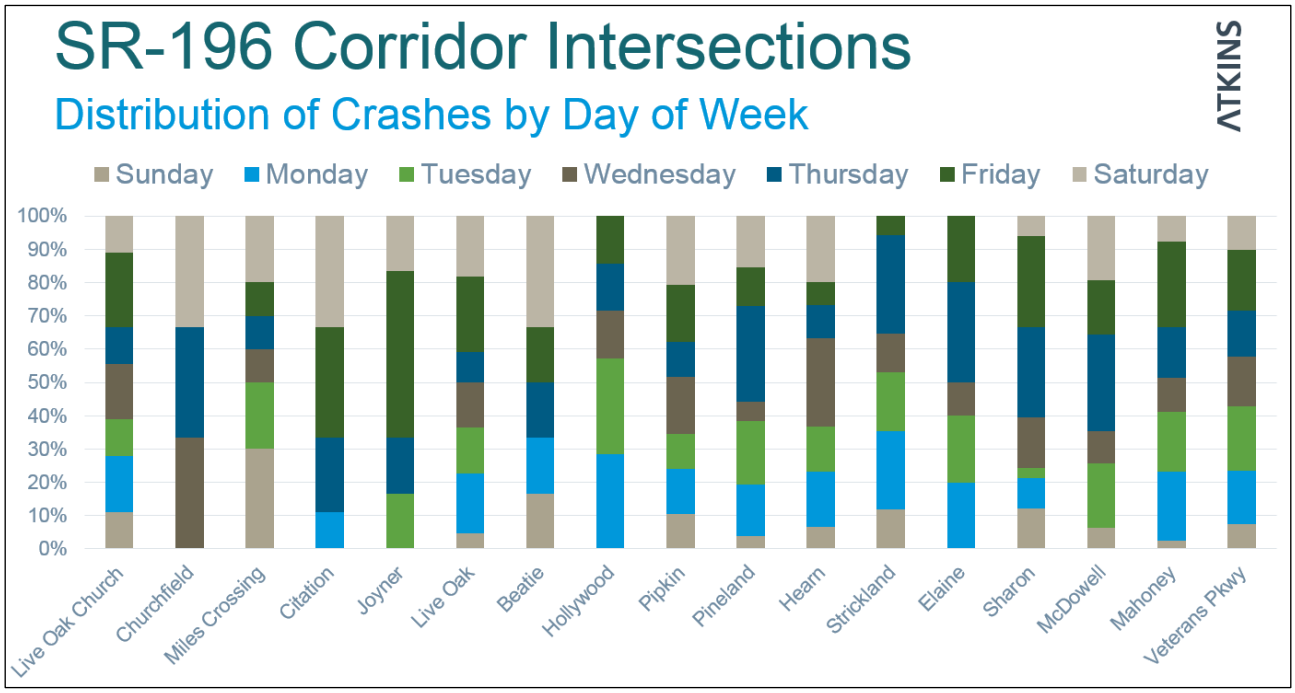


Figure A-4 Distribution of Intersection Crashes by Day of Week

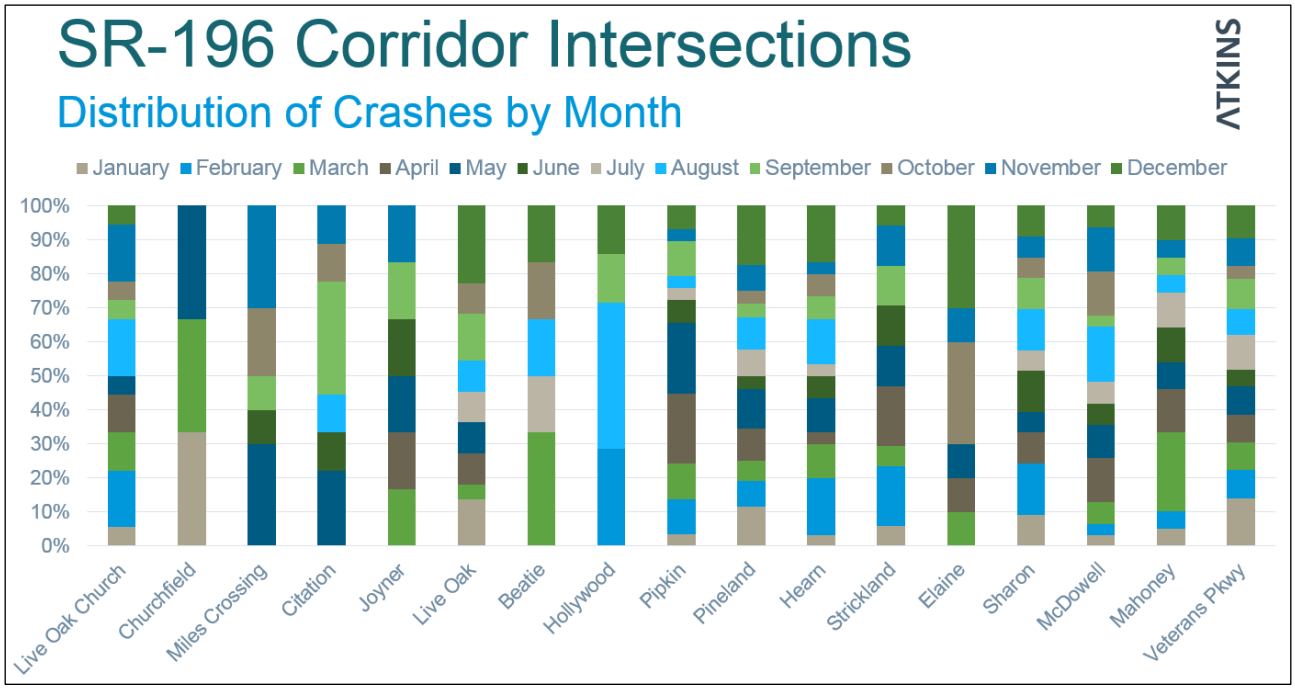


Figure A-5 Distribution of Intersection Crashes by Month

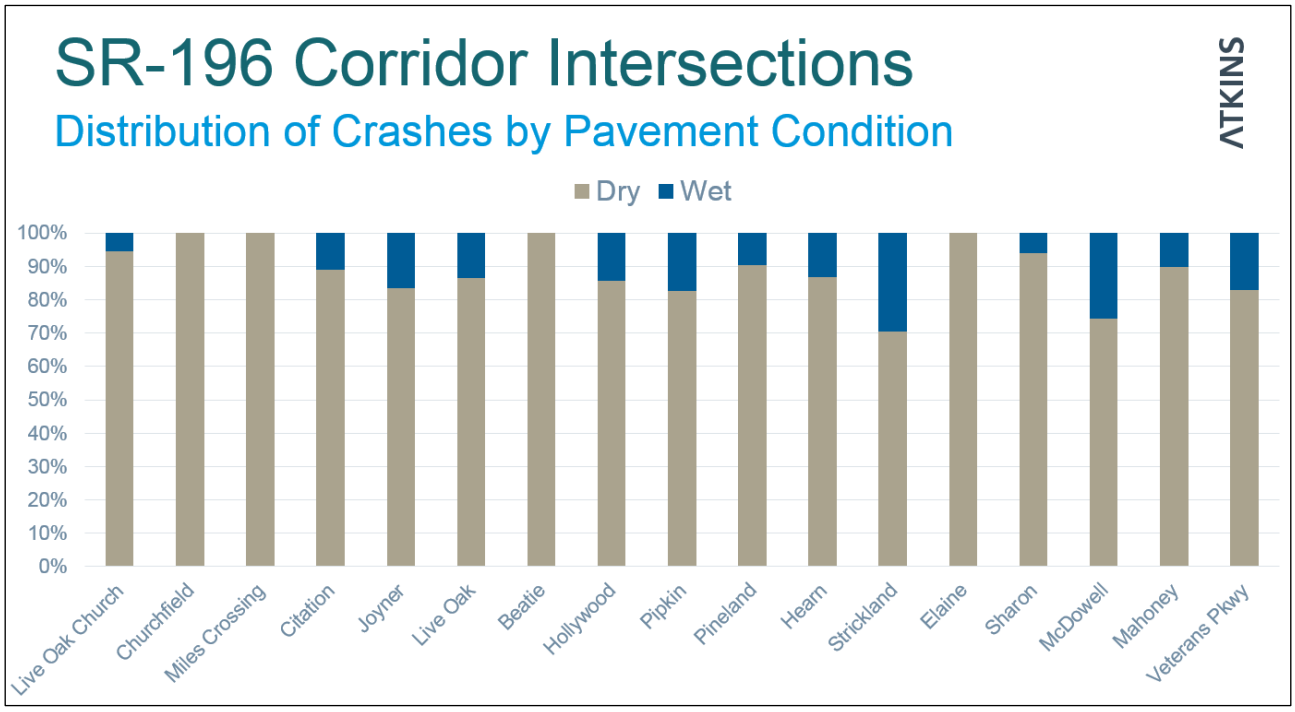


Figure A-6 Distribution of Intersection Crashes by Pavement Condition

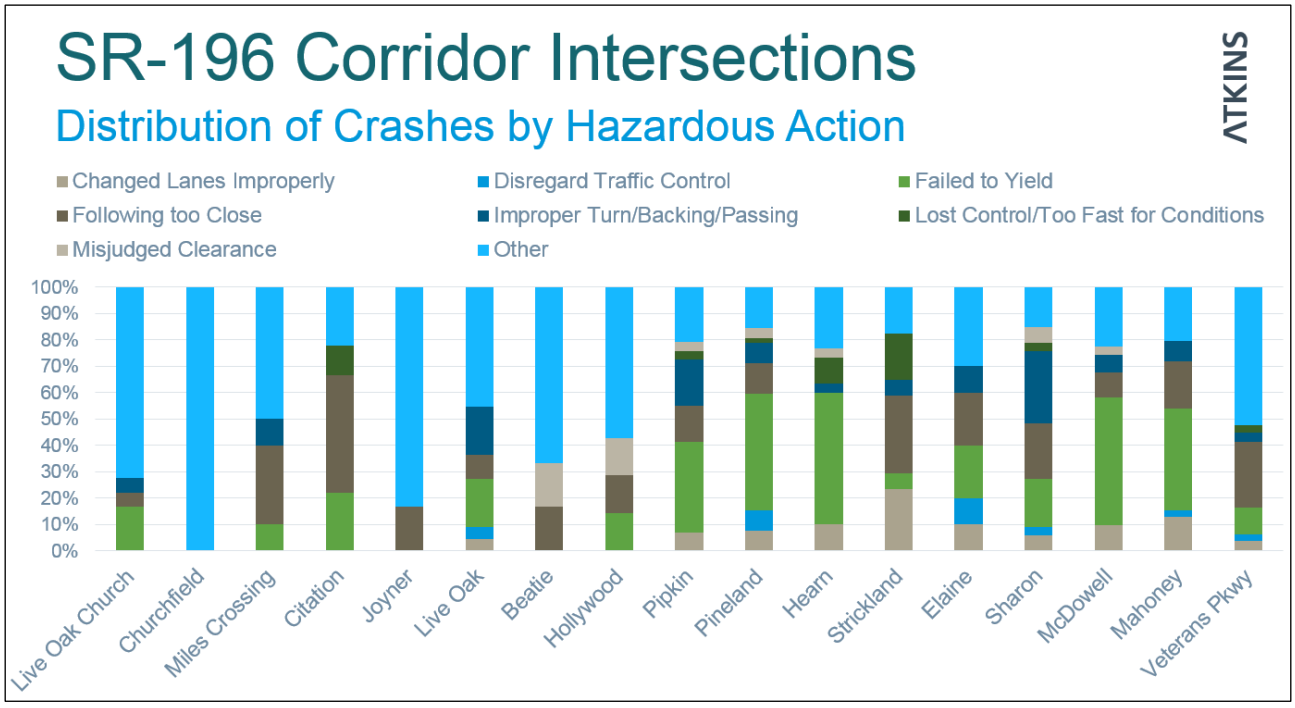


Figure A-7 Distribution of Intersection Crashes by Hazardous Action

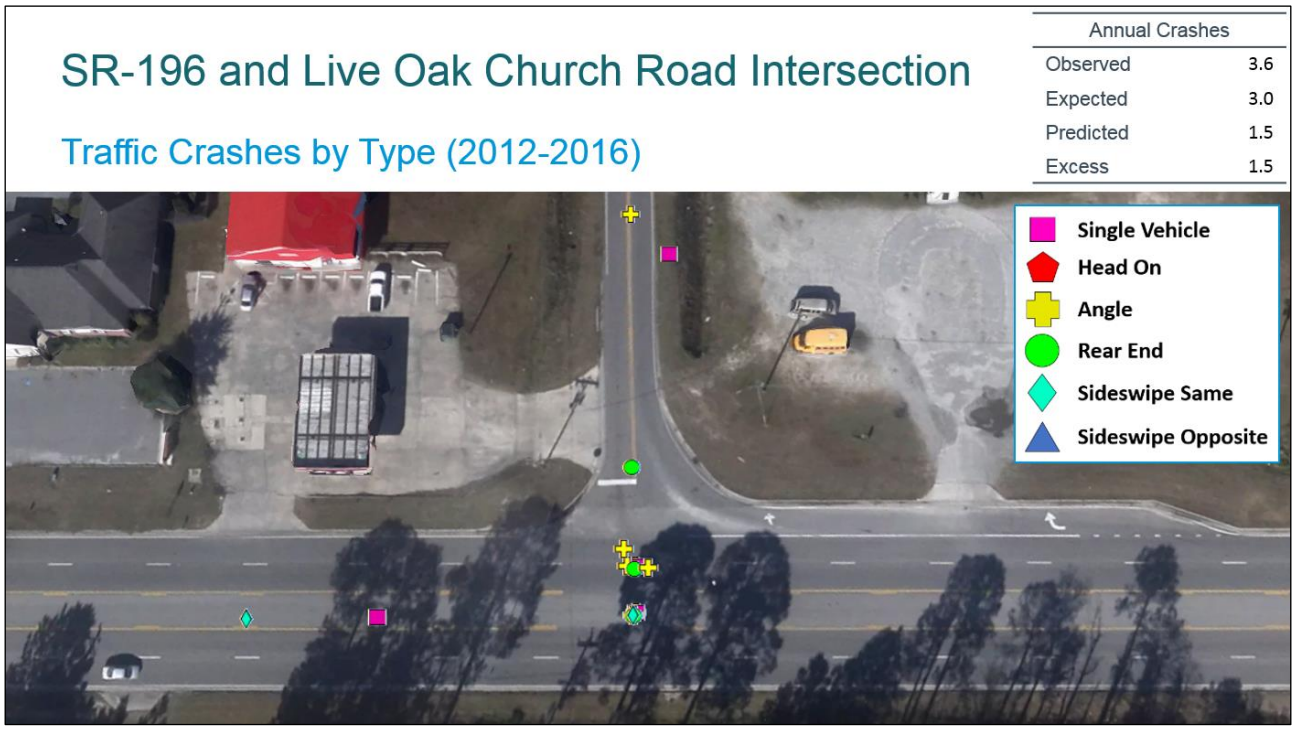


Figure A-8 Crash Diagram for SR-196 and Live Oak Church Road Intersection (2012-2016)

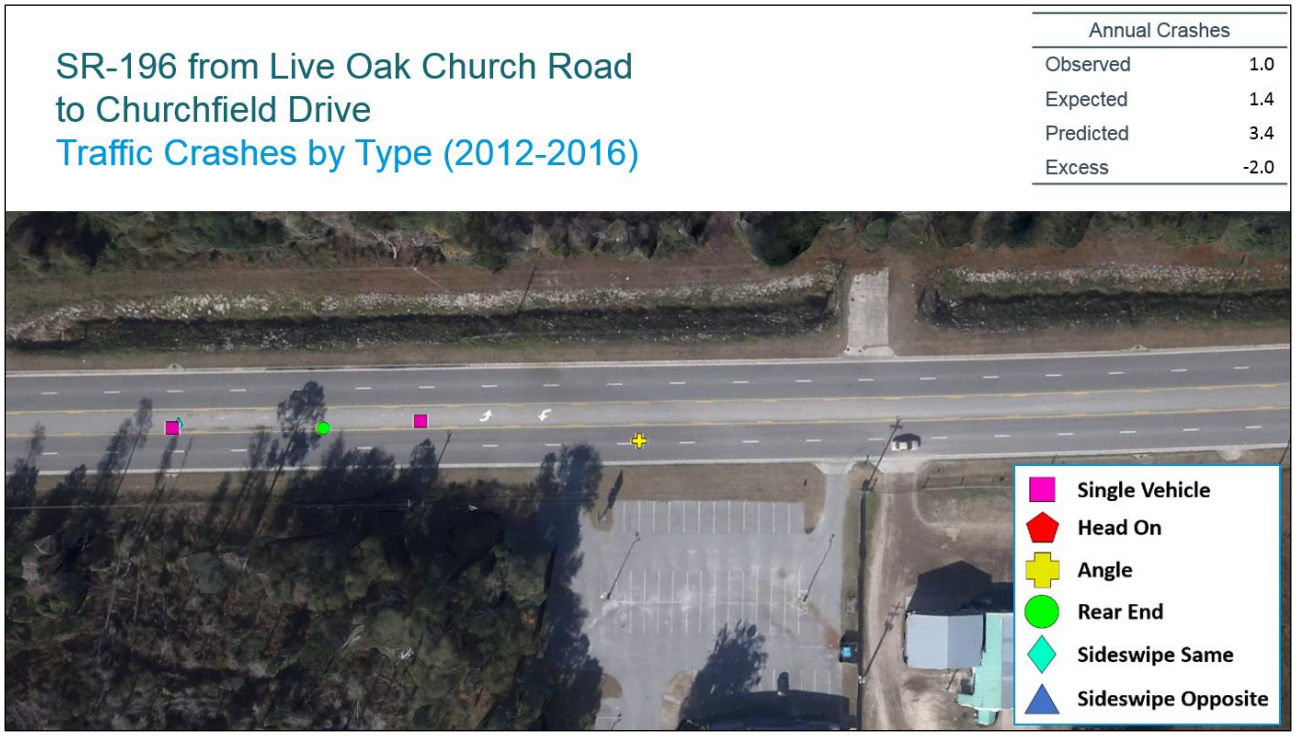


Figure A-9 Crash Diagram for SR-196 from Live Oak Church Road to Churchfield Drive (2012-2016)

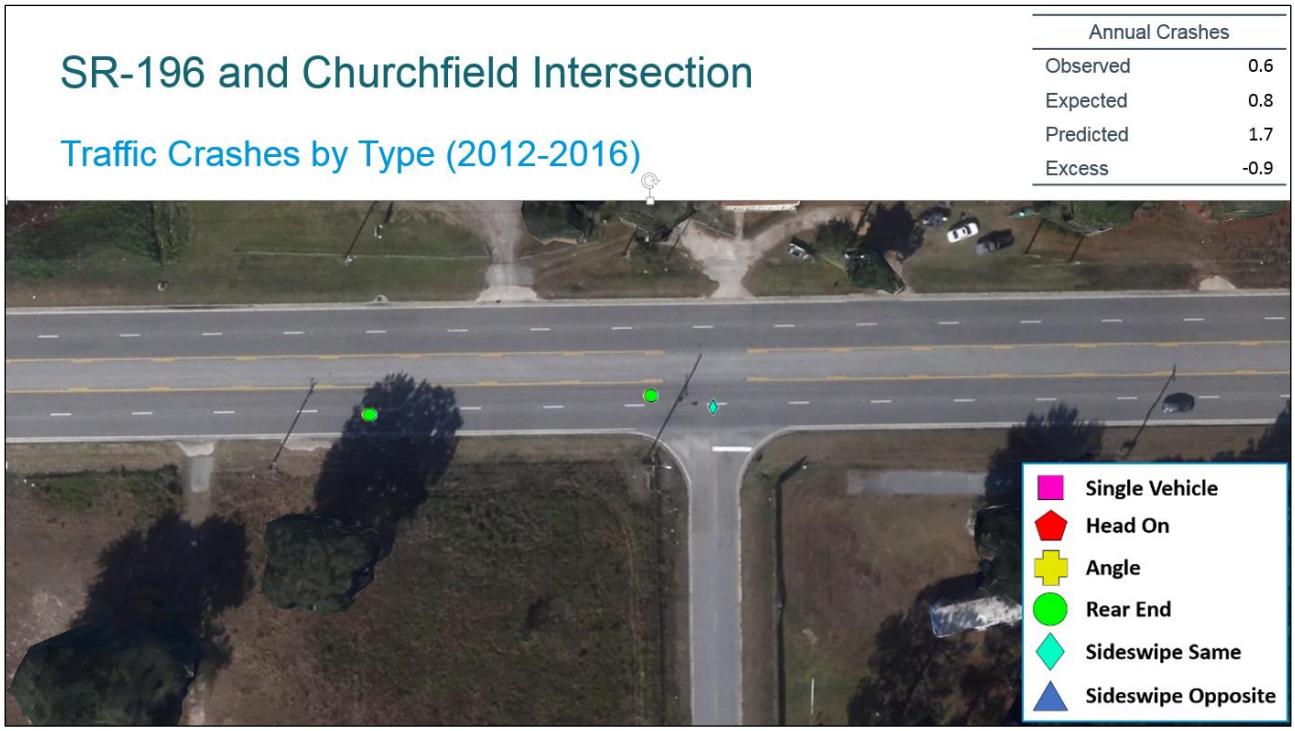


Figure A-10 Crash Diagram for SR-196 and Churchfield Intersection (2012-2016)

Figure A-11 Crash Diagram for SR-196 and Miles Crossing Intersection (2012-2016)

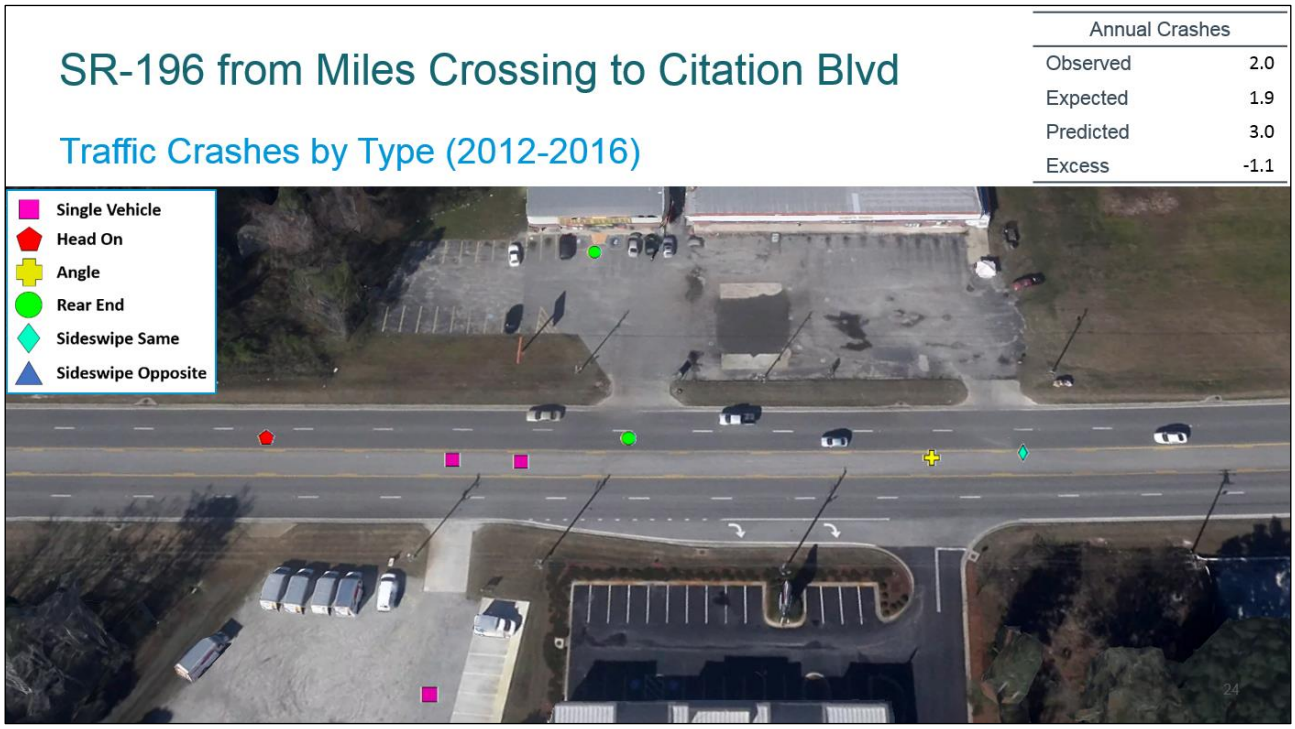


Figure A-12 Crash Diagram for SR-196 from Miles Crossing to Citation Blvd (2012-2016)

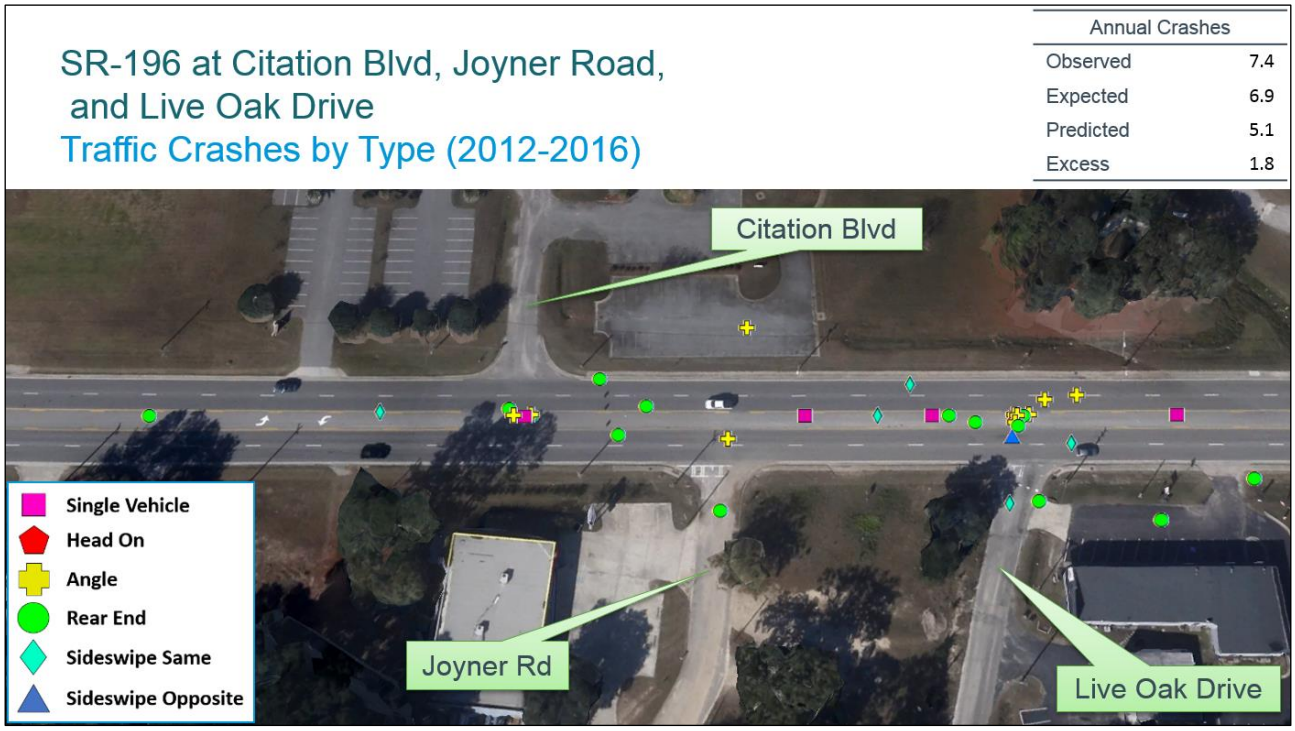


Figure A-13 Crash Diagram for SR-196 at Citation Blvd, Joyner Road, and Live Oak Drive (2012-2016)

Figure A-14 Crash Diagram for SR-196 and Beatie Blvd Intersection (2012-2016)

Figure A-15 Crash Diagram for SR-196 and Hollywood Drive Intersection (2012-2016)

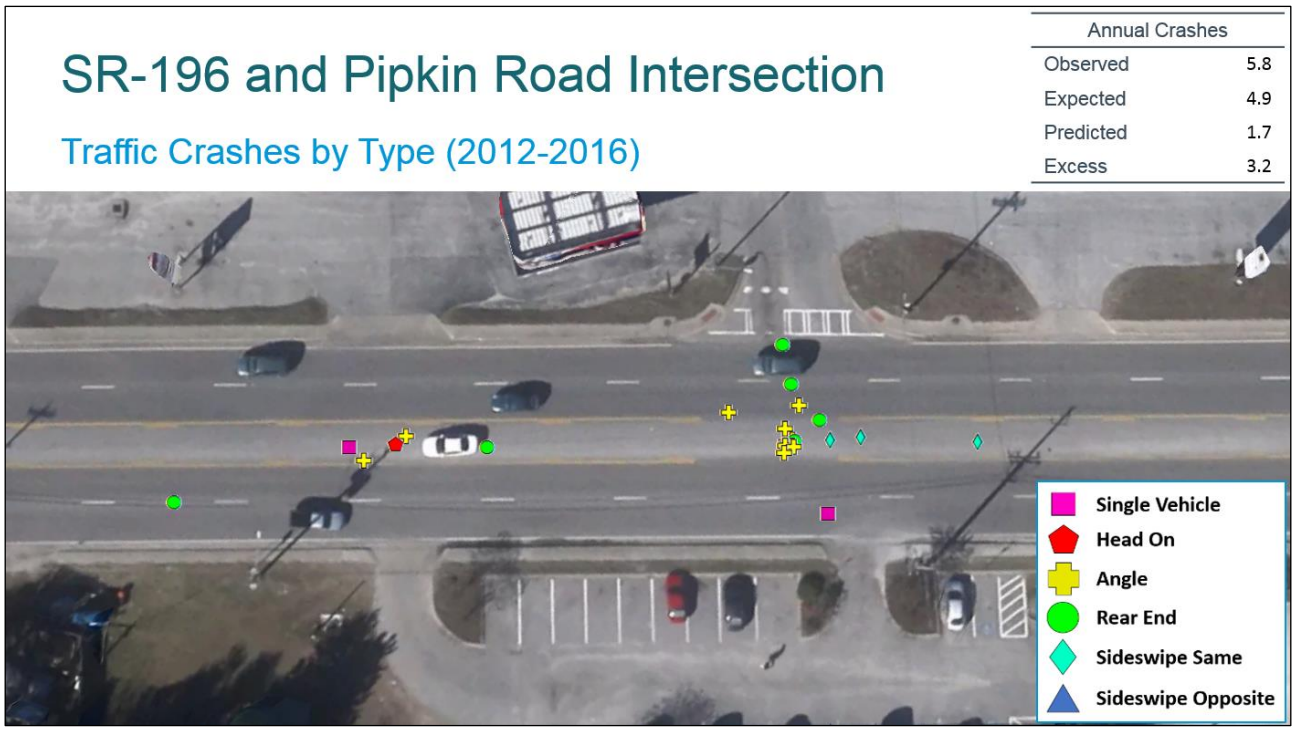


Figure A-16 Crash Diagram for SR-196 and Pipkin Road Intersection (2012-2016)

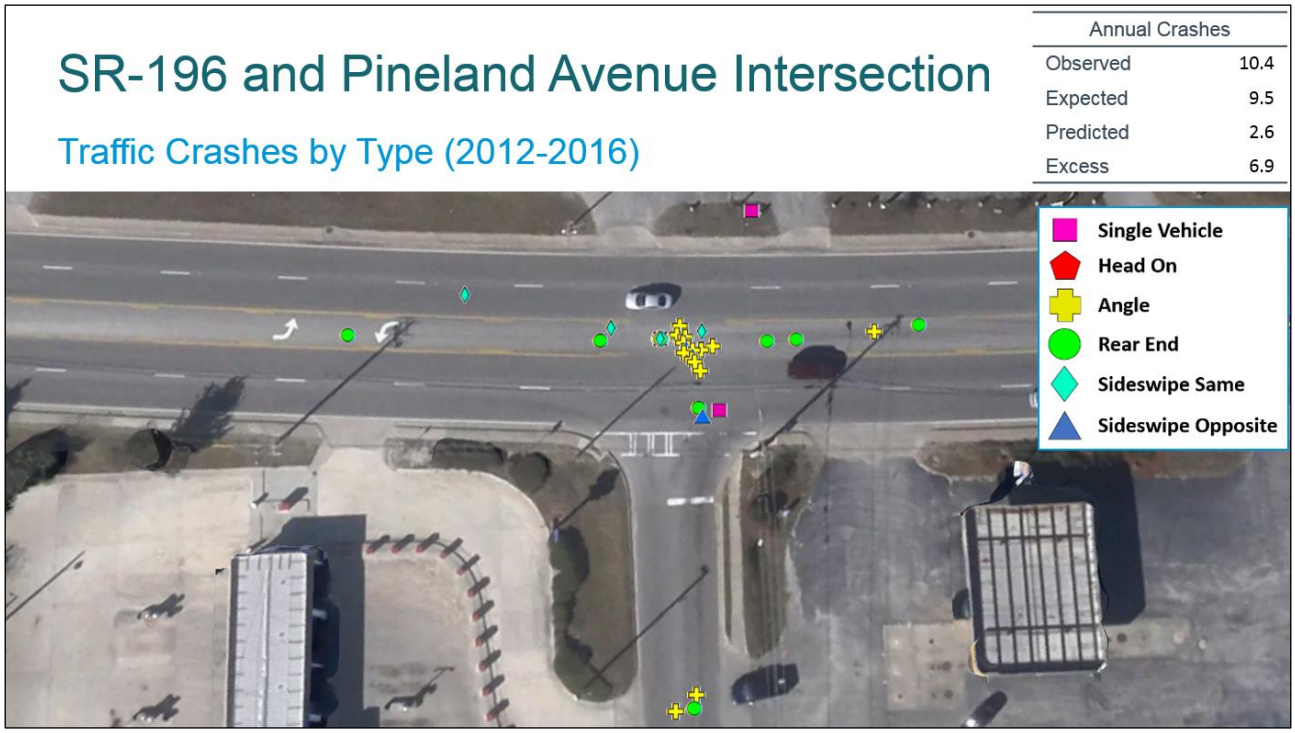


Figure A-17 Crash Diagram for SR-196 and Pineland Avenue Intersection (2012-2016)

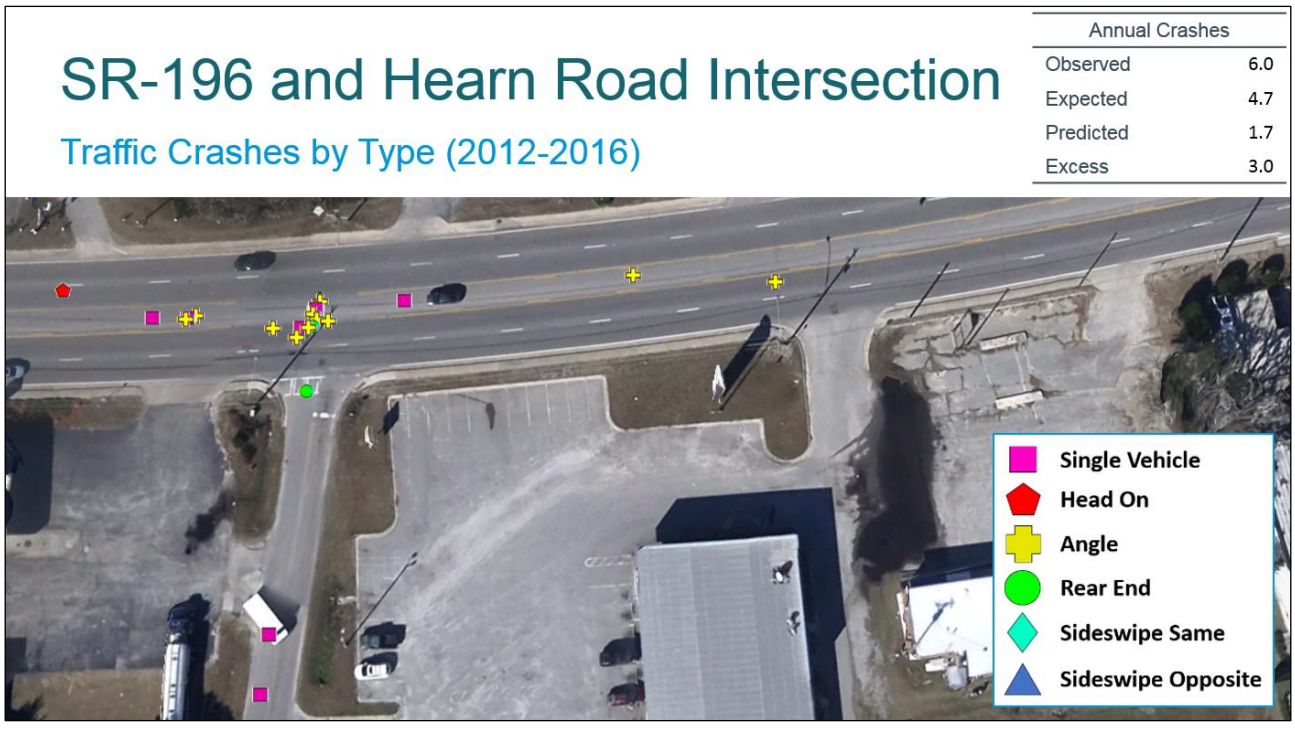


Figure A-18 Crash Diagram for SR-196 and Hearn Road Intersection (2012-2016)

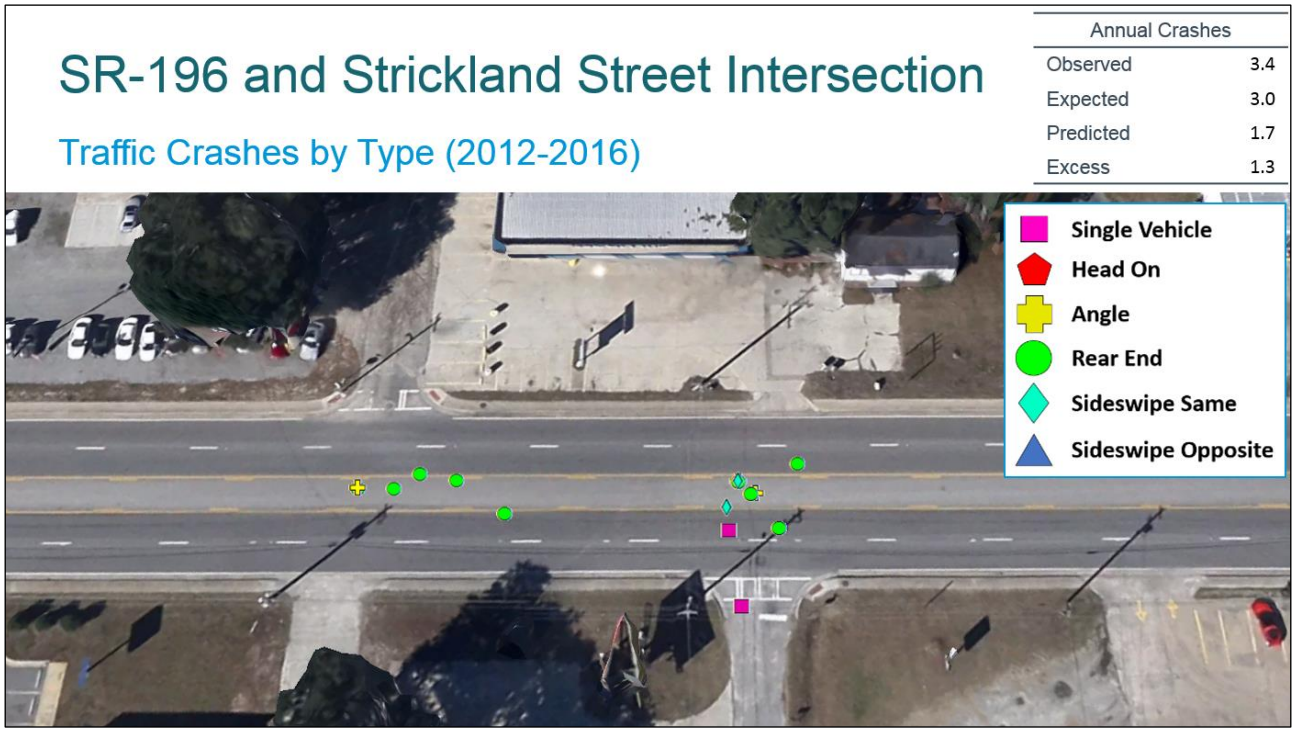


Figure A-19 Crash Diagram for SR-196 and Strickland Street Intersection (2012-2016)

Figure A-20 Crash Diagram for SR-196 and Elaine Street Intersection (2012-2016)

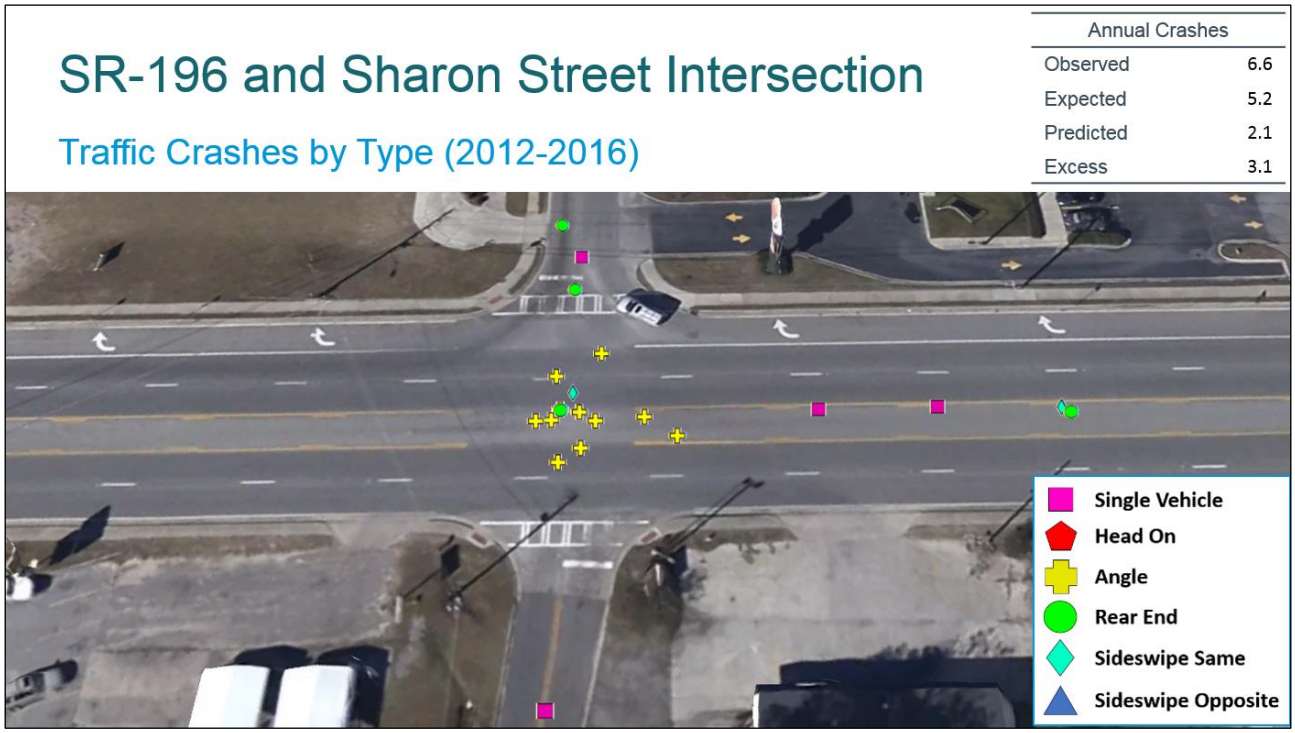


Figure A-21 Crash Diagram for SR-196 and Sharon Street Intersection (2012-2016)

Figure A-22 Crash Diagram for SR-196 and McDowell Road Intersection (2012-2016)

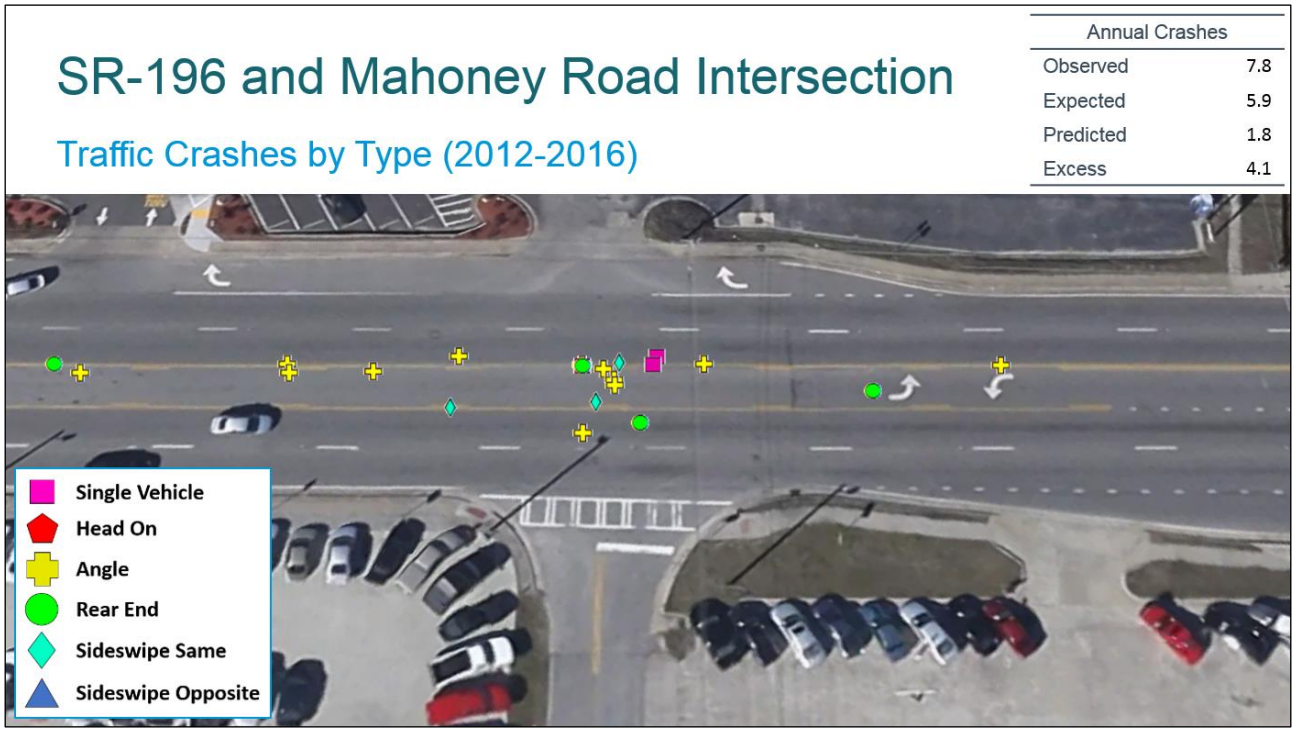


Figure A-23 Crash Diagram for SR-196 and Mahoney Road Intersection (2012-2016)

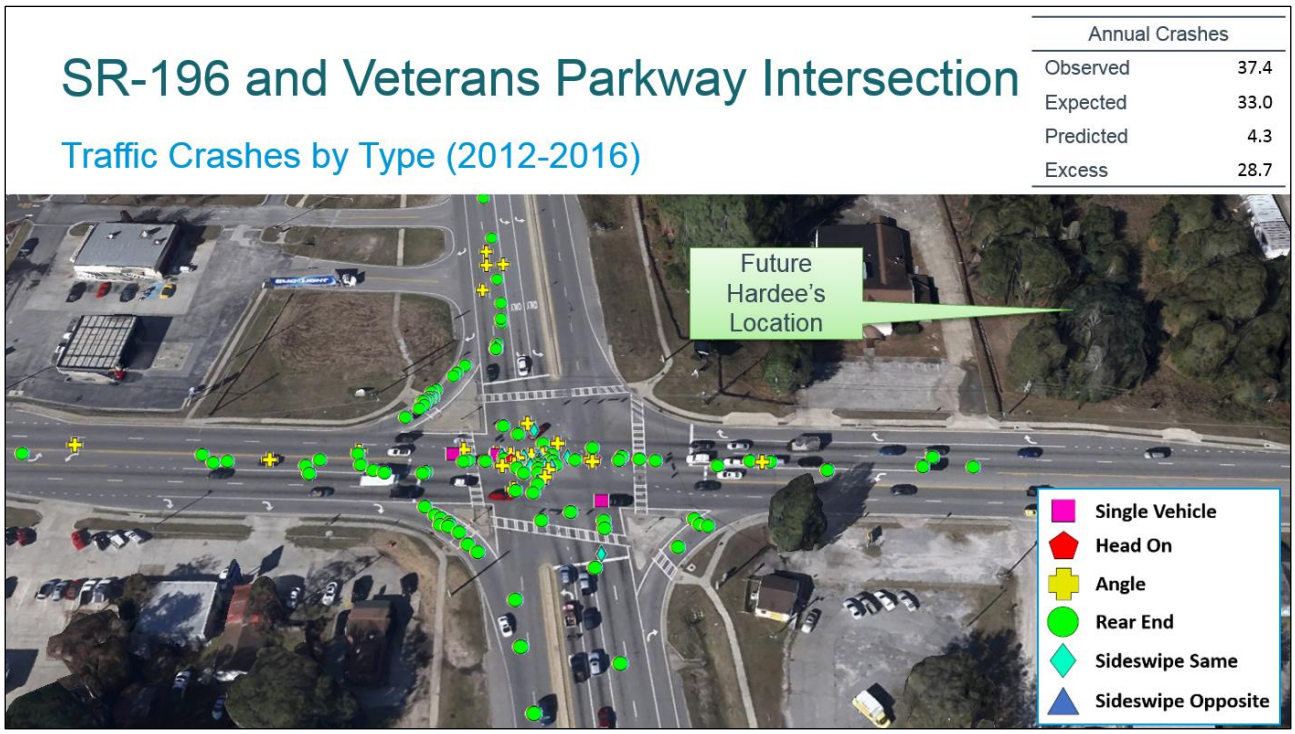
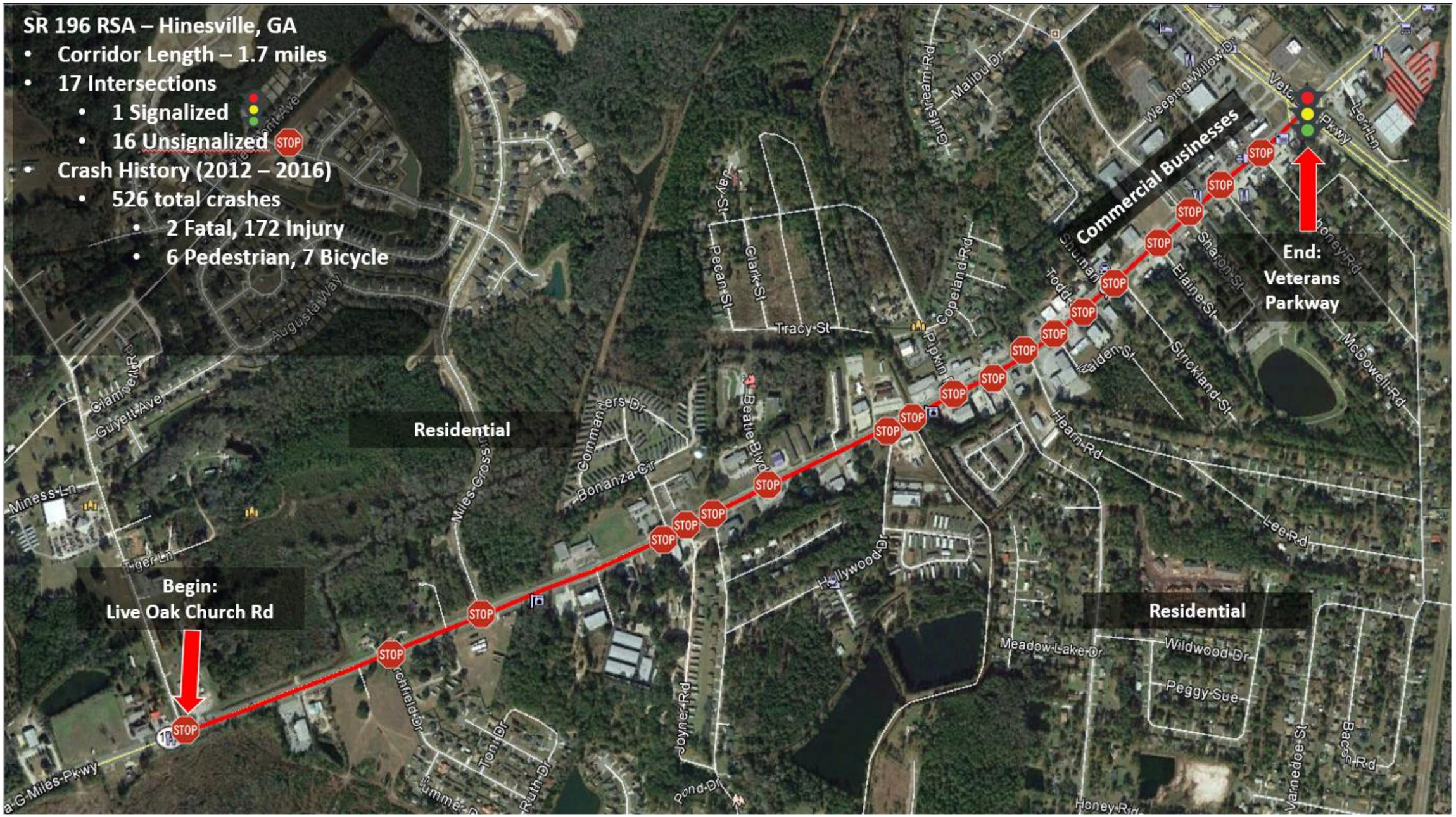


Figure A-24 Crash Diagram for SR-196 and Veterans Parkway Intersection (2012-2016)

Appendix C – RSA Map



Appendix D – RSA Recommendations List

Location	RSA Item	Recommendation	Safety Benefit	Time Frame	Cost/Effort
Western SR 196 Study Corridor	1	Install sidewalks where missing, including ADA-compliant crosswalks. Should be coordinated with planned Liberty County sidewalk installation project.	High	Intermediate	Moderate
	2	Implement raised median along SR 196, including converting intersections to either RCUT, MUT, or other appropriate design in conjunction with median.	High	Long	High
	3	Implement pedestrian hybrid beacon to allow controlled crossing along SR 196.	High	Long	Moderate
	4	Implement multi-use path to accommodate bicyclists. Should be coordinated with planned Liberty County sidewalk installation project.	Moderate	Intermediate	Moderate
	5	Install additional lighting.	Moderate	Long	High
	6	Protect or remove adjacent ditches along SR 196. Should be coordinated with planned Liberty County sidewalk installation project.	Low	Short	Low
	7	Replace painted channelizing island at Miles Crossing with raised concrete island.	Low	Short	Low
Eastern SR 196 Study Corridor	8	Implement raised median including appropriate intersection conversions or potential bicycle lanes along SR 196.	High	Long	High
	9	Install additional lighting.	Moderate	Long	High
	10	Repair damaged sidewalks.	Moderate	Short	Low
	11	Ensure sufficient width available for non-motorized road users along existing sidewalks.	Moderate	Short	Low
	12	Repair misaligned state route guidance signs.	Low	Short	Low
	13	Evaluate excessively long exclusive right-turn lane on SR 196 and consider geometric changes to reduce traffic conflicts.	Low	Intermediate	Moderate

Location	RSA Item	Recommendation	Safety Benefit	Time Frame	Cost/Effort
SR 196 at Veterans Parkway	14	Replace existing channelizing islands with updated 30-60-90 degree raised concrete channelizing islands.	High	Intermediate	Moderate
	15	Eliminate direct left-turn movements from Veterans Parkway using MUT design.	High	Long	High
	16	Replace and relocate W3-3 Signal Ahead warning signs farther upstream.	Moderate	Short	Low
	17	Perform signal timing study to potentially reduce queueing.	Moderate	Short	Low
	18	Install pedestrian count down signal heads.	Moderate	Intermediate	Moderate
	19	Install flashing yellow arrows for left-turn signal heads on eastbound and westbound approaches.	Moderate	Intermediate	Low
	20	Install retroflective backplates.	Moderate	Intermediate	Low
	21	Install supplementary signal heads.	Moderate	Intermediate	Low
	22	Implement dual left-turn lanes for SR 196 approaches.	Low	Intermediate	High
	23	Consolidate driveways in functional area of intersection.	Low	Intermediate	Low

Atkins North America, Inc.