Section 2:

Crash Study

TABLE OF CONTENTS

Introduction

This report is a summary of the analyses and findings of a citywide crash study conducted as a part of the Auburn citywide traffic study by Skipper Consulting, Inc. Crash data was compiled for study intersections and analyzed to determine locations in Auburn where intersection safety should be addressed. The purposes and objectives of this study are as follows:

- to examine crash histories at intersections maintained by the City of Auburn;
- to identify possible locations of concern based upon a systematic traffic crash analyses applied citywide;
- to identify possible crash patterns at locations identified as high crash locations; and,
- to make recommendations to possibly mitigate any crash patterns and improve traffic safety at locations of concern.

Sources of information used in this report include: the City of Auburn, Alabama; the Alabama Department of Transportation; the Institute of Transportation Engineers; the American Association of State Highway and Transportation Officials; the Transportation Research Board; the University of Alabama Care Research and Development Laboratory; and the files and field reconnaissance efforts of Skipper Consulting, Inc.

Basic Crash Evaluation Principles

The basic goal and principle associated with the Auburn Citywide Crash Study is to examine the existing traffic conditions and determine ways to improve the safety along roadways and at intersections within the City of Auburn. The basic crash evaluation principles are as follows:

- determine the total crashes at a location over a given time period;
- examine and rank locations with crashes to determine priorities for safety improvements;
- examine the crashes experienced at crash locations to determine how many (if any) were similar in character;
- examine existing roadway conditions along with crash patterns at given locations to determine if roadway conditions and/or environmental conditions may have contributed to the cause of the crashes experienced; and,
- determine possible roadway improvements to mitigate any crashes caused by roadway conditions.

All study locations were examined using these basic crash evaluation principles.

Historical Crash Trends

Since the previous Auburn citywide traffic study was completed in 2005, there have been advances in statewide crash reporting. New technology like the e-crash system allows transportation safety officials greater access to more consistently reported crash records in various means and methods. This has led to the possibility of providing much more detailed analysis in crash trends over a sustained period of time. The following table is a comparison of general crash data for locations throughout the State of Alabama for both the 2005 study period as well as the latest data reported at the time of this report. The purpose of this comparison is to illustrate general crash trends at other cities in Alabama since the time of the previous 2005 crash study.

Table 1 - Crash Trends for Alabama Cities 2003-2015

City	2005 Citywide Crash Study Data					2018 Citywide Crash Study Data				
	2003 Population	2003 Total Crashes	2003 Crashes/ 1000 people	2003 Crashes with Injuries	2003 crashes with Fatalities	2015 Estimated Population	2015 Total Crashes	2015 crashes/ 1000 people	2015 crashes with injuries	2015 crashes with fatalities
Birmingham	236,620	13,679	57.8	2,569	47	212,543↓	15,723↑	74↑	3424↑	40↓
Montgomery	200,123	9,935	49.6	2,693	29	200,917↑	9,070↓	45.1↑	3171↑	29
Mobile	193,464	9,600	49.6	2,370	29	193,393	11,641↑	60.2↑	2801↑	16↓
Huntsville	164,237	7,669	46.7	2,216	23	190,943↑	7,960↑	41.7↓	2090↓	11↓
Tuscaloosa	79,294	4,642	58.5	1,156	11	98,368↑	5,322↑	54.1↓	1444↑	9↓
Hoover	65,070	3,102	47.7	413	6	84,715↑	3,135	37↓	501↑	6
Dothan	60,036	3,265	54.4	931	8	68,492↑	2,964↓	43.3↓	1125↑	4↓
Auburn	***46,923***	***1,911***	***40.7***	***361***	***4***	***61,979↑***	***1,922***	***31↓***	***389***	***2↓***
Decatur	54,239	2,311	42.6	570	6	55,354↑	1,944↓	35.1↓	463↓	3↓
Madison	34,080	865	25.4	187	2	46,970↑	1,257↑	26.8↑	293↑	3↑
Florence	35,852	1,527	42.6	272	3	39,964↑	1,447↓	36.2↓	336↑	5↑
Phenix City	28,444	1,493	52.5	459	3	37,129↑	2,296↑	61.8↑	684↑	6↑
Gadsden	37,619	1,759	46.8	515	2	36,024↓	1,807↑	50.2↑	549↑	4↑
Bessemer	29,108	1,794	61.6	544	4	26,722↓	1,673↓	62.6↑	451↓	8↑
Homewood	24,399	1,454	59.6	279	0	25,754↑	1,629↑	63.3↑	201↓	2↑
Prichard	27,983	606	21.7	185	5	22,282↓	837↑	37.6↑	259↑	8↑

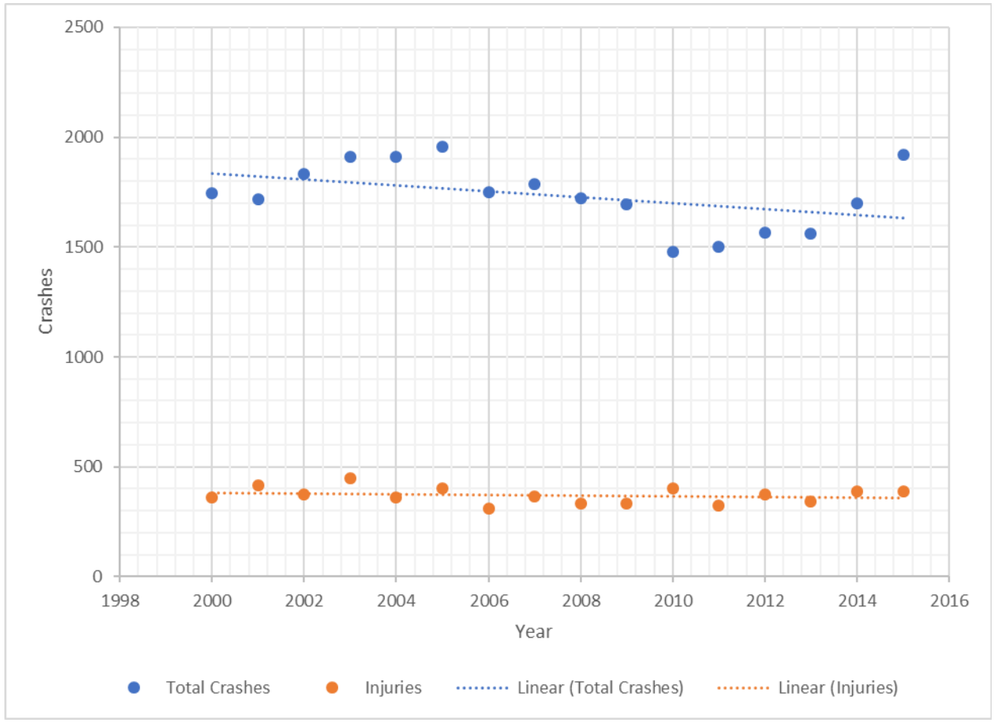
Table 1 basically details how the City of Auburn compares to other cities in Alabama based upon crash experience. Since there are many different variables that contribute to the crash experience in the various cities, the analysis detailed in Table 1 compare the overall crash statistics with population. The following conclusions could be drawn from the information in Table 1:

- Auburn has experienced a reduction in the citywide crash rate, and a reduction in traffic fatalities since 2003. This has been while the population has grown approximately 32%.
- The total number of crashes and crashes with injuries experienced in 2015 is similar when compared with 2003.
- Auburn ranked in the 13th percentile for crash rates out of the cities examined in 2003 and the 7th percentile for 2015. This indicates approximately 93% of the crash rates surveyed from other cities were higher than the crash rate experienced in Auburn during 2015.

Note, this data is gathered from the Alabama Crash Facts book as published by the Center for Advance Public Safety at the University of Alabama.

While the previous table compared the crash experience in Auburn to other cities in Alabama, the following figure examines crash experience over time in Auburn only. Figure 1 illustrates analyses to examine the crash experience in Auburn between 2000 to 2015.

Figure 1 - Historical Auburn Crash Trends



As with the information detailed in Table 1, this data is gathered from the Alabama Crash Facts book as published by the Center for Advance Public Safety at the University of Alabama. Items to note as shown in Figure 1:

- While the total crash experience in Auburn over the period analyzed has been up and down, the trend (illustrated by the dotted line on the graph) has shown that crashes have decreased since 2000.
- Considering the crash experience since 2013, it is possible that total crash experience in Auburn may begin to trend upward. This trend is worthy of further observation in the coming years.
- The crashes with injuries have been mostly consistent from 2000-2015. The trend line shows a slight decrease but could be considered mostly stable.

Analyzing the crash experience in Auburn when compared with other cities, as well as the historical crash trends in Auburn gives a reference point to understand the crash experience in Auburn. The results could be stated that Auburn experiences lower crash rates than similar cities in Alabama. It could also be stated that Auburn has seen an overall decline in crashes since 2000, however, crash experience in recent years appear to be trending upward.

Basic Crash Data Analysis

Basic crash trends were analyzed for the year 2015 for all intersections in Auburn. This analysis is an overall look at basic crash trends experienced in Auburn. Basic crash statistics can be used on a programmatic basis citywide to determine the types of crashes and conditions to target for overall safety improvement campaigns. The crash data analyzed is as recorded by the CARE system. The top primary causes are illustrated as follows

Figure 2 - Primary Causes of Crashes in Auburn

Primary Cause of Crash	% of Total Crashes Recorded
Follow too close	22%
Failed to Yield ROW	21.5%
Distracted Driving	16%
Improper Traffic Movement	12.3%
Other/Misc.	12%
Misjudge Stopping Distance	4%
DUI	3%
Ran Traffic Signal	3%
Unknown	3%
Driving too fast	2%
Swerved to avoid	2%
Fatigued/Asleep	0.85%
Ran off road	0.75%

22%

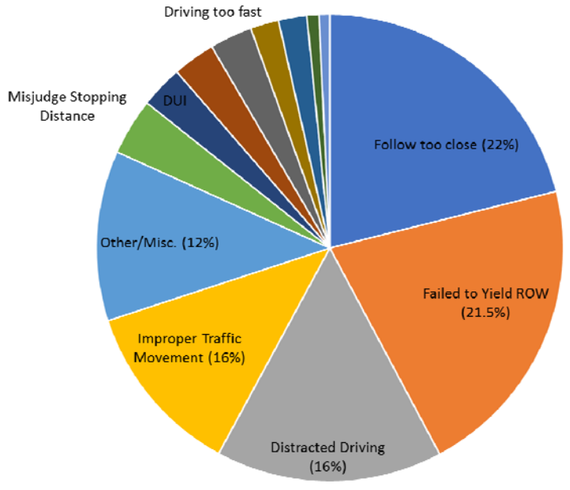
Following too Close

Most Common Primary Cause of Crashes

16%

Distracted Driving

Largest Increase in Primary Cause of Crashes



In addition to primary causes of crashes, the environmental conditions were examined for crashes experienced in Auburn.

Table 2 - Environmental Conditions for Auburn Crashes

Lighting Conditions	% of Total Crashes Recorded
Daylight	72%
Dark Conditions (With Lighting)	22%
Dark Conditions (No Lighting)	4%
Dusk/Dawn/Other	2%
Weather Conditions	
Clear	73%
Cloudy	17%
Rain	7%
Mist	2%
Snow/Sleet/Other	1%

Notable Crash Trends

Basic review of the crash data indicates several notable trends. As noted previously, injury crashes are stable while total crashes have been in decline but are starting to increase. The following conclusions could be considered when examining the overall crash experience in Auburn:

- The primary cause of crashes in Auburn would be indicative of the types of crashes experienced in an urban/suburban setting. Specifically, rear-end crashes and failed to yield ROW crashes are expected where there are signalized intersections in an urbanized area. Typically, the rear end crashes are less severe than other crashes.
- Crashes mostly occur during daylight hours. This is typical of most any location. It is noteworthy that crashes during dark conditions occur mostly at intersections with lighting. This would indicate that there doesn't appear to be a prevalent issue with dark unlit intersections.
- Most crashes occur during clear/cloudy and otherwise dry conditions. Again, this is typical of most locations in Alabama considering there are more days without rain than with.

The Rise of Distracted Driving. In most locations across Alabama, distracted driving has become more prevalent in recent years. Distracted driving is the third most common primary cause of crashes in Auburn. This is the aggregate of all types of distracted driving and includes distracted by someone/something inside the vehicle, outside the vehicle, and distracted by electronic device. This primary cause is worthy of monitoring. Distracted driving was not a prevalent crash trend in the 2005 Auburn citywide crash study. As society continues to change, this primary crash cause could continue to grow. It is recommended the City of Auburn monitor these type crashes in coming years and consider this crash type when considering programmatic campaigns to address crashes in Auburn.

Detailed Crash Analysis

The goal of the crash evaluation is to determine a list of locations that require attention based upon crash experience. The goal is also to determine a list of intersections that require further monitoring for crash experience, but no immediate action is necessary. This analysis takes the basic crash evaluation detailed earlier a step further and examines actual crashes at specific locations within Auburn. Crash analysis procedures used to analyze the crash data was developed using guidance as published in the Highway Safety Manual, 1st Edition, published by AASHTO. A screening process is used to determine locations that experience higher numbers of crashes or crash severity when compared to other locations within Auburn. This process considers multiple characteristics at the locations to compare all types of intersections in an even and fair manner. The following flow chart illustrates the crash analysis procedure from data collection to development of results/recommendations.

Step #1 - Crash Data Collection

Collect crash data for the City of Auburn from 2014 to 2016.

↓

Step #2 - Preliminary Screening Process

Conduct the Predictive Method to analyze crashes and identify locations where crash experience was greater than predicted by the HSM.

↓

Step #3 – Network Screening

LOSS Analysis –
Sites are ranked by comparing their observed crash frequency to the predicted average crash frequency for the entire population of Auburn

Equivalent Property Damage Only (EPDO) Average Crash Frequency –

- Sites are assigned weighting factors to crashes by severity to develop a single combined frequency and severity score
- Each type of crash at an intersection is assigned a societal crash cost and summarized for the 2014-2016 period

↓

Continued next page

Step #4 – Identification of Locations of Concern

High Priority –	**Moderate Priority –**	**Low Priority –**
Locations that rank the highest in all screening methods. These locations exhibit the greatest potential for improvements to crash experience.	Locations that experience elevated crash experience but do not meet the criteria of high priority.	Locations identified to exhibit more crashes than predicted by the HSM. These locations are anticipated to have low potential for crash experience improvements.

Step #5 - Crash Pattern Analysis

Conduct a detailed Crash Pattern Analysis for all High Priority Intersections.

Step #6 - Crash Improvement Recommendations

High Priority Locations	**Moderate Priority Locations**	**Low Priority Locations**
Roadway/Traffic Control Improvements for High Priority Locations	Conduct crash analysis for any locations when included within the limits of other roadway improvement projects.	Monitor Conditions.

The following sections give details regarding each crash analysis step:

Step #1 - Data Collection: Crash data from the years 2014 to 2016 was utilized as the basis for this crash evaluation. The crash data was supplied by the City of Auburn for the purposes of this study effort only. The data was derived from the Critical Analysis Reporting Environment (CARE) as developed by the Center for Advanced Public Safety at the University of Alabama.

As noted by the Center for Advance Public Safety, CARE

"is a data analysis software package originally designed for problem identification and countermeasure development in traffic safety applications. It uses advanced analytical and statistical techniques to generate valuable information directly form data."

The CARE software is utilized statewide by public agencies for the purposes of traffic safety and planning.

Step #2 - Preliminary Screening: All study intersections within the City of Auburn's jurisdiction were considered for the preliminary screening of crash experience. The method used to conduct the preliminary screening is the Predictive Method as outlined in the Highway Safety Manual 1st Edition.

As stated in the Highway Safety Manual (HSM) the Predictive Method utilizes an 18-step procedure to estimate the "expected average crash frequency" of a roadway network, facility, or site. Predictive models are used to determine predicted crashes for varying modes of transportation and severity levels. The predictive method utilizes the following general equation (HSM equation 12-1) to determine the predicted crash experience at a site location.

$$N_{predicted} = (N_{spf} \times (CMF_{1x} \times CMF_{2x} \times \ldots \times CMF_{yx}) + N_{pedx} + N_{bikes}) \times C_x$$

Where:

$N_{predicted}$ = predicted average crash frequency for a specific year on site type x;
N_{spfx} = predicted average crash frequency determined for base conditions of the SPF developed for site type x;
N_{pedx} = predicted average number of vehicle-pedestrian collisions per year for site type x;
N_{bikex} = predicted average number of vehicle-bicycle collisions per year for site type x;
CMF_{yx} = crash modification factors specific to site type x and specific geometric design and traffic control features y; and
C_x = calibration factor to adjust SPF for local conditions for site type x.

Equation 12-1 is the general form of the predictive method equation. The HSM predictive method uses specialized versions of this equation to determine specific crash predictions for the various types of intersections and specific crash types.

Cx Calibration Factor Calculation - To apply the predictive method, calibration to local conditions is recommended. The factor C_x listed in equation 12-1 is a factor placed to provide this calibration. Currently, there is not a calibration factor that exists to calibrate to local Auburn or even Alabama traffic conditions. Therefore, for the purposes of this project, factors were developed for Auburn as a local conditions calibration. The HSM has a process for the calculation of the calibration factor. The process is completed in basically three steps:

1. Examine existing crash data for a specific time frame and segregate the data to specific crash types and intersections/segments.
2. Calculate the predicted crash experience for each of the crash types and intersections/segments considered.
3. Calculate the calibration factor by comparing the existing crashes to the predicted crashes for each crash type and intersections/segments using equation A-1 (below)

$$C = \frac{\sum_{\text{all sites}} \text{observed crashes}}{\sum_{\text{all sites}} \text{predicted crashes}}$$

The results of the above calculations yield the following calibration factors for the City of Auburn local conditions:

C 4-way signalized intersections	= 6.524	C 4-way unsignalized intersections	= 4.184
C 3-way signalized "T" intersections	= 3.524	C 3-way unsignalized "T" intersections	= 4.443

To progress from the preliminary screening step, the subject intersection must exhibit more observed crashes than predicted crashes. Any intersections with fewer observed crashes than predicted crashes were considered low priority locations that do not warrant further examination.

Step #3 – Network Screening: The analysis in Step #2 identifies locations that currently experience more crashes than predicted by the Highway Safety Manual (HSM). The network screening process as defined in the HSM Chapter 4 is

"a process for reviewing a transportation network to identify and rank sites from most likely to least likely to realize a reduction in crash frequency with implementation of a countermeasure."

The results of the network screening process are the identification of locations to be studied in more detail to identify crash patterns, any contributing factors, and to select crash countermeasures. The network screening process used for this crash evaluation utilizes multiple crash screening methodologies which focus on different crash characteristics. The procedures used are as follows:

Level of Service of Safety (LOSS) – This methodology compares the average crash frequency to the predicted crash frequency for the lists of different intersection types. The crash frequencies are then ranked by their degree of separation from predicted average crash frequency. This method identifies locations where there are low, moderate, and high potential for crash reduction.

Equivalent Property Damage Only – This methodology assigns weighting factors to crashes by severity to develop a single combined frequency and severity score by location. The resultant scores are relative to property damage only (PDO) crashes. The locations are ranked from the highest to the lowest score in order of priority. Crash severity at a location heavily influences its EPDO score. The weighting scale is as follows (Taken from the HSM equation 4-4):

Table 3 - EPDO Crash Analysis Weights

Crash Severity	Estimated Societal Crash Cost*	EPDO Weight
Fatal (K)	$5,612,460	542
Injury (A/B/C)	$115,640	11
PDO (O)	$10,360	1

**The estimated cost is calculated in 2016-dollar values which corresponds to the latest year of the detailed crash analysis.*

Step #4 – Identification of Locations of Concern: Analyses conducted in steps 2&3 were compiled, ranked, and compared. The results were utilized to generate a list of locations and a ranking of their priority level. The following rankings were developed for the study locations:

- High Priority – Locations that rank the highest in all screening methods. These locations exhibit the greatest potential for improvements to crash experience.
- Moderate Priority – Locations that experience elevated crash experience but do not meet the criteria of high priority.
- Low Priority – Locations identified to exhibit more crashes than predicted by the HSM. These locations are anticipated to have low potential for crash experience improvements.

Step #5 – Detailed Crash Analysis: The detailed crash analysis takes high priority crash locations and examined actual crash reports for the latest 12-month period available at the time of this study. The crashes are mapped and analyzed to determine crash patterns. One crashes have been analyzed to determine any patterns or common characteristics, crash countermeasures and selected and evaluated.

Step #6 – Crash Improvement Recommendations: Once the detailed analysis is complete for the high priority crash locations, recommendations are evaluated and determined. Recommendations for each intersection priority level are as follows:

- High Priority Crash Locations – Detailed improvements are recommended for each location identified based upon the detailed crash evaluation.
- Moderate Priority Crash Locations – Crash experience at locations identified as moderate priority should be monitored on a yearly basis. If crash experience increases, these locations should be targeted for safety improvement projects as conditions warrant. These locations should be considered for safety improvements any time they fall within the limits of adjacent roadway construction/improvement projects.
- Low Priority Crash Locations – Crash experience at these locations should be considered for safety improvements any time they fall within the limits of adjacent roadway construction/improvement projects.

Crash Analysis/Network Screening Results

The results of the crash analysis are included in the following sections. The listings begin with the higher priority locations in Table 4, followed by the moderate priority crash locations in Table 5 and finish with the lower priority locations in Table 6.

Table 4 - High Priority Crash Locations

Intersection	Predictive Method		Network Screening Results			
	Predicted Crashes	Observed Crashes	Predictive Rank	LOSS Priority	EPDO Rank	Crash Cost
South College St at Longleaf Dr	62	152	3	High	4	$3,507,100
South College St at East University Dr/ Shug Jordan Pkwy (S)	67	194	1	High	1	$9,104,590
South College St at Donahue Dr	44	96	5	High	6	$3,123,080
North/South College St at Magnolia Ave	29	93	4	High	17	$1,455,600
North College St at Glenn Ave	32	68	8	High	12	$1,824,460
North College St at East University Dr/ Shug Jordan Pkwy (N)	54	81	12	Moderate	7	$2,472,840
North College St at Farmville Rd	12	49	7	High	14	$1,644,020
Opelika Rd at Dean Rd	47	75	10	Moderate	8	$2,203,820
Opelika Rd at East University Dr	57	154	2	High	5	$3,334,640
West Glenn Ave at Wright St	6	34	11	High	48	$547,140
East Glenn Ave at Dean Rd	49	95	6	High	10	$1,990,760
Shug Jordan Pkwy at North Donahue Dr	58	62	34	Moderate	9	$2,197,600
Shug Jordan Pkwy at Ware Dr	19	54	9	High	11	$1,913,900

Table 5 - Moderate Priority Crash Locations

Intersection	Predictive Method		Network Screening Results			
	Predicted Crashes	Observed Crashes	Predictive Rank	LOSS Priority	EPDO Rank	Crash Cost
Shug Jordan Pkwy at Samford Ave (W)	19	34	18	Moderate	27	$971,220
Shug Jordan Pkwy at MLK Dr Ramps	24	36	20	Moderate	13	$1,802,620
East University Dr at Stoker St	25	27	39	Moderate	23	$1,108,520
East University Dr at Dean Rd (N)	51	52	43	Moderate	25	$1,056,240
South College St at Thach Ave	29	36	28	Moderate	30	$892,700
West Glenn Ave at North Donahue Dr	26	45	15	Moderate	40	$670,840
East Glenn Ave at Gay St	34	60	13	Moderate	20	$1,313,680
East Glenn Ave at East University Dr	42	58	17	Moderate	18	$1,396,760
Dean Rd at Annalue Dr	20	24	35	Moderate	33	$770,600
Dean Rd at Stage Rd	25	39	19	Moderate	21	$1,327,640
Magnolia Ave at Donahue Dr	24	40	16	Moderate	26	$1,023,640
Magnolia Ave at Gay St	24	44	14	Moderate	31	$869,560
Gay St at Thach Ave	25	37	21	Moderate	39	$684,980

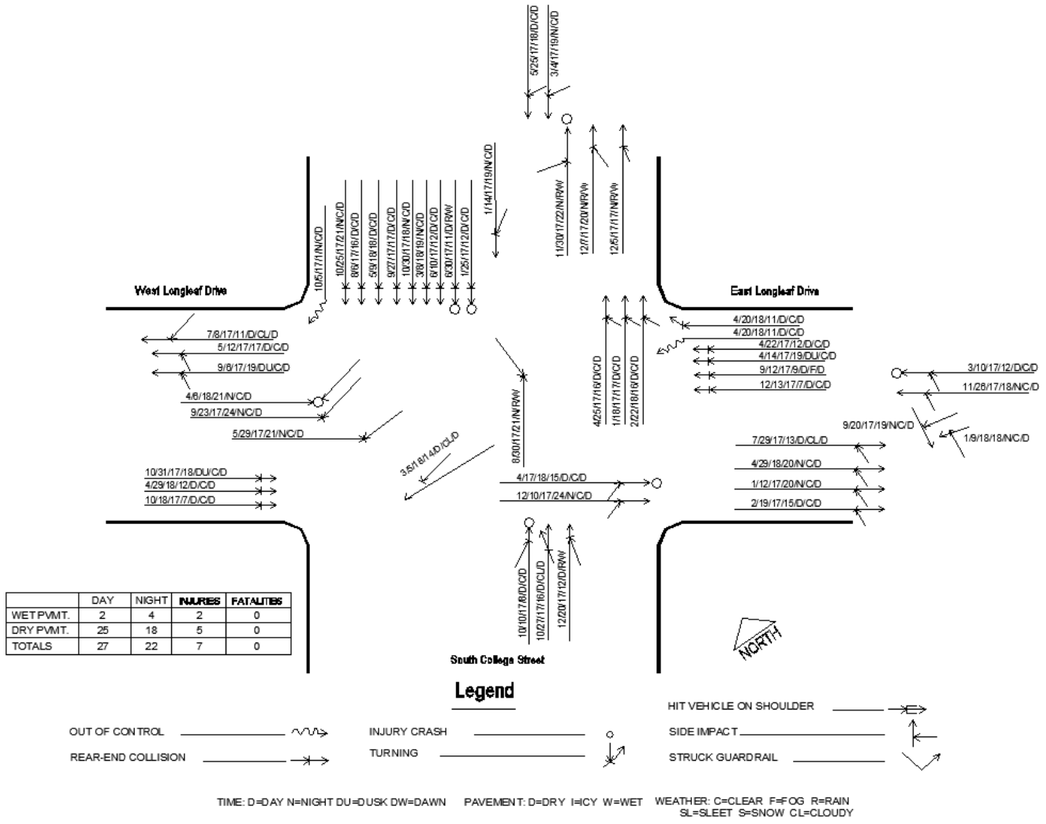
Table 6 - Low Priority Crash Locations

Intersection	Predictive Method		Network Screening Results			
	Predicted Crashes	Observed Crashes	Predictive Rank	LOSS Priority	EPDO Rank	Crash Cost
South College St at Shell Toomer Pkwy	15	18	38	Moderate	46	$586,640
South College St at I-85	18	19	44	Moderate	72	$191,660
North College St at Tichenor Ave	16	22	29	Moderate	60	$319,020
North College St at Bragg Ave	11	19	24	Moderate	71	$195,360
North College St at Asheton Ln	11	16	31	Moderate	47	$568,880
East University Dr at Wrights Mill Rd	17	18	45	Moderate	65	$276,100
West Glenn Ave at Cox St	6	11	30	Moderate	49	$526,820
West Glenn Ave at Thomas St	8	17	22	Moderate	55	$382,980
Opelika Rd at Gay St	15	17	42	Moderate	50	$471,000
Opelika Rd at Gentry Dr	11	20	23	Moderate	45	$610,320
Opelika Rd at Saugahatchee Rd	14	21	27	Moderate	44	$627,460
Magnolia Ave at Thomas St	7	14	26	Moderate	79	$143,560
Magnolia Ave at Wright St	20	25	32	Moderate	51	$456,120
Magnolia Ave at Ross St	7	9	41	Moderate	70	$197,040
Samford Ave at Gay St	16	28	40	Moderate	37	$697,760
Gay St at Tichenor Ave	7	10	36	Moderate	69	$206,660
Gay St at Mitcham Ave	15	23	25	Moderate	67	$231,620
Dean Rd at Harper Ave	14	17	37	Moderate	74	$173,900
Moores Mill Rd at Grove Hill Rd	18	22	33	Moderate	42	$646,820

Detailed Crash Analysis/Crash Recommendations

The following sections outlined the detailed crash analysis and recommendations for each high priority crash location.

High Priority Crash Location #1 - South College Street at Longleaf Drive



	DAY	NIGHT	INJURIES	FATALITIES
WET PVMT.	2	4	2	0
DRY PVMT.	25	18	5	0
TOTALS	27	22	7	0

Figure 3 - Intersection Crash Diagram - South College Street at Longleaf Drive

Notable Crash Patterns:

- Rear end crashes along the southbound approach of South College Street
- Crashes between eastbound thru traffic along Longleaf Drive and traffic entering/exiting the Wal-Mart shopping center access

Crash Narrative:

The primary crash pattern at this intersection is the rear end crashes along the southbound approach of South College Street. Crash exeperience at the intersection also indicates a pattern of traffic entering/exiting development driveways and crashing with traffic along Longleaf Drive.

Recommended Improvements:

- Implement access management along South College Street and East Longleaf Drive. The access management stragety recommended is to restrict left turn movements to and from adjacent fully directional devleopment access driveways where crash expereince is illustrated.
- Adjust the traffic signal timings to update clearance times to current ITE guidelines and adjust green time to comply with capacity needs as identified in the corridor traffic operations study.

The College Street roadway corridor study addresses the recommended improvements at this study location. The following figure is included in the College Street roadway corridor study and depicts all recommended safety improvements at this study location.

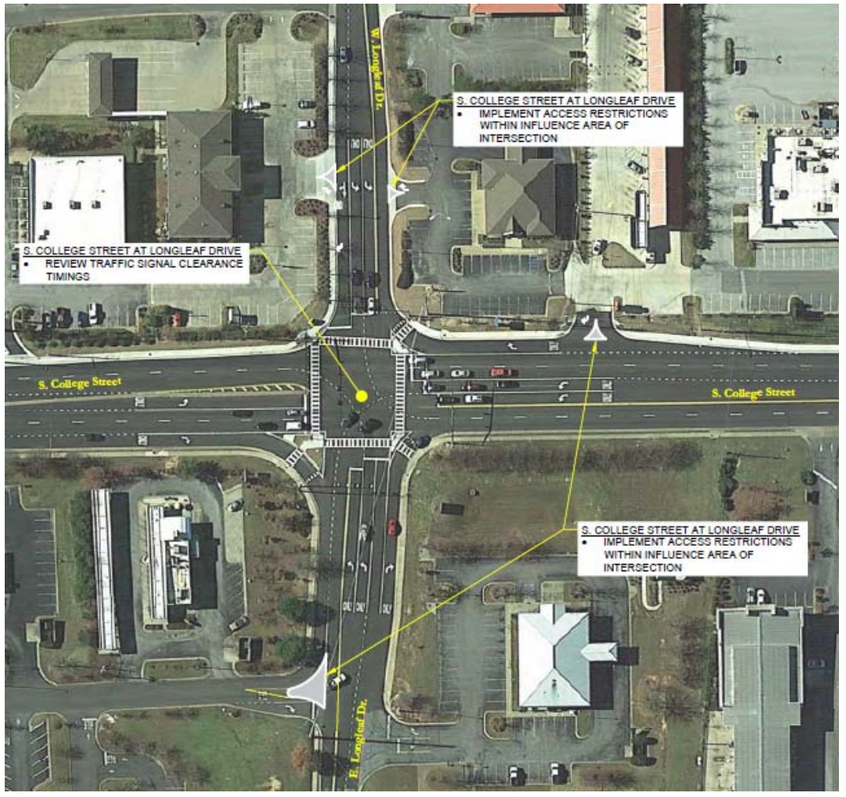
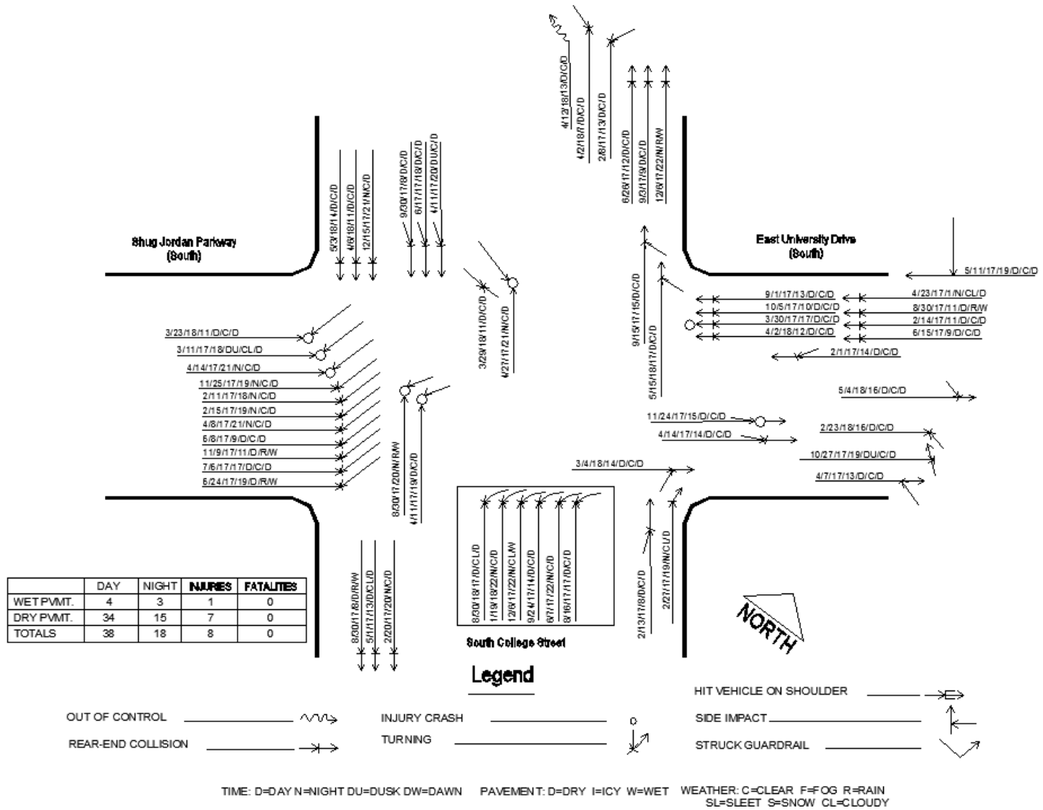


Figure 4 - Recommended Improvements - South College Street at Longleaf Drive

Anticipated Safety Impacts of Recommended Improvements:

The proposed roadway improvement countermeasures are anticipated to improve roadway safety at the study intersection. Based upon information presented in the Crash Modification Factors Celaringhouse, it is reasonable to anticipate a reduction in crash expereince of approximately 20% for crashes of all severity levels. A review of the crash diagram indicates int would be reasonable to anticipate approximately 20% of the crashes would be removed as a result of the recommended safety improvements.

High Priority Crash Location #2 – South College Street at Shug Jordan Parkway/East University Drive (South)



	DAY	NIGHT	INJURIES	FATALITIES
WET PVMT.	4	3	1	0
DRY PVMT.	34	15	7	0
TOTALS	38	18	8	0

**Crashes shown in box were located 100 feet-300 feet south of the intersection at development driveways*

Figure 5 - Intersection Crash Diagram - South College Street at Shug Jordan Parkway/East University Drive

Notable Crash Patterns:

- Crashes between westbound left turning vehicles and eastbound thru vehicles
- Crashes between northbound thru vehicles and westbound left turning vehicles
- Crashes between eastbound thru traffic and traffic entering/exiting the Tiger Crossing shopping center access

Crash Narrative:

The primary crash pattern at this intersection is the westbound left turning vehicles crashing with northbound and eastbound thru vehicles. These crashes occur primarily after 4:00 PM and equally in day/night lighting conditions.

An additional crash pattern at this intersection is the conflict of vehicles coming out of the Tiger Crossing shopping center access with traffic traveling eastbound along East University Drive. The primary pattern here is the left turn out of the shopping center acces, but also there appears to be some crashes associated with lane changes to get into the shopping center from East Uhniversity Drive eastbound.

Recommended Improvements:

- Implement Proctected/Permissing Flashing Yellow Arrow (FYA) left turn phasing.
- Adjust the traffic signal timings to update clearance times to current ITE guidelines and adjust green time to comply with capacity needs as identified in the corridor traffic operations study.
- Restrict left turn movements within the influence area of the study intersection

The College Street roadway corridor study addresses the recommended improvements at this study location. The following figure is included in the College Street roadway corridor study and depicts all recommended safety improvements at this study location.

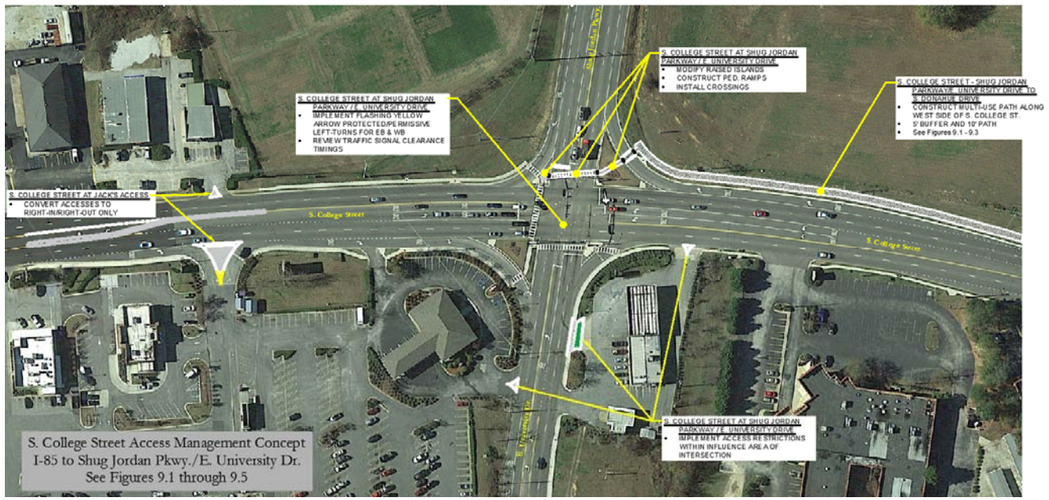
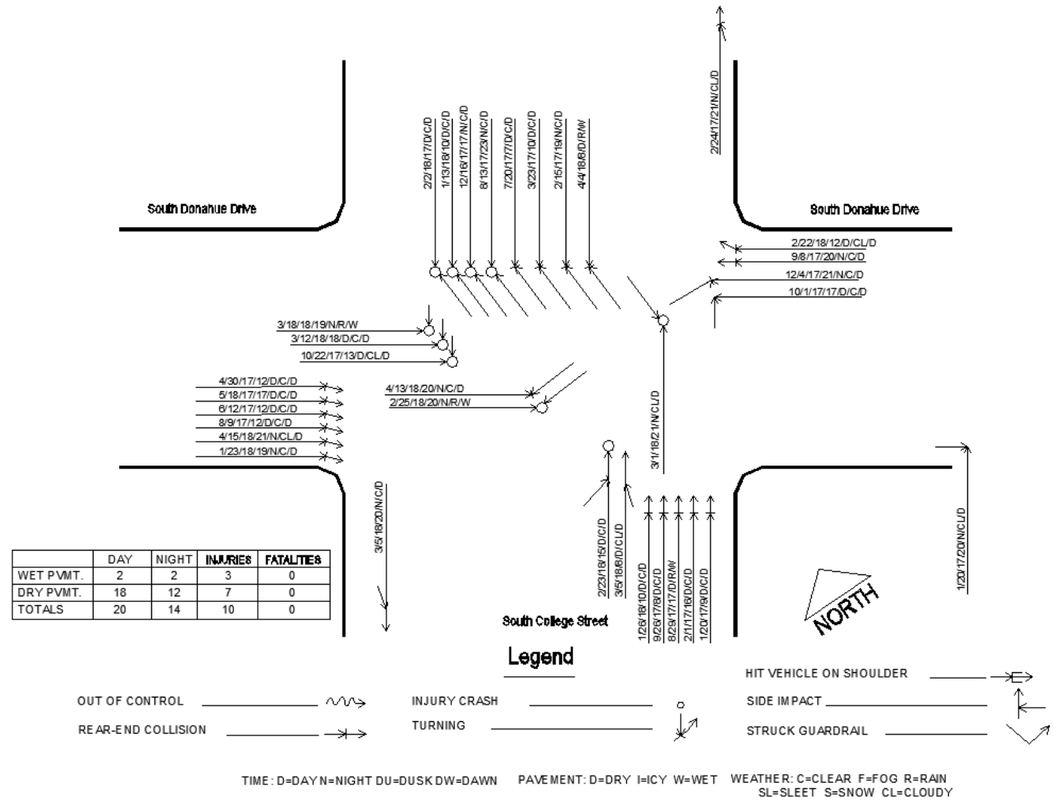


Figure 6 - Recommended Improvements - South College Street at Shug Jordan Parkway/East University Drive

Anticipated Safety Impacts of Recommended Improvements:

The proposed roadway improvement countermeasures are anticipated to improve roadway safety at the study intersection. Based upon information presented in the Crash Modification Factors Celaringhouse, it is reasonable to anticipate a reduction in crash expereince of approximately 20% for crashes of all severity levels. A review of the crash diagram indicates int would be reasonable to anticipate approximately 20% of the crashes would be removed as a result of the recommended safety improvements.

High Priority Crash Location #3 – South College Street at South Donahue Drive



	DAY	NIGHT	INJURIES	FATALITIES
WET PVMT.	2	2	3	0
DRY PVMT.	18	12	7	0
TOTALS	20	14	10	0

Figure 7 - Intersection Crash Diagram - South College Street at South Donahue Drive

Notable Crash Patterns:

- Crashes between southbound thru traffic and northbound left turning traffic onto Donahue Drive.
- Crashes between thru traffic on Donahue Drive and South College Street
- Rear end crashes on the northbound and eastbound approaches.

Crash Narrative:
The primary crash pattern at this intersection is the southbound thru traffic conflicting with northbound left turn traffic onto Donahue Drive. This pattern presents the largest number crashes with injuries. Secondary crash patterns worthy of consideration include rear end crashes on the north and eastbound approaches of the intersection.

Overall, the crashes do not appear to be related to environmental conditions. They occur during both day and nightime hours and mostly on dry pavement.

Recommended Improvements:

- Construct a right turn lane along the eastbound Donahue Drive approach
- Construct positive offset left turn lanes both nurth and southbound along South College Street
- Evaluate the intersection for the need of protected only phasing
- Adjust the traffic signal timings to update clearance times to current ITE guidelines and adjust green time to comply with capacity needs as identified in the corridor traffic operations study.

The College Street roadway corridor study addresses the recommended improvements at this study location. The following figure is included in the College Street roadway corridor study and depicts all recommended safety improvements at this study location.

Figure 8 - Recommended Improvements - South College Street at South Donahue Drive

Recommended Improvements Safety Evaluation:

The proposed roadway improvement countermeasures are anticipated to improve roadway safety at the study intersection. Based upon information presented in the Crash Modification Factors Celaringhouse, it is reasonable to anticipate a reduction in crash expereince of approximately:

- 9% for crashes of all severity levels based upon the addition of a right turn lane
- 38% for left turn crashes of all severity levels based upon the addition of offset left turn lanes

A review of the crash diagram indicates int would be reasonable to anticipate approximately 18% of the crashes would be removed as a result of the recommended safety improvements.

High Priority Crash Location #4 – South College Street at Magnolia Avenue

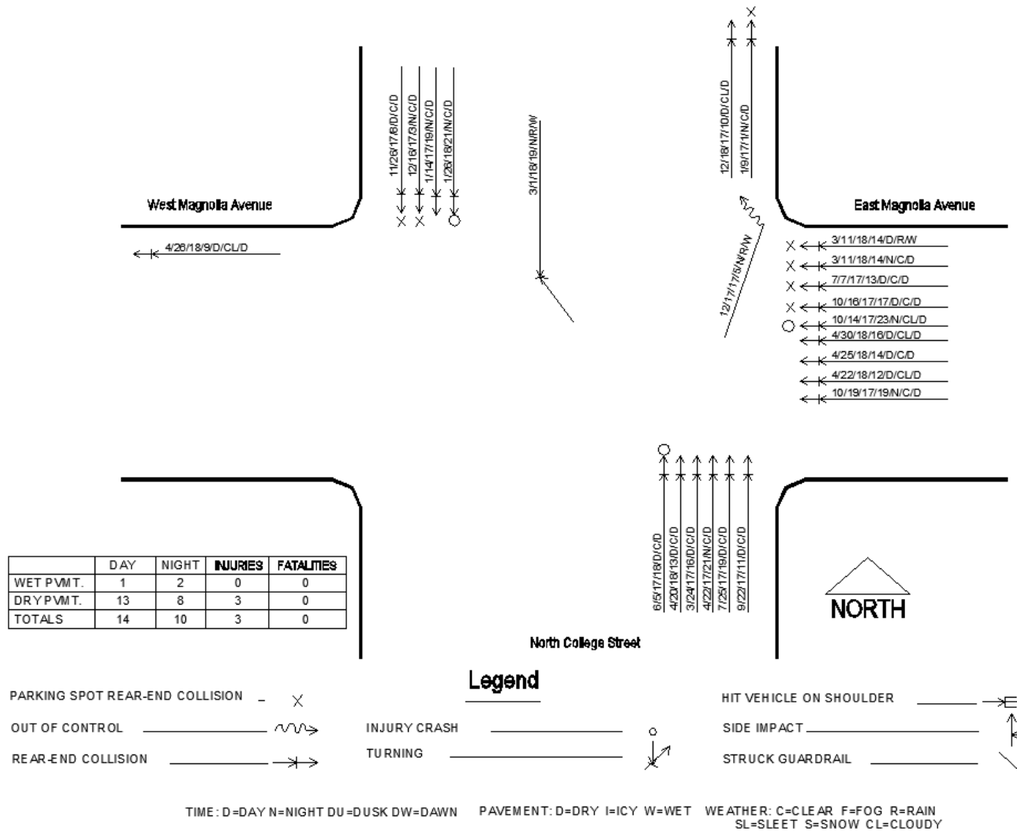


Figure 9 - Intersection Crash Diagram - South College Street at Magnolia Avenue

Notable Crash Patterns:

- Crashes between cars in parking manuevers and thru traffic on both Magnolia Avenue and North College Street

Crash Narrative:
Crashes occuring at this intersection are mostly related to traffic entering and exiting on-street parking spaces. For the most part crashes are low speed low severity.

Recommended Improvements:
Crashes at the study intersection are lagely due to traffic conflicting with vehicles entering and exiting on-street parking spaces. Potential strategies to address this crash expereince include:

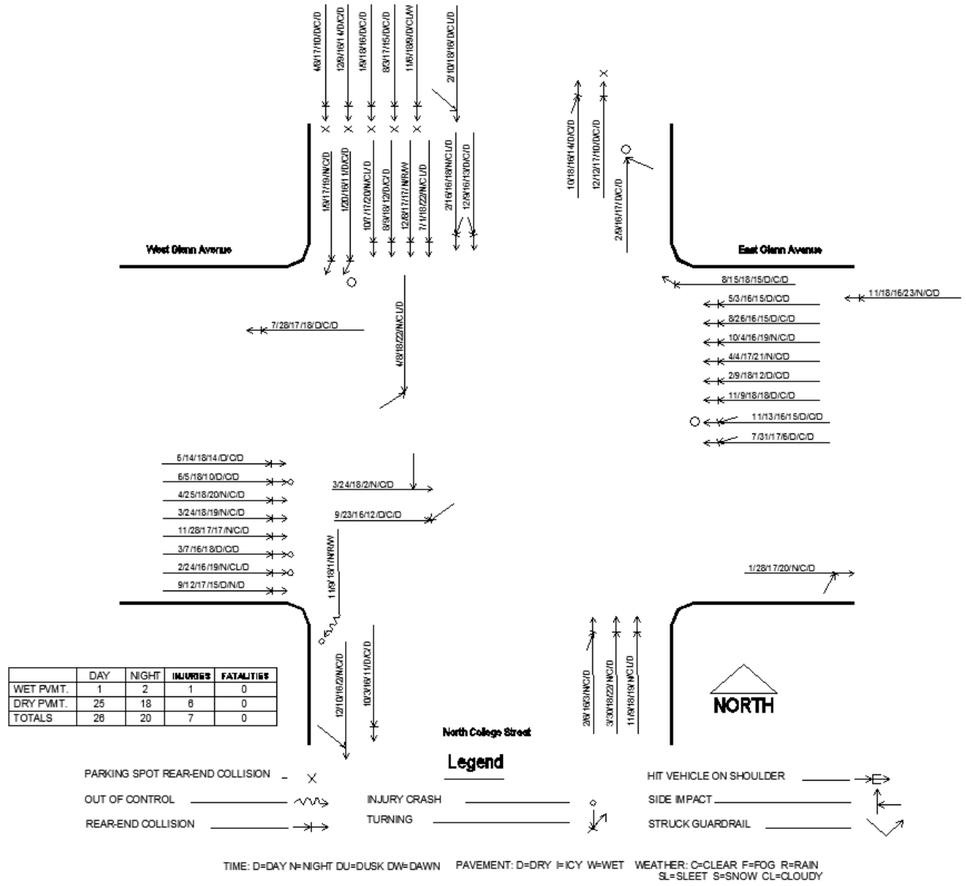
- Removing/prohibiting on-street parking
- Converting from angled parking to parrallel parking

Each potential strategy has its benefits and constraints. Based upon information presented in the Crash Modification Factors Celaringhouse, it is reasonable to anticipate a reduction in crash expereince of approximately:

- 35% for crashes of all severity levels based upon the conversion of angle parking to parallel parking
- 42% for crashes of all severity levels based upon the prohibition of on street parking.

Each potential solution reduces the amount of on-street parking available. Considering this is located within a business district the removal of any or all on street parking would likely be an unreasonable solution for the City of Auburn. At this time, there are no recommendations to address the crash expereince at this intersection. If the City of Auburn wishes to implement a strategy to address crash experience at this intersection, the strategies listed above would be recommended for consideration by the City of Auburn.

High Priority Crash Location #5 - North College Street at Glenn Avenue



	DAY	NIGHT	INJURIES	FATALITIES
WET PVMT.	1	2	1	0
DRY PVMT.	25	18	6	0
TOTALS	26	20	7	0

Figure 10 - Intersection Crash Diagram - North College Street at Glenn Avenue

Notable Crash Patterns:

- Rear end crashes on all approaches of the intersection
- Crashes between cars making parking manuevers with traffic traveling southbound on North College Street

Crash Narrative:

The primary crash pattern at this intersection is rear end crashes. The crashes occur on all approaches of the intersection in various times of the day on mostly dry pavement conditions. Crashes occuring along the southbound approach of North College Street could be impacted by the grade difference over the railroad crossing adjacent to the intersection.

Recommended Improvements:

- Construct a right turn lane along the eastbound West Glenn Avenue Approach*
- Construct a right turn lane along the westbound East Glenn Avenue Approach
- Remove/prohibit on-street parking along the southbound approach of North College Street at this intersection
- Adjust the traffic signal timings to update clearance times to current ITE guidelines and adjust green time to comply with capacity needs as identified in the corridor traffic operations study.

*Based upon adjacent development along West Glenn Avenue, the recommended right turn lane would not be feasible at this time. If at some point in the future conditions in the area change, it is recommended that a gith turn lane be constructed in this location to addres crash experience.

The Glenn Avenue roadway corridor study addresses the recommended improvements at this study location. The following figure is included in the Glenn Avenue roadway corridor study and depicts all recommended safety improvements at this study location.

Figure 11 - Recommended Improvements - North College Street at Glenn Avenue

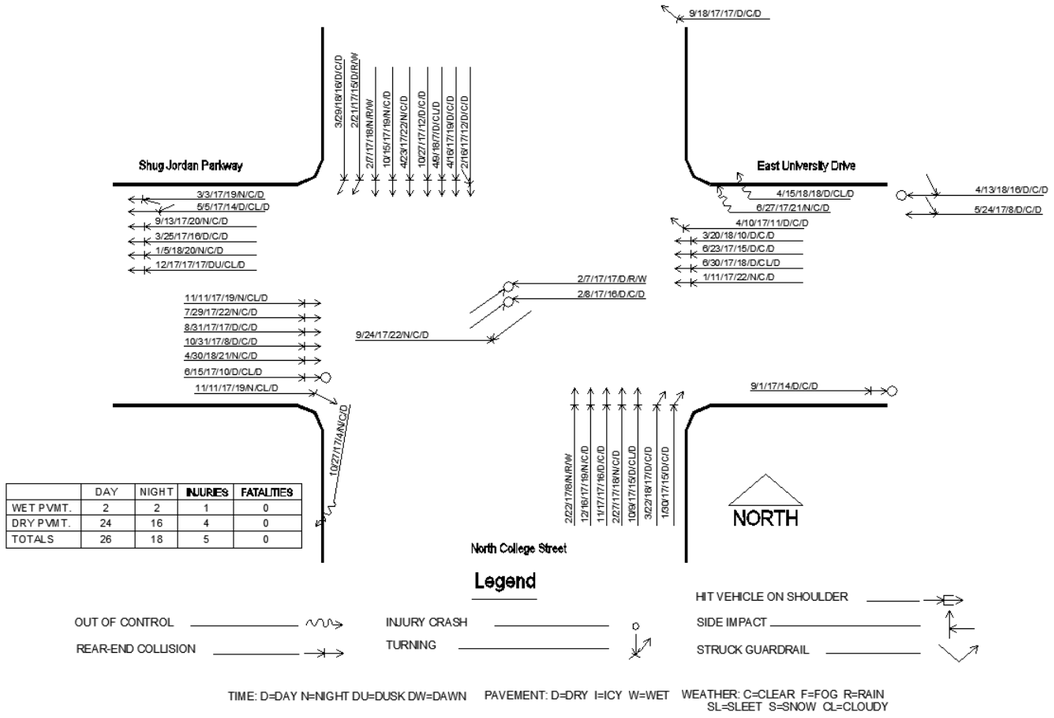
Recommended Improvements Safety Evaluation:

The proposed roadway improvement countermeasures are anticipated to improve roadway safety at the study intersection. Based upon information presented in the Crash Modification Factors Celaringhouse, it is reasonable to anticipate a reduction in crash expereince of approximately:

- 9% for crashes of all severity levels based upon the addition of a right turn lane
- 42% for crashes of all severity levels based upon the prohibition of on street parking

A review of the crash diagram indicates int would be reasonable to anticipate approximately 26% of the crashes would be removed as a result of the recommended safety improvements.

High Priority Crash Location #6 - North College Street at Shug Jordan Parkway/East University Drive (North)



	DAY	NIGHT	INJURIES	FATALITIES
WET PVMT.	2	2	1	0
DRY PVMT.	24	16	4	0
TOTALS	26	18	5	0

Figure 12 - Intersection Crash Diagram - North College Street at Shug Jordan Parkway/East University Drive

Notable Crash Patterns:

- Rear end crashes on all approaches of the intersection

Crash Narrative:

The primary crash pattern at this location is rear end crashes. The crashes occur on all approaches of the intersection in various times of the day on mostly dry pavement conditions. Based upon crash data reviewed, environmental conditions do not appear to have an impact on crash expereince at this location. The northbound, eastbound, and westbound approaches do not currently provide right turn deceleration lanes at the intersection. This could be a contributing factor to the crash expereince at the intersection.

Recommended Improvements:

- Construct an eastbound right turn lane on Shug Jordan Parkway
- Construct a westbound right turn lane on East University Drive
- Construct a northbound right turn lane on North College Street
- Adjust the traffic signal timings to update clearance times to current ITE guidelines and adjust green time to comply with capacity needs as identified in the corridor traffic operations study.

The College Street roadway corridor study addresses the recommended improvements at this study location. The following figure is included in the roadway corridor study and depicts all recommended safety improvements at this study location. It should be noted that the City of Auburn currently has a project to address most of the recommendations as depicted in the figure below.

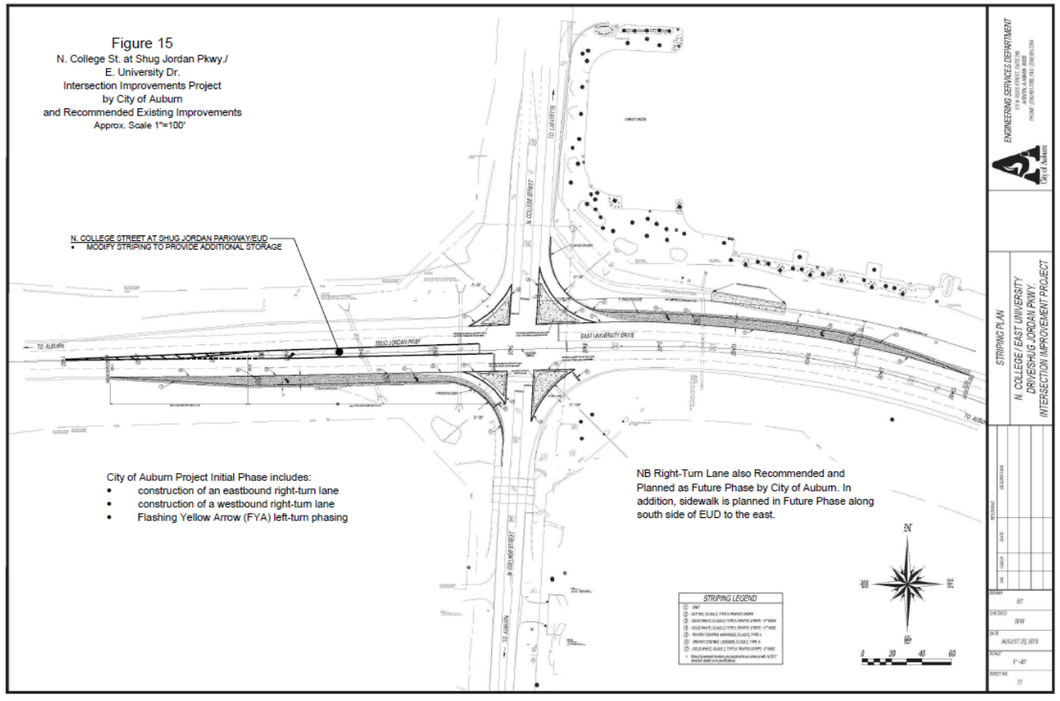


Figure 13 - Recommended Improvements - North College Street at Shug Jordan Parkway/East University Drive

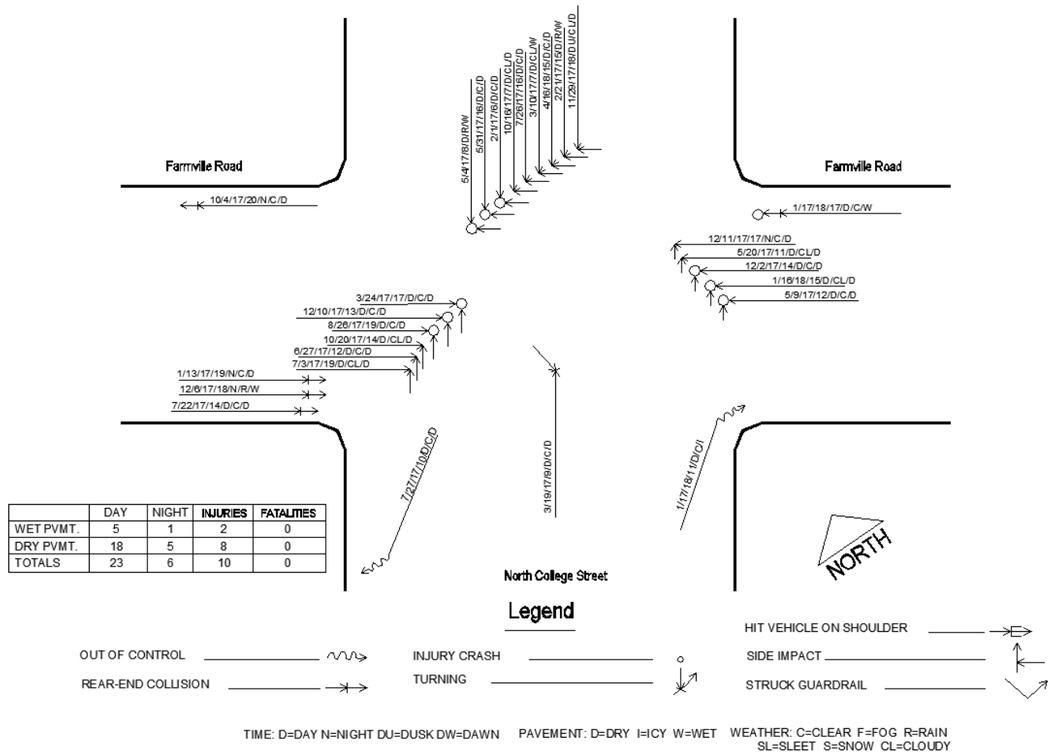
Recommended Improvements Safety Evaluation:

The proposed roadway improvement countermeasures are anticipated to improve roadway safety at the study intersection. Based upon information presented in the Crash Modification Factors Celaringhouse, it is reasonable to anticipate a reduction in crash expereince of approximately:

- 9% for crashes of all severity levels based upon the addition of a right turn lane

A review of the crash diagram indicates it would be reasonable to anticipate approximately 12% of the crashes would be removed as a result of the recommended safety improvements.

High Priority Crash Location #7 - North College Street at Farmville Road



	DAY	NIGHT	INJURIES	FATALITIES
WET PVMT.	5	1	2	0
DRY PVMT.	18	5	8	0
TOTALS	23	6	10	0

Figure 14 - Intersection Crash Diagram - North College Street at Farmville Road

Notable Crash Patterns:

- Right angle crashes between traffic on Farmville Road crossing North College Street and traffic travelling thru on North College Street

Crash Narrative:
Crash expereince at this intersection has been well documented previously by both the City of Auburn and the Alabama Department of Transportation. The intersection is located along a segment of North College Street that have both horizontal and vertical curvature. The Farmville Road approaches enter the intersection at a skewed angle which likely contributes to the crash expereince as well.

Recommended Improvements:
At the time of this study effort, the Alabama Department of Transportation has a project underway to implement a roundabout at this intersection to address the crash expereince. There has been Public Information meetings held by ALDOT on this project and project design is progressing. This project will likely be constructed within the 2019-2020 time frame. An illustration of the current concept is included below. Note this is only a concept and the final design is likely to change from the concept illuistrated below.

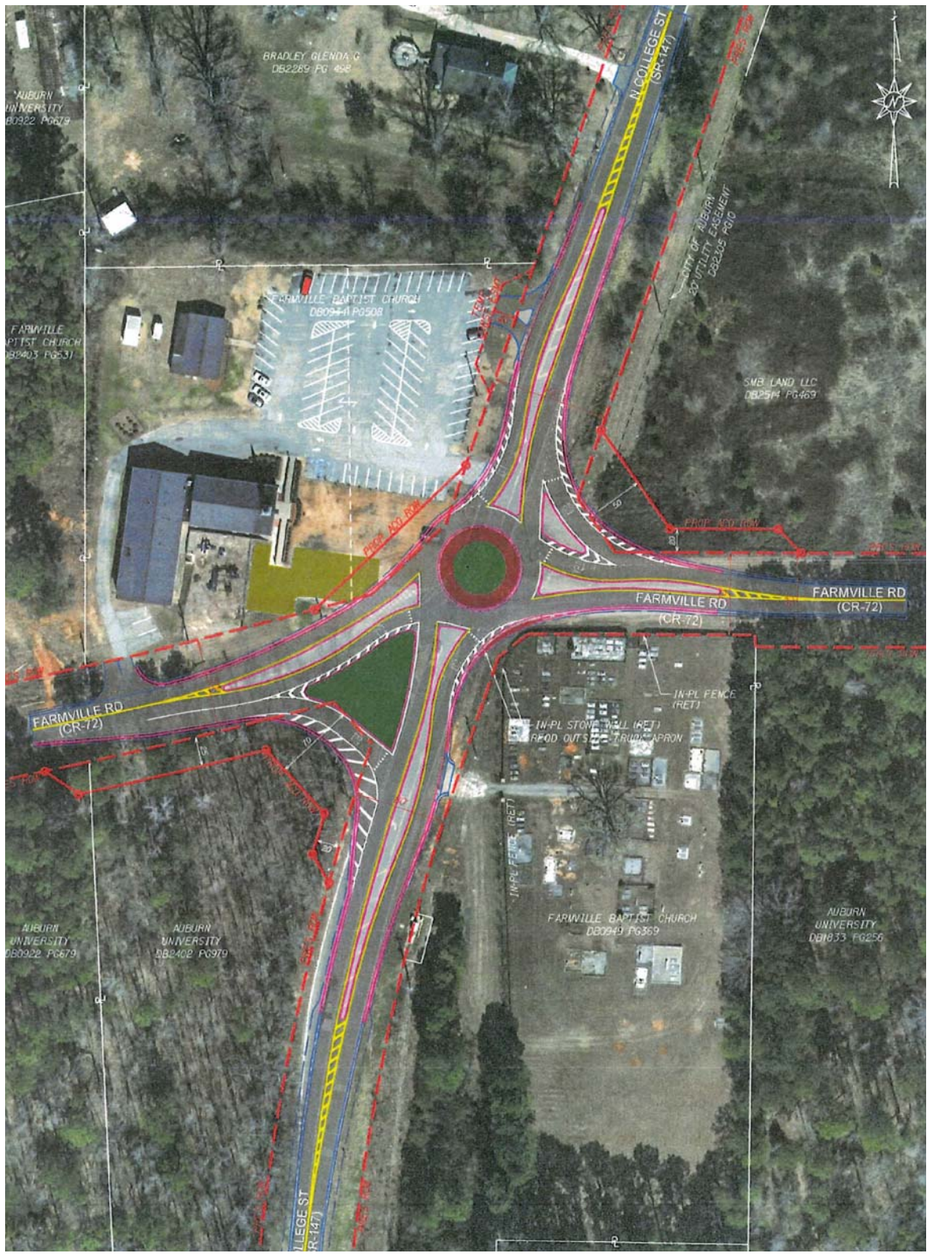
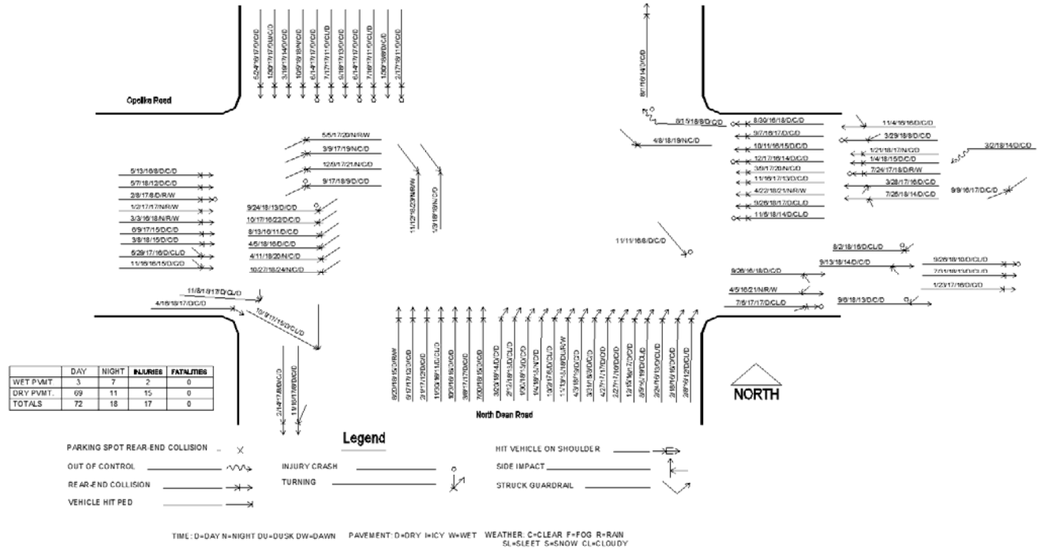


Figure 15 - ALDOT Roadway Improvement Project - North College Street at Farmville Road

High Priority Crash Location #8 – Opelika Road at Dean Road



	DAY	NIGHT	INJURIES	FATALITIES
WET PVMT	3	7	2	0
DRY PVMT.	69	11	15	0
TOTALS	72	18	17	0

Figure 16 - Intersection Crash Diagram - Opelika Road at Dean Road

Notable Crash Patterns:

- Rear end crashes on all approaches. Especially on the northbound approach of Dean Road

Crash Narrative:

The primary crash patterns at this location is rear end crashes. The northbound approach along Dean Raod appears to be the intersection approach affected by this the most. Most crashes occur during after noon on dry pavement. There is a mix of both night and daylight crashes. Environmental conditions do not appear to contribute to the crash expereince at his location.

Recommended Improvements:

- Construct a raised concrete island for pedestrian refuge in the northeast quadrant of the intersection
- Modify the northbound right turn lane to provide a safety right turn (70 degree right)
- Remove excess paving along the south side of Opelika Road and construct a sidewalk/planted strip
- Adjust the traffic signal timings to update clearance times to current ITE guidelines and adjust green time to comply with capacity needs as identified in the corridor traffic operations study.

The following is a diagram of the recommended improvements.

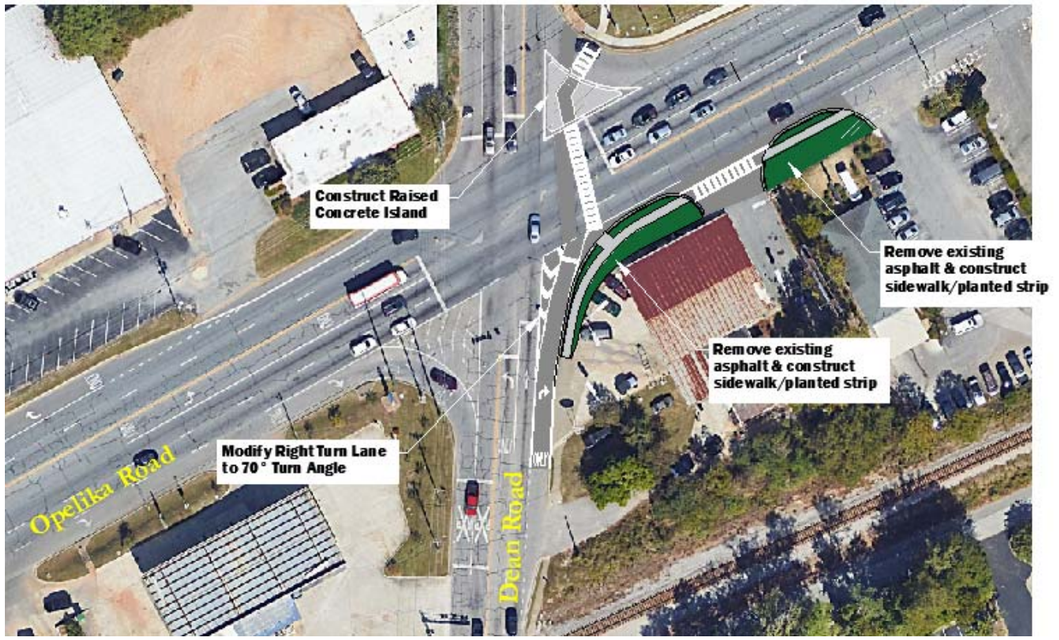


Figure 17 - Recommended Improvements - Opelika Road at Dean Road

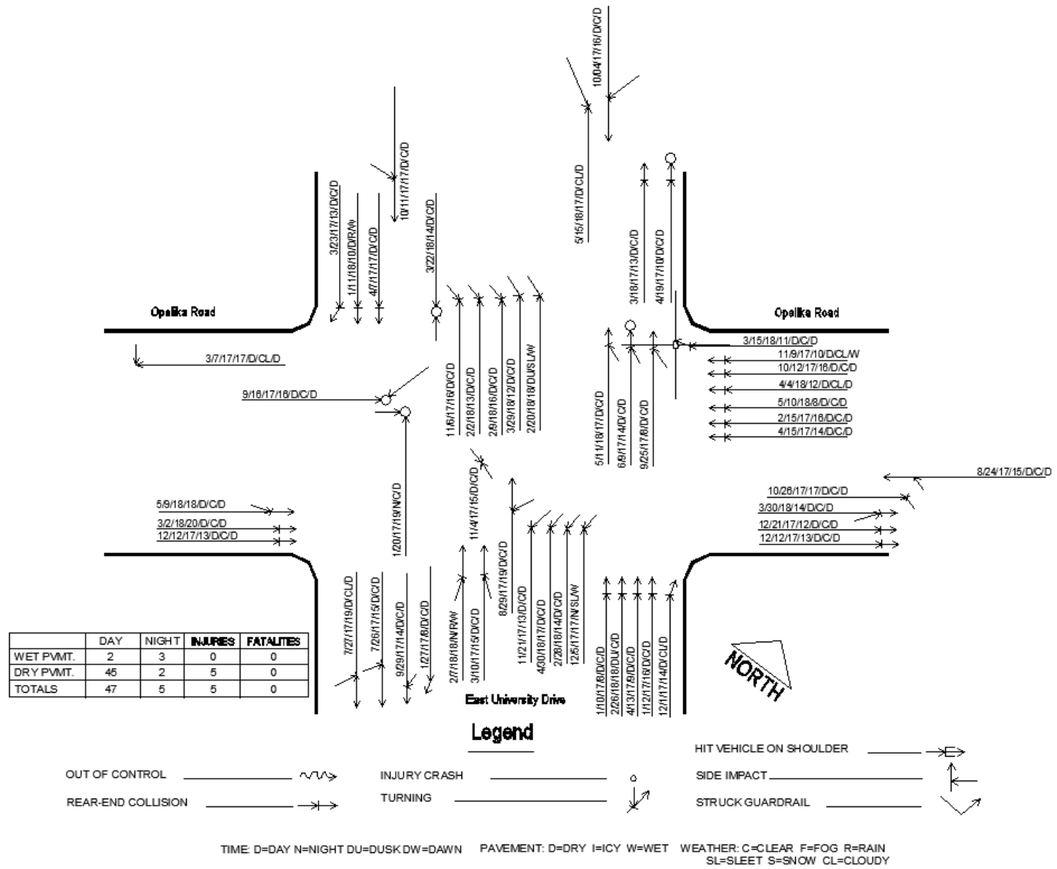
Recommended Improvements Safety Evaluation:

The proposed roadway improvement countermeasures are anticipated to improve roadway safety at the study intersection. Based upon information presented in the Crash Modification Factors Celaringhouse, it is reasonable to anticipate a reduction in crash expereince of approximately:

- 44% for crashes of all severity levels based upon the reconfiguration of the right turn lane
- 25% for crashes of all severity levels based upon the construction of a raised island with crosswalk

A review of the crash diagram indicates int would be reasonable to anticipate approximately 35% of the crashes would be removed as a result of the recommended safety improvements.

High Priority Crash Location #9 - Opelika Road at East University Drive



	DAY	NIGHT	INJURIES	FATALITIES
WET PVMT.	2	3	0	0
DRY PVMT.	45	2	5	0
TOTALS	47	5	5	0

Figure 18 - Intersection Crash Diagram - Opelika Road at East University Drive

Notable Crash Patterns:

- Turning crashes involving the northbound, southbound, and westbound traffic.

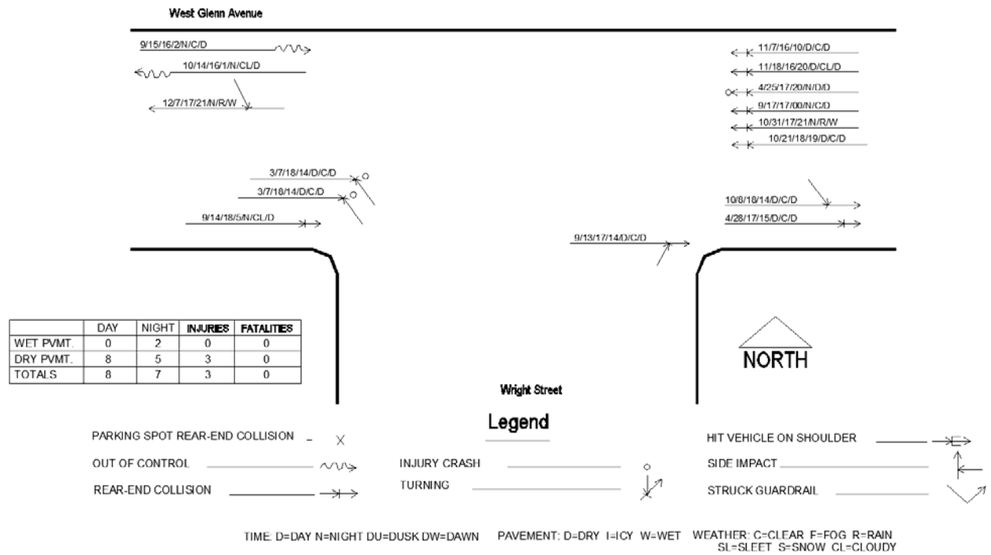
Crash Narrative:

The crash expereince at this location is largely related to signalized left turn movements. The conflict appears to be northbound traffic conflicting with southbound left turn traffic and westbound left turn traffic. One possible explanation for this would be traffic congestion at the intersection. The left turn phases that conflict with the northbound approach occur at both the beginning and end of the northbound green phase of the traffic signal. There doesn't appear to be any envirionmental conditions that would impact the crash expereince.

Recommended Improvements:

- Adjust the traffic signal timings to update clearance times to current ITE guidelines and adjust green time to comply with capacity needs as identified in the corridor traffic operations study.
- Examine roadway improvements as a part of the corridor traffic operations evaluations to improve traffic operations and reduce traffic congestion

High Priority Crash Location #10 - West Glenn Avenue at Wright Street



	DAY	NIGHT	INJURIES	FATALITIES
WET PVMT.	0	2	0	0
DRY PVMT.	8	5	3	0
TOTALS	8	7	3	0

Figure 19 - Intersection Crash Diagram - West Glenn Avenue at Wright Street

Notable Crash Patterns:

- Rear end crashes westbound associated with traffic stopped on West Glenn Avenue

Crash Narrative:
The crash expereince at this location is related to westbound traffic on West Glenn Avenue approaching the crosswalk and being rear ended when stopped for a pedestrian in the crosswalk. Environmental condtions do not appear to contribute to the crashes at this intersection, however night crashes are slightly over-represented.

Recommended Improvements:

- Install pedestrian crossing flashers at the crosswalk for the West Glenn Avenue approaches

It is recommended to monitor the crash expereince at this location after flashers are installed. If rearend crashes persist, a possible next step could be to relocate the crosswalk on West Glenn Avenue from the east side of the intersection to the west side of the intersection to improve distance and visibility.

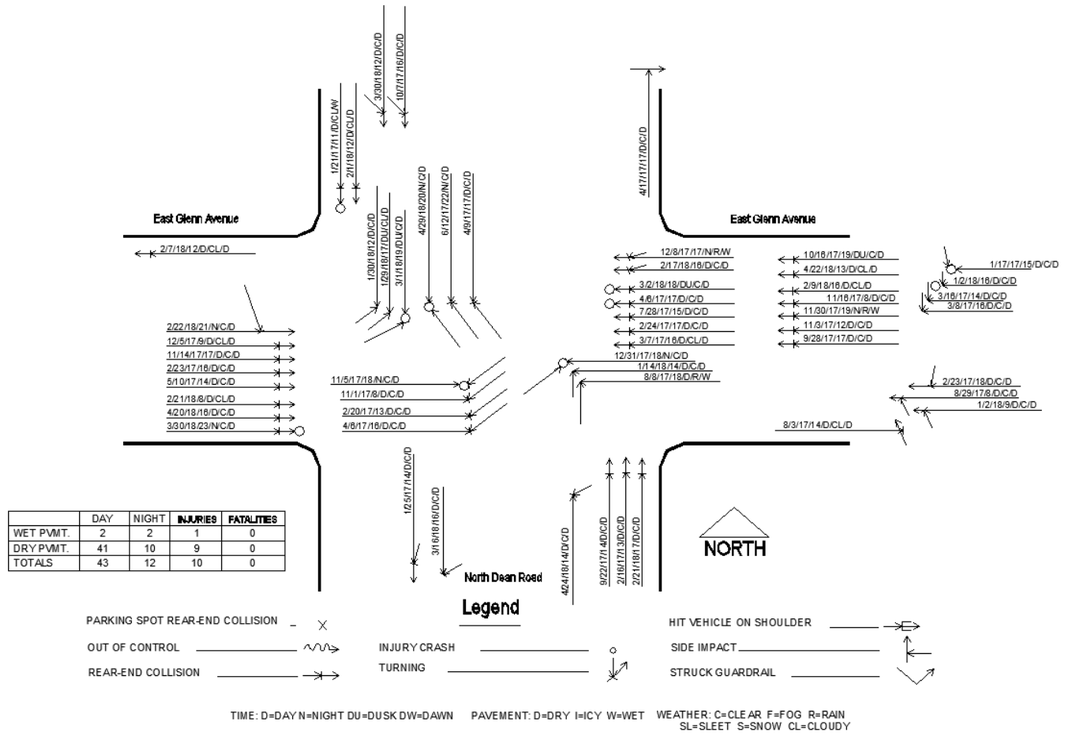
Recommended Improvements Safety Evaluation:

The proposed roadway improvement countermeasures are anticipated to improve roadway safety at the study intersection. Based upon information presented in the Crash Modification Factors Celaringhouse, it is reasonable to anticipate a reduction in crash expereince of approximately:

- 7% for rear end crashes of all severity levels based upon the addition of a rectangular rapid flashing beacon

A review of the crash diagram indicates it would be reasonable to anticipate approximately 7% of the crashes would be removed as a result of the recommended safety improvements.

High Priority Crash Location #11 - East Glenn Avenue at North Dean Road



	DAY	NIGHT	INJURIES	FATALITIES
WET PVMT.	2	2	1	0
DRY PVMT.	41	10	9	0
TOTALS	43	12	10	0

Figure 20 - Intersection Crash Diagram - East Glenn Avenue at North Dean Road

Notable Crash Patterns:

- Rear end crashes along the approaches of Glenn Avenue
- Crashes between westbound thru traffic along East Glenn Avenue and traffic entering/exiting development access driveways
- Left turning crashes at the intersection between thru traffic and left turning traffic

Crash Narrative:
The primary crash pattern at the intersection is rear end crashes at the signalized intersection. Crashes are mostly associated with the traffic signal at the intersection. Environmental conditions do not appear to have an impact on crash experience at the intersection. Crashes also occur at the Kroger access driveway east of the intersection. The primary issue at the Kroger access is traffic turning left out of the access and conflicting with thru traffic on Glenn Avenue.

Recommended Improvements:

- Implement access management along East Glenn Avenue. The access management stragety recommended is to restrict left turn movements to and from adjacent fully directional devleopment access driveways where crash expereince is illustrated.
- Construct a right turn lane along Eastbound Glenn Avenue
- Construct a right turn lane along westbound Glenn Avenue
- Adjust the traffic signal timings to update clearance times to current ITE guidelines and adjust green time to comply with capacity needs as identified in the corridor traffic operations study.

The Glenn Avenue roadway corridor study addresses the recommended improvements at this study location. The following figure is included in the Glenn Avenue roadway corridor study and depicts all recommended safety improvements at this study location.

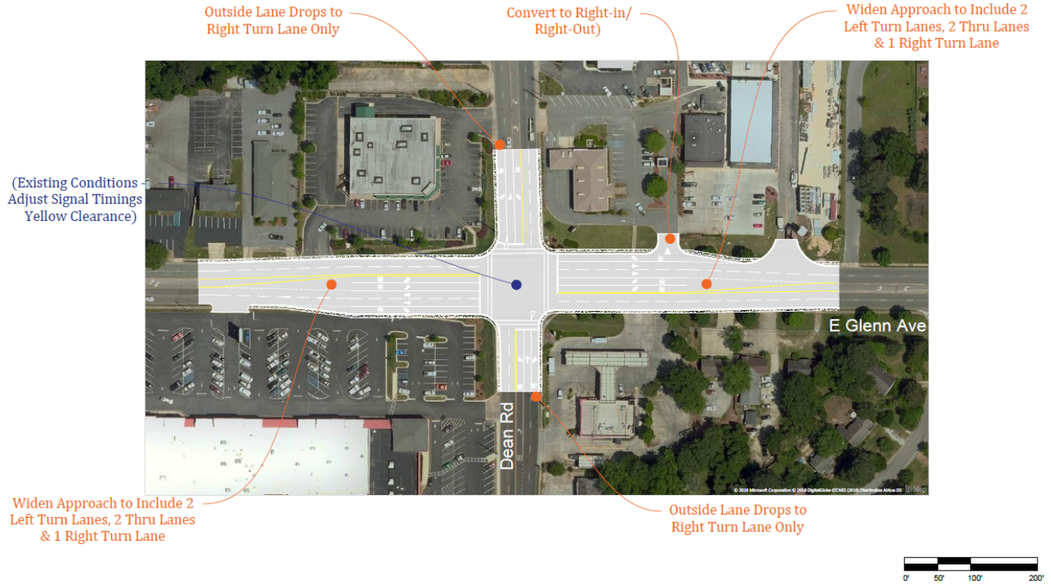


Figure 21 - Recommended Improvements - East Glenn Avenue at North Dean Road

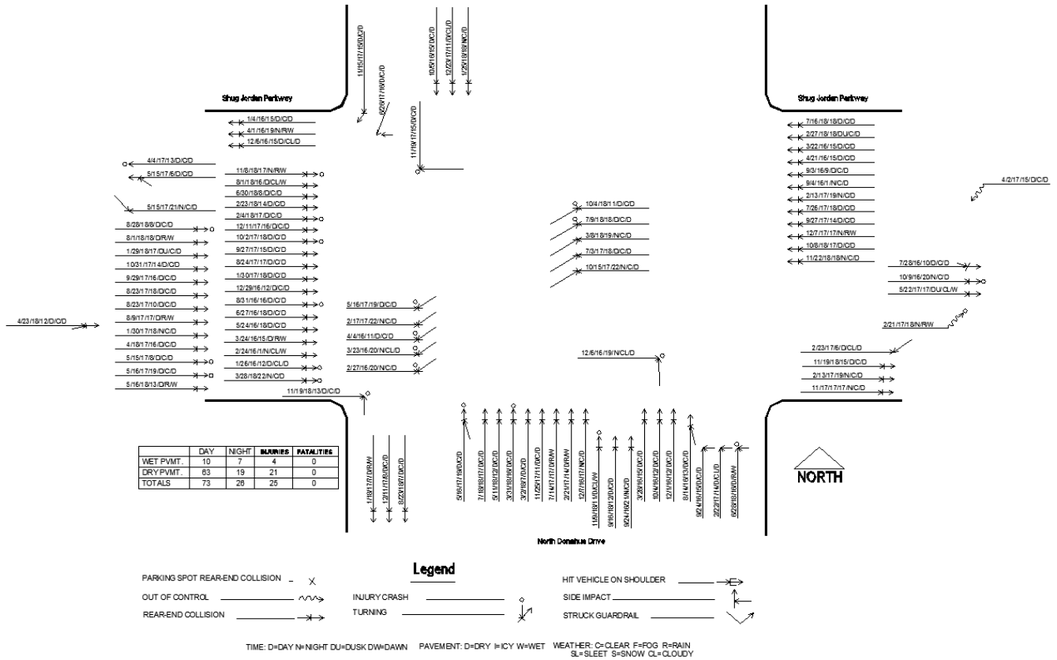
Recommended Improvements Safety Evaluation:

The proposed roadway improvement countermeasures are anticipated to improve roadway safety at the study intersection. Based upon information presented in the Crash Modification Factors Celaringhouse, it is reasonable to anticipate a reduction in crash expereince of approximately:

- 9% for crashes of all severity levels based upon the addition of a right turn lane
- 20% for crashes of all severity levels based upon the recommended Access Management driveway closures

A review of the crash diagram indicates int would be reasonable to anticipate approximately 27% of the crashes would be removed as a result of the recommended safety improvements.

High Priority Crash Location #12 – Shug Jordan Parkway at North Donahue Drive



	DAY	NIGHT	INJURIES	FATALITIES
WET PVMT.	10	7	4	0
DRY PVMT.	63	19	21	0
TOTALS	73	26	25	0

Figure 22 - Intersection Crash Diagram - Shug Jordan Parkway at North Donahue Drive

Notable Crash Patterns:

- Rear end crashes along the approaches of Shug Jordan Parkway and Northbound North Donahue Drive
- Left turning crashes at the intersection between thru traffic and left turning traffic

Crash Narrative:

The primary crash pattern at the intersection is rear end crashes at the signalized intersection. Crashes are mostly associated with the traffic signal at the intersection. Environmental conditions do not appear to have an impact on crash experience at the intersection.

Recommended Improvements:

- Construct a right turn lane along Eastbound Shug Jordan Parkway
- Construct a right turn lane along westbound Shug Jordan Parkway
- Construct a right turn lane along northbound North Donahue Drive
- Adjust the traffic signal timings to update clearance times to current ITE guidelines and adjust green time to comply with capacity needs as identified in the corridor traffic operations study.

The Donahue Drive roadway corridor study addresses the recommended improvements at this study location. The following figure is included in the Donahue Drive roadway corridor study and depicts all recommended safety improvements at this study location.

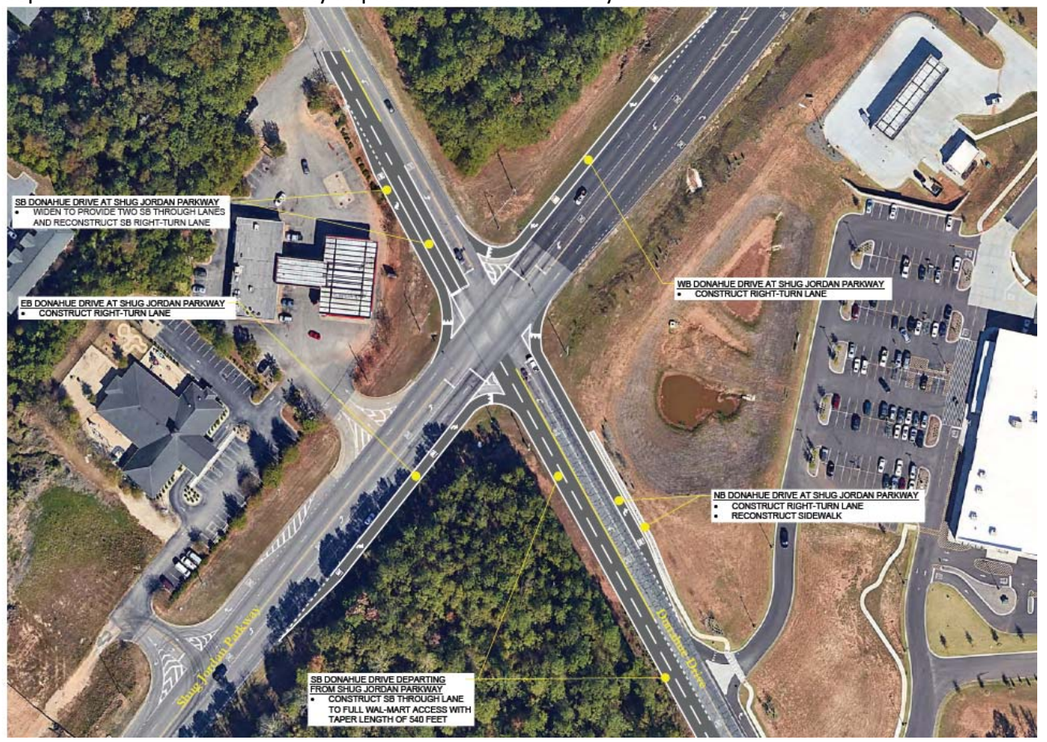


Figure 23 - Recommended Improvements - Shug Jordan Parkway at North Donahue Drive

Recommended Improvements Safety Evaluation:

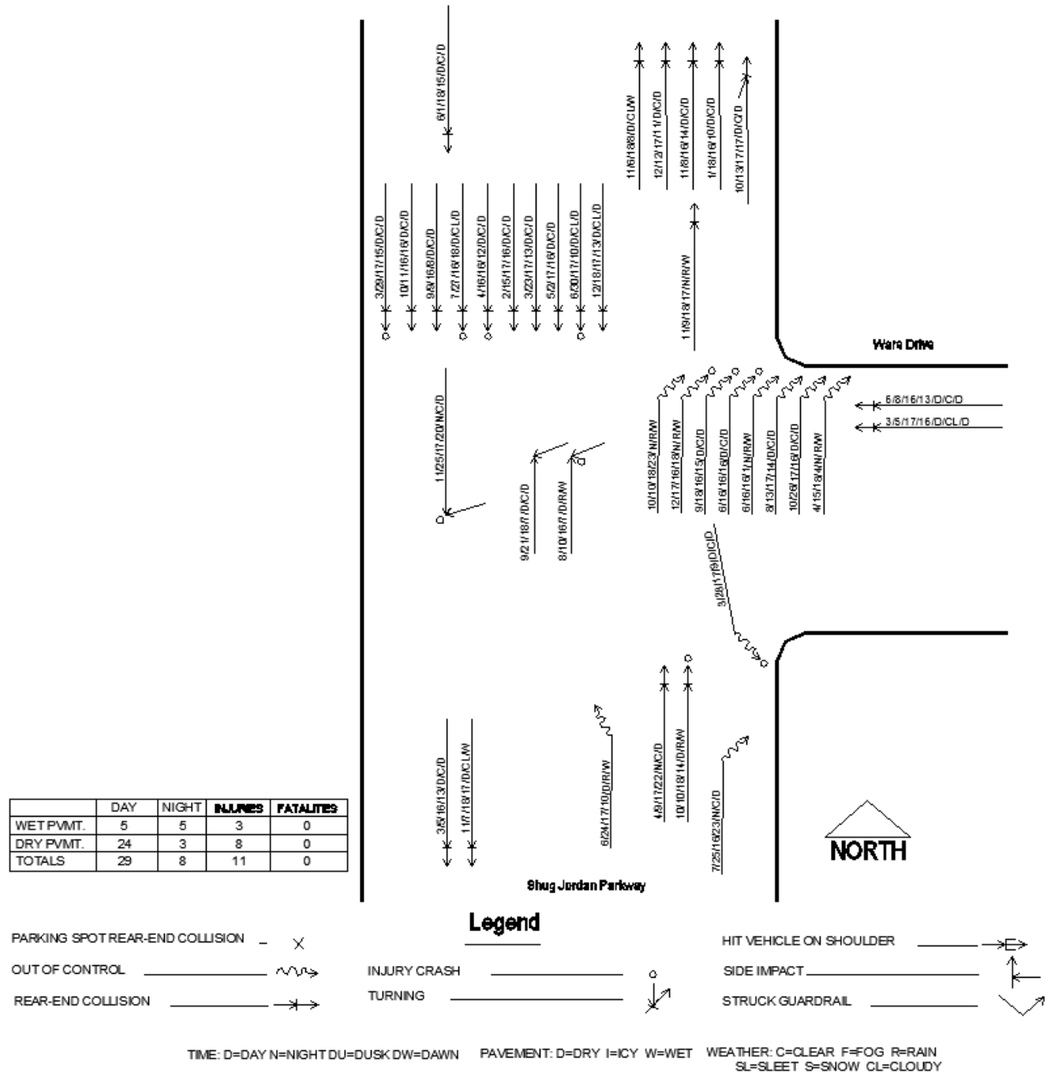
The proposed roadway improvement countermeasures are anticipated to improve roadway safety at the study intersection. Based upon information presented in the Crash Modification Factors Celaringhouse, it is reasonable to anticipate a reduction in crash expereince of approximately:

- 9% for crashes of all severity levels based upon the addition of a right turn lane

A review of the crash diagram indicates int would be reasonable to anticipate approximately 12%* of the crashes would be removed as a result of the recommended safety improvements.

*Note 12% is the value calculated based upon information presented in the Highway Safety Manual. It is reasonable to assume that based upon the crash expereince at this intersection, there could be a higher reduction in crashes than 12% as calculated.

High Priority Crash Location #13 – Shug Jordan Parkway at Ware Drive



	DAY	NIGHT	INJURIES	FATALITIES
WET PVMT.	5	5	3	0
DRY PVMT.	24	3	8	0
TOTALS	29	8	11	0

Figure 24 - Intersection Crash Diagram - Shug Jordan Parkway at Ware Drive

Notable Crash Patterns:

- Rear end crashes along the southbound approach of Shug Jordan Parkway
- Loss of control crashes along the northbound approach of Shug Jordan PArkway

Crash Narrative:

The primary crash pattern at the intersection is rear end crashes along the southbound approach of Shug Jordan Parkway. The primary contributing circumstance is traffic trying to turn left and being struck in the rear by thru traffic. There is no left turn lane at this location. An additional pattern is northbound traffic crashes with a loss of control. Wet weather crashes are over-represented at this location, and could be a contributing circumstance with this pattern.

Recommended Improvements:

- Construct a southbound left turn lane along Shug Jordan Parkway
- Reviwe pavement conditions for potential polishing/pavement surface friction issues. Consider high friction surface treatments for the pavement if Shug Jordan Parkway is not programmed for resurfacing in the latest paving cycle.

Recommended Improvements Safety Evaluation:

The proposed roadway improvement countermeasures are anticipated to improve roadway safety at the study intersection. Based upon information presented in the Crash Modification Factors Celaringhouse, it is reasonable to anticipate a reduction in crash expereince of approximately:

- 25% for crashes of all severity levels based upon the addition of a right turn lane
- 24% for crashes of all severity levels based upon increasing pavement friction

A review of the crash diagram indicates int would be reasonable to anticipate approximately 33% of the crashes would be removed as a result of the recommended safety improvements.