I-95 at SR 442 (Indian River Boulevard) Interchange Operational Analysis Report (IOAR)

FPID# 238002-6

Volusia County
January 29, 2021

Florida Department of Transportation
District Five

719 S. Woodland Blvd.
DeLand, Florida 32720

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Interchange Operational Analysis Report (IOAR)

Interstate 95 (I-95) at State Road 442 (SR 442)

FPID - 238002-6

Florida Department of Transportation

Determination of Safety, Operational and Engineering Acceptability

Acceptance of this document indicates successful completion of the review and determination of safety, operational and engineering acceptability of the Interchange Access Request. Approval of the access request is contingent upon compliance with applicable Federal requirements, specifically the National Environmental Policy Act (NEPA) or Department's Project Development and Environment (PD&E) Procedures. Completion of the NEPA/PD&E process is considered approval of the project location design concept described in the environmental document.

Requestor	DocuSigned by: Michael Sanders 2BA62826809F457... Michael Sanders, P.E. District Five	1/29/2021 | 12:33 PM EST Date
Interchange Review Coordinator	DocuSigned by: Suraj Pamulapati FE89B647E4043B... Suraj Pamulapati, P.E., PTOE District Five	1/29/2021 | 12:36 PM EST Date
Systems Management Administrator	DocuSigned by: Jenna Bowman 4AD03E6A337F4C1... Jenna Bowman, PE Systems Implementation Office – Central Office	2/8/2021 | 10:49 AM EST Date
State Chief Engineer	DocuSigned by: 022E6284209B41A... Will Watts, P.E. Central Office	2/10/2021 | 9:23 AM EST Date

PROFESSIONAL ENGINEER CERTIFICATE

Financial Project ID: 238002-6

Project: I-95 at SR 442 (Indian River Boulevard) IOAR

County: Volusia

FDOT District: Five

I, Hari Salkapuram, Florida P.E. Number 79663, have prepared and reviewed the I-95 at SR 442 (Indian River Boulevard) IOAR. I have specifically followed the guidelines as adopted by the Florida Department of Transportation, FDOT Policy No. 000-525-015-h, and FDOT Procedure No. 525-030-160-i. Based on traffic count information, general data sources, and other pertinent information, the IOAR has been prepared using current traffic engineering, transportation planning, and Florida Department of Transportation practices and procedures.

Hari

Digitally signed by Hari
DN: C=US, E=hari.salkapuram@hdrinc.com, CN=Hari
Date: 2021.01.29 09:48:22-05'00'

Hari Salkapuram, P.E. #79663

1/29/2021

Date

SYSTEMS IMPLEMENTATION OFFICE

QUALITY CONTROL CERTIFICATION FOR INTERCHANGE ACCESS REQUEST SUBMITTAL

Submittal Date: 1/29/2021

FM Number: 238002-6

Project Title: I-95 at SR 442 (Indian River Boulevard) IOAR

District: Five

Requestor: Michael Sanders, P.E Phone: 386-943-5339

District IRC: Suraj Pamulapati, P.E., PTOE Phone: 386/943-5378

Document Type: ☐ MLOU ☐ IJR ☐ IMR ☒ IOAR ☐ OTHER (Specify)

Status of Document (Only complete documents will be submitted for review; however, depending on the complexity of the project, interim reviews may be submitted as agreed upon in the MLOU)

Quality Control (QC) Statement

This document has been prepared following FDOT Procedure Topic No. 525-030-160 (New or Modified Interchanges) and complies with the FHWA two policy requirements. Appropriate District level quality control reviews have been conducted and all comments and issues have been resolved to their satisfaction. A record of all comments and responses provided during QC review is available in the project file or Electronic Review Comments (ERC) system.

Requestor DocuSigned by: Michael Sanders 2BA62026809F457... Date: 1/29/2021 | 12:33 PM EST

Michael Sanders, P.E.

IRC DocuSigned by: Suraj Pamulapati FE89B6447E1043B... Date: 1/29/2021 | 12:36 PM EST

Suraj Pamulapati, P.E., PTOE

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Executive Summary

Introduction

The Florida Department of Transportation (FDOT) District Five has prepared this Interchange Operational Analysis Report (IOAR) for the I-95 and SR 442 (Indian River Boulevard) interchange for installing a traffic signal at the I-95 southbound ramp terminal intersection. The signalization of the I-95 southbound ramp terminal addresses the existing and anticipated (future) issues along the southbound exit ramp. This improvement is a low-cost, short-term improvement that requires no Right-Of-Way (ROW) acquisition. The signalization project is currently under design and subsequent phases will be funded under the FDOT District Five Traffic Operations Pushbutton contract. The construction letting date is scheduled for January 2021 with an anticipated construction start date that will be within two months from the letting date.

The I-95 and SR 442 interchange is located in the City of Edgewater, Volusia County, Florida, approximately 4.8 miles south of the I-95 at SR 44 interchange and approximately 12.9 miles north of I-95 at CR 5A (Stuckway Road/Deering Parkway) interchange. The I-95 at SR 442 diamond configuration interchange provides connections to the City of Edgewater and the East Central Regional Rail Trail.

Purpose and Need

The purpose of the signalization project is to improve traffic flow and reduce queuing from the I-95 southbound ramp terminal intersection. Currently, the heavy southbound left-turn movement at the I-95 southbound ramps and SR 442 intersection is controlled by a stop sign and experiences long delays (Level of Service (LOS) E), with the queue occasionally extending upstream into the I-95 mainline during the PM peak hours. The existing deficiencies are expected to be exacerbated with the increase in traffic in future due to the planned developments – “Farmton Development of Regional Impact (DRI), Restoration DRI and Deering Creek Community Center District” to the west of the interstate. A safety review revealed that there are a relatively low number of crashes experienced and reported at this interchange in existing conditions; however, the increase in traffic volumes is expected to introduce more conflicts at the interchange in the future.

Compliance with FHWA Policy Points

This IOAR was developed in accordance with FDOT Policy No. 000-525-015-h: Approval of New or Modified Access to Limited Access Highways on the State Highway System (SHS), FDOT Procedure No. 525-030-160-i: New or Modified Interchanges and the 2020 Interchange Access Request User Guide (IARUG).

The FHWA Policy on access to the Interstate System provides the requirements for the justification and documentation necessary to substantiate any proposed changes in access to the Interstate System. The policy is published under the Federal Register, Volume 74, Number 43743, dated May 22, 2017. The responses provided herein for each of the two policy

statements demonstrate compliance with these requirements and provide justification of proposed improvements at the I-95 at SR 442 Interchange in Volusia County, Florida.

Policy Point 1: An operational and safety analysis has concluded that the proposed change in access does not have a significant adverse impact on the safety and operation of the interstate facility (which includes mainline lanes, existing, new, or modified ramps, and ramp intersections with crossroads) or on the local street network based on both the current and the planned future traffic projections. The analysis should, particularly in urbanized areas, include at least the first adjacent existing or proposed interchange on either side of the proposed change in access (Title 23, Code of Federal Regulations (CFR), paragraphs 625.2(a), 655.603(d) and 771.111(f)). The crossroads and the local street network, to at least the first major intersection on either side of the proposed change in access, should be included in this analysis to the extent necessary to fully evaluate the safety and operational impacts that the proposed change in access and other transportation improvements may have on the local street network (23 CFR 625.2(a) and 655.603(d)). Requests for a proposed change in access should include a description and assessment of the impacts and ability of the proposed changes to safely and efficiently collect, distribute, and accommodate traffic on the Interstate facility, ramps, intersection of ramps with crossroad, and local street network (23 CFR 625.2(a) and 655.603(d)). Each request should also include a conceptual plan of the type and location of the signs proposed to support each design alternative (23 U.S.C. 109(d) and 23 CFR 655.603(d)).

Response: A detailed operational and safety analysis was conducted in this IOAR to address this policy point.

Operations Analysis

The SR 442 at I-95 southbound ramp terminal is currently operating below adopted LOS E in the PM peak hour in existing conditions. The heavy southbound left-turn movement is currently experiencing long delays (LOS E) and the queue briefly extends upstream into the I-95 mainline during the PM peak hour. The AM peak hour currently operates at LOS B; therefore, the PM peak hour is the critical hour for the SR 442 at I-95 southbound ramp terminal intersection.

As shown in **Table ES-1** and **Table ES-2**, the signalization of the I-95 southbound ramp terminal at SR 442 improves operational efficiency and will eliminate the queue spillback into I-95 mainline in the critical PM peak hour. For the No-Build Alternative, the I-95 southbound ramp terminal is anticipated to operate at LOS F in 2022 and 2032 PM peak hours and the 95th percentile queue is anticipated to spill back to I-95 mainline in 2032 PM peak hours. In the Build Alternative, the intersection operates at LOS D or better through the Design Year with an improvement in delay up to 94%. With a reduction in the queue of up to 66% from No-Build to Build, the Build queue is not anticipated to spill back into the I-95 mainline. The detailed individual movement delay and LOS are discussed in Chapter 5.

Table ES-1. PM Peak Hour Southbound Ramp Terminal Intersection LOS

Alternative	Target LOS	Delay (s/veh)		LOS	
		PM		PM	
		2022	2032	2022	2032
No-Build	D	72.6	611.6	F	F
Build	D	18.1	36.5	B	D
Percent Improvement	**-**	**75%**	**94%**	**-**	**-**

Table ES-2. PM Peak Hour Southbound Ramp Queue

Alternative	Ramp Storage (ft.)[1]	95th Percentile Queue (ft.)	
		2022	2032
No-Build	1,400	550	1,925
Build	1,400	350	650
Percent Improvement	**-**	**36%**	**66%**

[1]Ramp storage is measured as the distance from the stop bar to the painted nose of the gore

Safety Analysis

A safety review revealed that there are a relatively low number of crashes reported at this interchange and within the Area of Influence (AOI) including one (1) crash occurred at the I-95 southbound ramp intersection within past five years. The safety analysis indicates a total crash reduction of approximately 0.06 (28%) crashes per year is estimated due to the proposed signalization improvement at the I-95 southbound ramp intersection.

Signing and Pavement Marking Plans

No signing or pavement marking changes are proposed to the I-95 mainline, as there are no changes to existing access points. The signing and pavement markings related to the proposed signal are included in **Appendix E** as part of the signal schematics for the proposed improvements.

Policy Point 2: The proposed access connects to a public road only and will provide for all traffic movements. Less than "full interchanges" may be considered on a case-by-case basis for applications requiring special access, such as managed lanes (e.g., transit or high occupancy vehicle and high occupancy toll lanes) or park and ride lots. The proposed access will be designed to meet or exceed current standards (23 CFR 625.2(a), 625.4(a)(2), and 655.603(d)). In rare instances where all basic movements are not provided by the proposed design, the report should include a full-interchange option with a comparison of the operational and safety analyses to the partial-interchange option. The report should also include the mitigation proposed to compensate for the missing movements, including wayfinding signage, impacts on local intersections, mitigation of driver expectation leading to wrong-way movements on-ramps, etc. The report should describe whether future provision of a full interchange is precluded by the proposed design.

Response: I-95 is a public facility and the SR 442 interchange within the AOI provides full access. The interchange improvements will occur at the I-95 and SR 442 southbound ramp terminal intersection. All basic movements are currently provided at the I-95 and SR 442 interchange. The proposed improvements at the I-95 and SR 442 interchange will continue to provide full access.

Analysis results presented in this IOAR conclude that the signalization of the I-95 southbound ramp terminal intersection at SR 442 improves operational efficiency, will significantly reduce the queue so that there is no projected spillback into the I-95 mainline in the critical PM peak hour, provides immediate and near-term relief from the recurring traffic congestion within the AOI, and will improve safety for all road users. The proposed signalization of the I-95 southbound ramp terminal intersection meets the two FHWA Policy Point requirements and satisfies the purpose and need. With this submittal, FDOT is seeking safety, operational and engineering (SO&E) acceptability of the proposed signalization of the I-95 and SR 442 southbound ramp terminal intersection.

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Appendices

1 Introduction

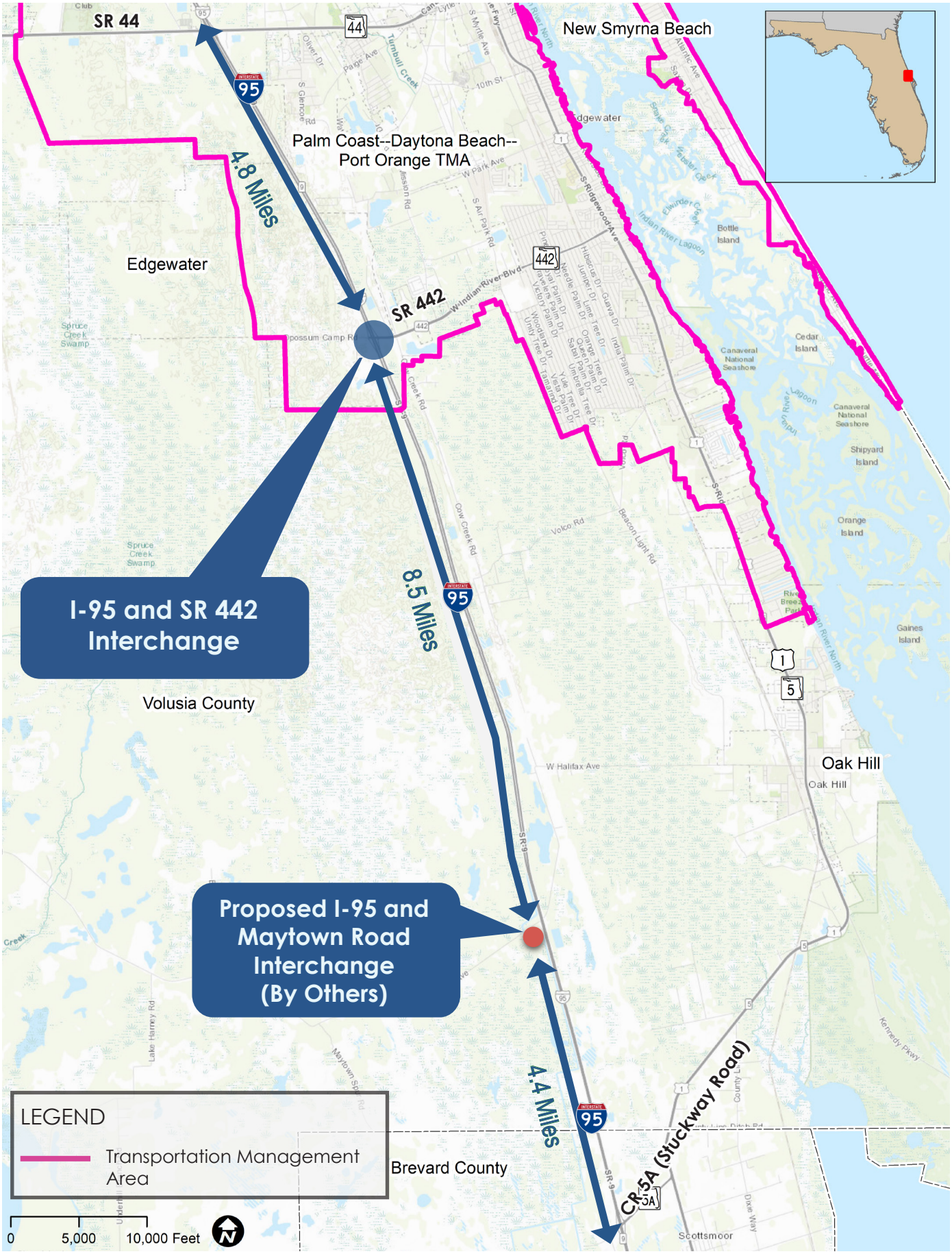
The Florida Department of Transportation (FDOT) District Five has prepared this Interchange Operational Analysis Report (IOAR) for the I-95 and SR 442 (Indian River Boulevard) interchange for installing a traffic signal at the I-95 southbound ramp terminal intersection. The signalization of the I-95 southbound ramp terminal addresses the anticipated queueing and existing delay issues along the southbound exit ramp. This improvement is a low-cost, short-term improvement that requires no Right-Of-Way (ROW) acquisition. The signalization project is currently under design and subsequent phases will be funded under the FDOT District Five Traffic Operations Pushbutton contract. The construction letting date is scheduled for January 2021 with an anticipated construction start date approximately two months from the letting date.

The I-95 and SR 442 interchange is located in the City of Edgewater, Volusia County, Florida, approximately 4.8 miles south of the I-95 at SR 44 interchange and approximately 12.9 miles north of I-95 at CR 5A (Stuckway Road/Deering Parkway) interchange. The project location is illustrated in **Figure 1-1**. The I-95 and SR 442 diamond interchange provides connections to the City of Edgewater and the East Central Regional Rail Trail.

A new interchange is being proposed at I-95 at Maytown Road (Developer funded) which is located approximately 8.5 miles to the south of the existing I-95 at SR 442 interchange. This is currently in the early planning stages with the Project Development and Environment (PD&E) study of the proposed interchange currently in Fiscal Year 2023 of the FDOT Work Program.

1.1 Purpose and Need

The purpose of the signalization project is to improve traffic flow and reduce queuing from the I-95 southbound ramp terminal intersection. Currently, the heavy southbound left-turn movement at the I-95 southbound ramps and SR 442 intersection is controlled by a stop sign and experiences long delays (Level of Service (LOS) E), with the queue occasionally extending upstream into the I-95 mainline during the PM peak hours. The existing deficiencies are expected to be exacerbated with the increase in traffic in future due to the planned developments – “Farmton Development of Regional Impact (DRI), Restoration DRI and Deering Creek Community Center District” to the west of the interstate. A safety review revealed that there are a relatively low number of crashes experienced and reported at this interchange in existing conditions; however, the increase in traffic volumes is expected to introduce more conflicts at the interchange in the future.



2 Methodology

This IOAR was developed in accordance with FDOT Policy No 000-525-015-h, FDOT Procedure 525-030-160-I, and the 2020 IARUG. In coordination with Central Office, it was determined that a Methodology Letter of Understanding (MLOU) was not needed for this I-95 at SR 442 IOAR.

2.1 Area of Influence

Along I-95

In accordance with Section 2.4.2 of the 2020 IARUG, the I-95 mainline, and ramps are not included in the Area of Influence (AOI) as improvements are focused on the ramp terminal intersections.

Along SR 442

Along SR 442, the AOI is from 0.5 miles west of the I-95 southbound ramp intersection to east of Old Mission Road located approximately 0.9 miles east of the I-95 and SR 442 northbound ramp intersection. West of I-95 is currently undeveloped and there are no intersections within 0.5 miles or beyond on the west side of the I-95 and SR 442 southbound ramp intersection.

There are three intersections under consideration within the AOI along SR 442. These intersections are listed below:

- SR 442 and I-95 southbound ramp (Unsignalized intersection)
- SR 442 and I-95 northbound ramp (Unsignalized intersection)
- SR 442 and Old Mission Road (signalized intersection)

Additionally, there are no planned major intersections to the west of the interchange in the near-term. The proposed new land use developments west of the interchange are in early stages of development with necessary comprehensive plan amendments yet to be approved through local agencies. This area west of the interchange will be monitored closely at the time of the approval of the comprehensive land use plan amendments and required improvements and studies will be part of those approvals through FDOT and local agencies. In addition, there are no traffic concerns from residents at the intersection of SR 442 and Coral Trace Blvd located east of the interchange at this time. This location will be considered in future projects AOI as needed when the land use amendments to the west of interchange are pursued. The AOI is shown in Figure 2-1.

2.2 Analysis Years

The years used for the traffic operational analysis are:

- Existing Year: 2019
- Opening Year: 2022
- Design Year: 2032

2.3 Considered Alternatives

Traffic operational analyses will be performed for No Build and Build Alternatives in the IOAR. The No-Build Alternative will utilize the existing geometry as there are no programmed roadway improvements within the AOI.

2.4 Analysis Approach

2.4.1 Travel Demand Forecasting

The Central Florida Regional Planning Model (CFRPM), Version 6.1 was used for travel forecasting. The CFRPM includes base year (2010) and horizon year (2040). The CFRPM was validated to year 2019. Subsequently, the growth factors were determined from 2019 and 2040 model volumes, historical traffic counts, and Bureau of Economic and Business Research (BEBR) growth projections. Future intersection turning movement volumes were developed using the TM Tool application, a recommended tool from the FDOT's 2019 Project Traffic Forecasting Handbook. The Annual Average Daily Traffic (AADT), Standard K factor, and D factor, together with existing turning movements, were used as input into the TM Tool application to calculate future year turning movements.

2.4.2 Traffic Operational Analysis

The intersection analysis was conducted using Synchro (version 10) for study intersections along SR 442 based on HCM 6th Edition control delay and LOS criteria as shown in **Table 2-1**. Synchro operational analysis was conducted with the following assumptions:

- Truck Percentages
    - Individual movement truck percentages were calculated from intersection turning movement data collection for AM and PM peak hours.
    - These percentages were used for existing year, Opening Year (2022), and Design Year (2032) with a minimum two percent.
- Peak Hour Factor (PHF)
    - Intersection PHF was calculated from the intersection turning movement data collected for AM and PM peak hours. The calculated PHF from existing data was used for each intersection for existing year.
    - For Opening Year (2022) and Design Year (2032) analysis, the calculated PHF from existing data was used with a minimum PHF of 0.95.

Table 2-1. Intersection Level of Service Criteria

LOS Grade	Signalized Intersections Control Delay (sec/veh) (LOS) (HCM Exhibit 19-8)	Unsignalized Intersections Control Delay (sec/veh) (LOS) (HCM Exhibit 20-2/21-8)
A	≤ 10	≤ 10
B	> 10-20	> 10-15
C	> 20-35	> 15-25
D	> 35-55	> 25-35
E	> 55-80	> 35-50
F	>80	>50

The following intersections were evaluated as part of the existing conditions in this study:

- SR 442 and I-95 southbound ramp intersection (Unsignalized)
- SR 442 and I-95 northbound ramp intersection (Unsignalized)
- SR 442 and Old Mission Road (Signalized)

The Measures of Effectiveness (MOE) assessed from the synchro include the following:

- Individual movement delay, LOS, and volume-to-capacity (V/C) ratio
- Overall intersection delay and intersection LOS
- Individual movement 95th percentile queue lengths

Additionally, a ramp capacity analysis was performed based on HCM 6th edition methodology (Exhibits 14-12, and 12-25 and Equations 14-1 and 12-10).

2.4.3 Safety Analysis

Crash records were obtained for the I-95 and SR 442 interchange within the AOI for the most recent five-year period on record from 2014 through 2018 from the FDOT's Crash Analysis Reporting (CAR) System database. Using this data, crash rates were calculated and compared with statewide crash rates for similar facilities.

2.4.4 Level of Service Target

LOS is a qualitative measure of how efficiently a roadway or intersection operates. LOS A represents the highest traffic flow quality, while LOS E represents traffic flow at capacity. LOS F represents forced flow congested conditions. The LOS performance criteria targets are as follows:

- SR 442: LOS D

3 Existing Conditions

This section documents the existing (2019) conditions analysis within the study area, including existing traffic volumes, transportation network, traffic operations and safety analysis for study intersection and ramps.

3.1 Data Collection

The following summarizes the location and type of data collected in support of this IOAR:

- A forty-eight (48) hour vehicle classification count was conducted during December 10 and 11, 2019 at the following location:
    - SR 442 east of I-95
- Forty-eight (48) hour bi-directional volume counts were conducted during December 10 and 11, 2019 at the following locations:
    - SR 442, West of I-95
    - Old Mission Road, North of SR 442
- Four-hour turning movement counts were conducted between 7-9 AM and 4-6 PM on December 10, 2019 at the following locations:
    - SR 442 and I-95 southbound ramp intersection (Unsignalized)
    - SR 442 and I-95 northbound ramp intersection (Unsignalized)
    - SR 442 and Old Mission Road (Signalized)
- Additional AADT data was extracted from 2019 Florida Transportation Online (FTO).
- Axle and seasonal adjustment factors for Volusia County/SR 442 are obtained from 2019 FTO.
- Traffic signal data for the signalized intersection at SR 442 and Old Mission Road was obtained from Volusia County.
- Crash records were obtained for I-95 and SR 442 interchange within the AOI for the most recent five-year period on record from 2014 through 2018 from the FDOT's CAR System database.
- Aerial photography was reviewed to collect information on existing geometry, storage lengths, traffic signal heads, and to determine/verify signal phasing information, such as protected/permitted left-turn operation, Right-Turn-On-Red (RTOR) restrictions, and phase overlaps, etc.

Data gathered from various sources is included in **Appendix A** and data collection locations are illustrated in **Figure 3-1**.

3.2 Roadway Characteristics

The existing I-95 and SR 442 interchange is located in Volusia County, Florida. I-95 is a six-lane (three lanes in each direction) north-south interstate facility in the vicinity of the existing SR 442 interchange. The posted speed limit on I-95 is 70 mph. SR 442 is a four-lane divided urban minor arterial on the west and east sides of the southbound and northbound ramp terminal intersections, respectively. SR 442 between the I-95 southbound and northbound ramp terminal intersections is a two-lane divided arterial with left-turn lanes approaching the ramp terminal intersections, while the segment of SR 442 between the I-95 northbound ramp and US 1 is a four-lane divided urban arterial. The posted speed limit on SR 442 is 45 mph within the interchange area and is 55 mph east of Cow Creek Road on SR 442. The I-95 entrance and exit ramps are single-lane diamond-style ramps and the ramp terminals currently operate as stop-controlled intersections. The context classification for SR 442 varies from suburban residential to rural. It is C3R (suburban residential) within the I-95 and SR 442 interchange area, C3C (suburban commercial) from east of SR 442 northbound ramp terminal and C2 (Rural) east of SR 442 and Old Mission Road intersection. SR 442 west of the interchange is currently undeveloped. The context classification information is included in **Appendix A**. The existing lane configurations within AOI are illustrated in **Figure 3-2.**

As previously mentioned, the existing adjacent interchanges are located almost 5 and 13 miles to the north and south, respectively. It should be noted that a new interchange is being proposed at I-95 at Maytown Road which is located approximately 8.5 miles to the south of the existing I-95 at SR 442 interchange. This developer-funded proposed interchange is dependent on a Local Funds Agreement between FDOT and Volusia County and is currently in the early planning stages with the PD&E study of the proposed interchange currently in Fiscal Year 2023 of the FDOT Work Program.

3.3 Peak Hour Volumes

As discussed in Section 3.1, turning movement count data was collected between 7-9 AM and 4-6 PM on December 10, 2019. Intersection turning movement count data was reviewed to determine peak hours for the AOI and those peak hours are listed below:

- 7:15 AM to 8:15 AM in the morning
- 4:30 PM to 5:30 PM in the evening

The applicable seasonal factor from Volusia County (1.02) was applied to raw peak-hour turning movement data to calculate seasonally adjusted peak-hour turning movement volumes. These peak-hour volumes were further balanced and are shown in **Figure 3-3**.

3.4 Traffic Operational Analysis

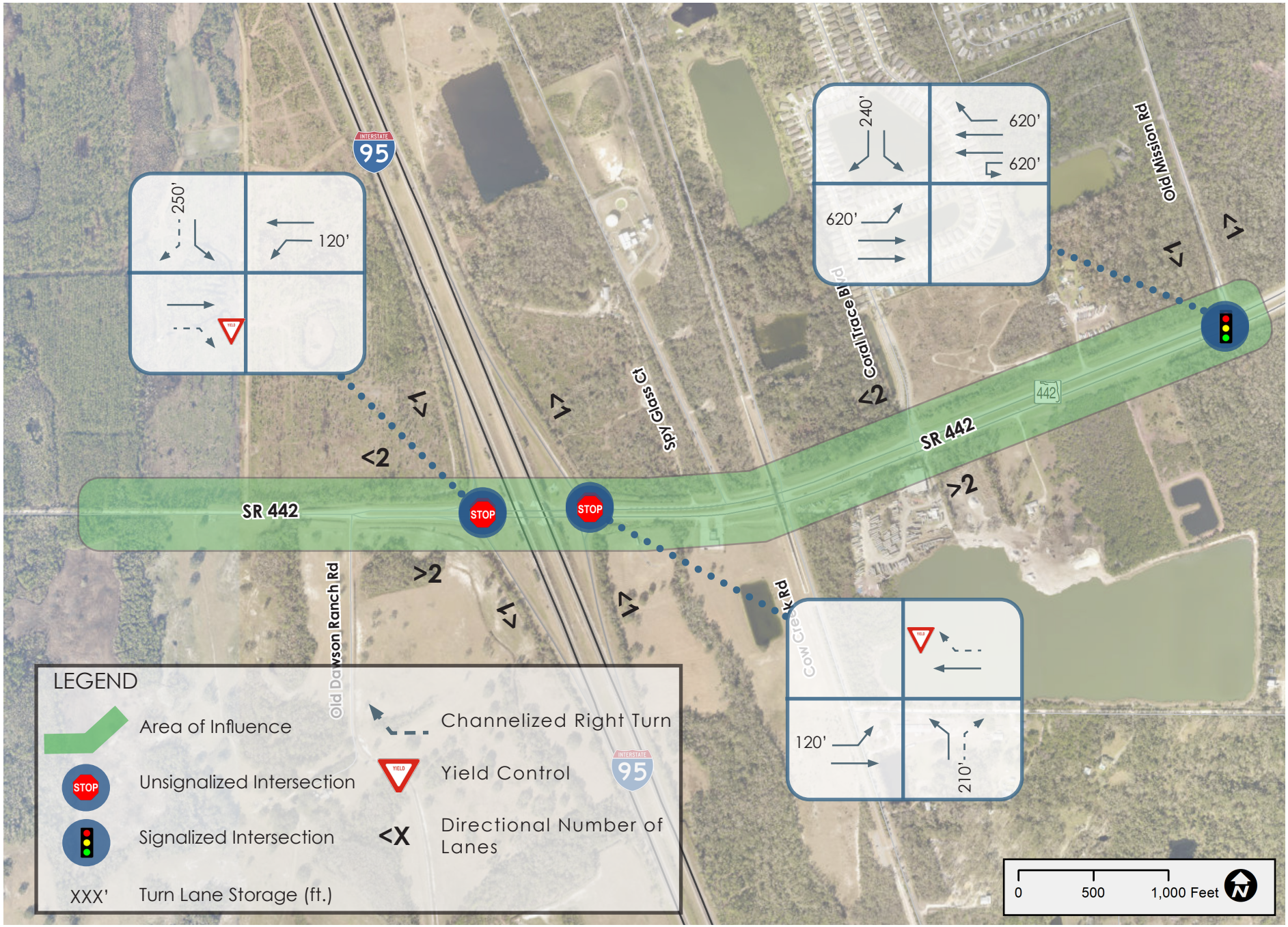
An existing traffic operational analysis was performed using the existing peak-hour volumes.

3.4.1 Existing Intersection Analysis

The intersection analysis was conducted using Synchro (version 10) for study intersections along SR 442 based on HCM 6th Edition control delay and LOS criteria. A summary of the

analysis is shown in Table 3-1 with LOS E or worse highlighted in red. The Synchro analysis outputs are provided in **Appendix B**. The Synchro intersection operational results indicate the following:

- The intersection of SR 442 at I-95 southbound Ramps is operating at LOS B in the AM peak hour and LOS E in the PM peak hour due to heavy southbound left turn movement.
- The rest of the study intersections along SR 442 within the AOI operate at target LOS B or better in both AM and PM peak hours.



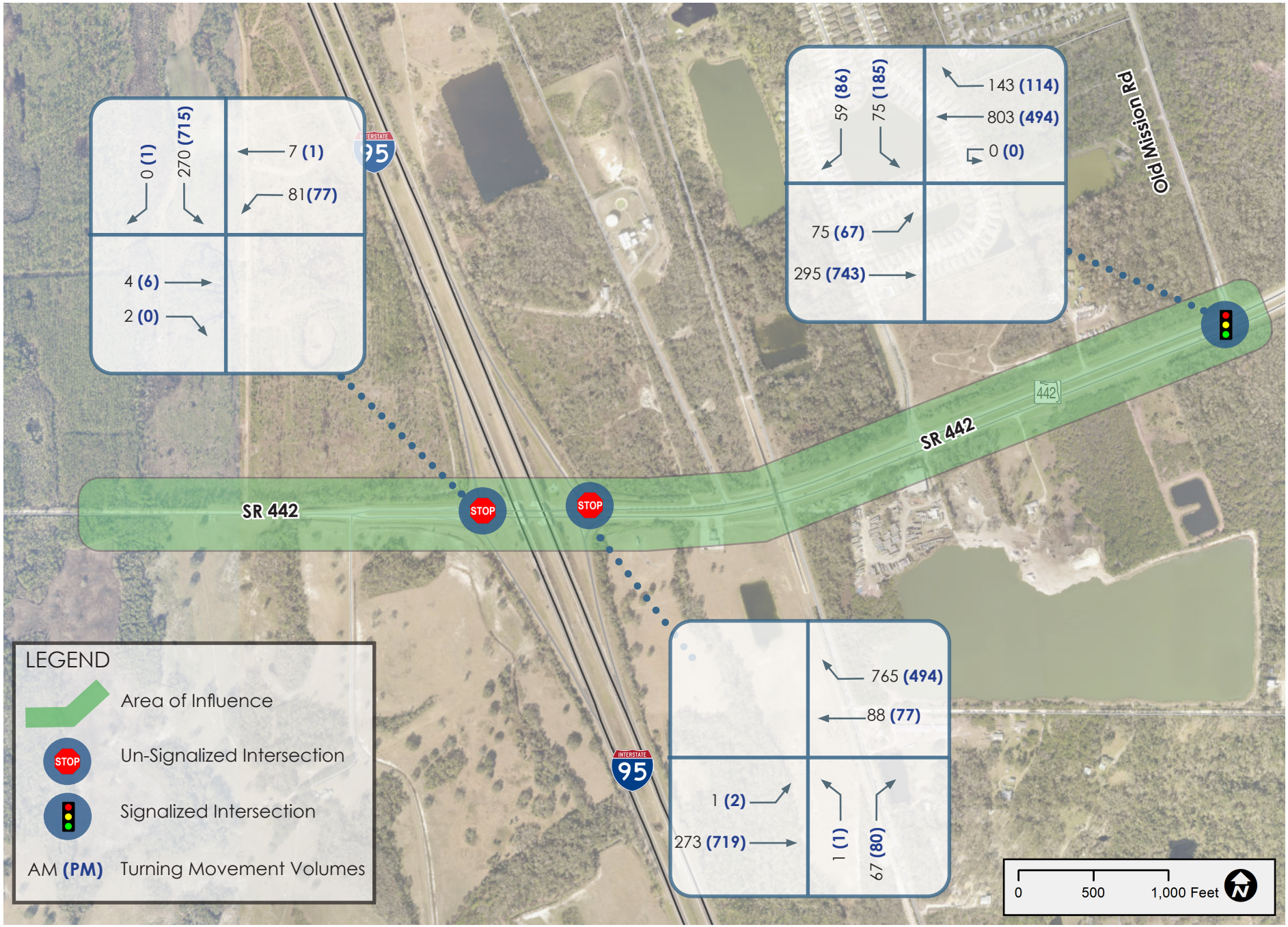


Table 3-1. Existing (2019) Intersection Analysis Summary

SR 442 Intersection	Signal Control	Movement	Delay (s/veh)		LOS		V/C		Intersection Delay (s/veh)		Intersection LOS	
			AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
I-95 SB Ramps	Stop	SBL	14.8	42.0	B	**E**	0.485	0.939	12.6	38.3	B	**E**
		SBR	0.0	0.0	A	A	-	-				
		WBL	7.5	7.4	A	A	0.067	0.05				
I-95 NB Ramps	Stop	NBL	11.1	15.3	B	C	0.002	0.003	0.0*	0.0*	A	A
		NBR	0.0	0.0	A	A	-	-				
		EBL	7.4	7.4	A	A	0.001	0.001				
Old Mission Rd	Signal	SBL	25.6	21.5	C	C	0.47	0.65	14.3	12.9	B	B
		SBR	27.0	18.3	C	B	0.50	0.35				
		EBL	47.1	33.1	D	C	0.78	0.63				
		EBT	4.1	7.0	A	A	0.15	0.41				
		WBT	13.5	14.8	B	B	0.63	0.52				
		WBR	11.0	13.6	B	B	0.25	0.27				

**The minor NBL movement is operating at LOS B and C in AM and PM, respectively.*

3.4.2 Queue Summary

Table 3-2 summarizes queue results for turn lanes from Synchro and available storage for both AM and PM peak hours; detailed outputs are included in **Appendix B**. The queue results indicate that the SR 442 southbound and northbound off-ramp queues do not extend to the I-95 mainline. However, FDOT District Five has received complaints from motorists that the queue from the SR 442 southbound off-ramp occasionally extends upstream into the I-95 mainline during the PM peak hour.

Table 3-2. Existing (2019) Queue Summary

SR 442 Intersection	Signal Control	Movement	Available Storage (ft.)	95th Percentile Queue (ft.)[5]	
				AM	PM
I-95 SB Ramps	Stop	SBL[1]	1,400	75	350
		SBR[2]	250	0	0
		WBL[3]	120	0	0
I-95 NB Ramps	Stop	NBL[1]	1,400	0	0
		NBR[2]	210	0	0
		EBL[3]	120	0	0
Old Mission Rd	Signal	SBL[4]	-	50	75
		SBR[3]	240	50	25
		EBL[3]	620	75	50
		WBR[3]	620	50	25

1. *Storage measured from the stop bar to the painted nose of the gore*
2. *Storage measured from the painted nose for channelization to the painted nose for the through movement*
3. *Storage measured from the stop bar to the end of taper*
4. *Through lane converts into an SBL and hence available storage is not listed*
5. *An assumed 25-feet per vehicle was used to calculate the 95th % queue length*

3.4.3 Ramp Capacity Analysis

A ramp capacity analysis was conducted for the existing conditions based on HCM 6th edition Methodology described in Section 2.4.2. **Table 3-3** is a summary of the ramp capacity analysis for the I-95 and SR 442 interchange ramps.

Table 3-3. Existing (2019) Ramp Capacity Analysis Summary

SR 442 Ramp	Number of Lanes	Speed Limit (mph)	Ramp Capacity (pc/h)[1]	Peak Hour Demand Volume (vph)		Peak Hour Demand Flow Rate (pc/h)[2]		Ramp Capacity Sufficient?
				AM	PM	AM	PM	
NB Off-Ramp	1	35	2,000	67	81	74	89	Yes
NB On-Ramp	1	50	2,200	766	496	844	546	Yes
SB Off-Ramp	1	30	2,000	270	716	297	789	Yes
SB On-Ramp	1	50	2,200	83	77	91	85	Yes

1. *Ramp Capacity is based of HCM 6th Exhibit 14-12*
2. *Flow rate in pc/h is estimated based on Exhibits 14-12, and 12-25 and Equations 14-1 and 12-10.with a PHF of 0.95 and 4.65 % for trucks using 2019 FDOT FTO T-factor of 9.3 for all SR 442 ramps*

3.5 Existing Safety Analysis

Crash records were obtained for the AOI for the most recent five-year period on record (2014 through 2018) from the FDOT's CAR System; they are graphically depicted in **Figure 3-4**. The raw crash data is included in **Appendix A.**

3.5.1 Crash Frequency and Severity

During the five-year analysis period, there were 22 reported crashes within the AOI with crashes increasing over the past five years. Of the 22 crashes, 8 crashes were injury related, 8 crashes resulted in Property Damage Only (PDO). The most common crash types were angle (36%) and "other" (36%) followed by rear-end (18%) crashes. Daytime crashes were the most common (64%). 27% of crashes occurred in the rain, and 36% of crashes occurred when the road surface was wet. The majority of crashes occurred between the northbound ramp terminal and Old Mission Road intersection. The historical crash data, crash reports, and analysis are documented in **Appendix A**. **Figure 3-4** illustrates the total crashes by year, and **Figure 3-5** illustrates the crashes by severity. Tables 3-4 through 3-6 summarize crashes by type, by location and by field conditions.

Figure 3-4. Crashes by Year

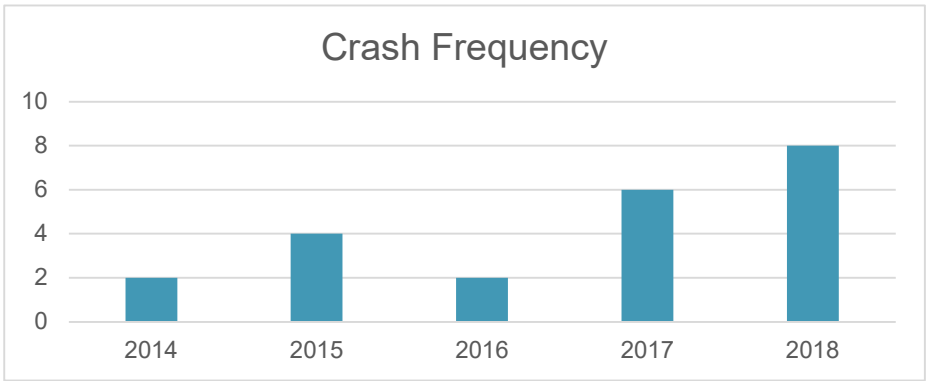


Figure 3-5. Crash Severity by Year

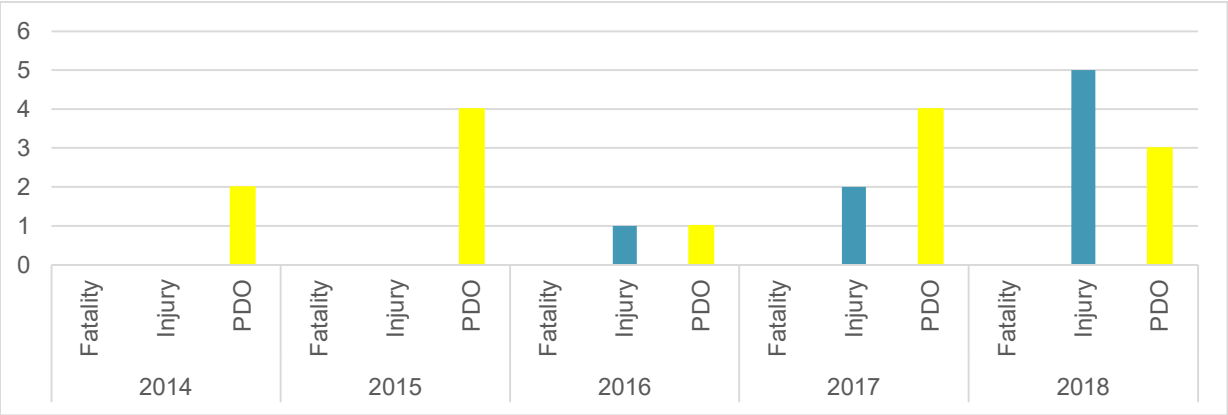


Table 3-4. Crash Type Summary

Crash Type	No. of Crashes	% of Total Crashes
Angle	8	36%
Other	8	36%
Rear-end	4	18%
Sideswipe	2	9%
Total	**22**	**100%**

Table 3-5. Crash Summary by Location

Location	Total Crashes	% of Total Crashes	Crash Frequency	Average Entering AADT	Crash Rate	Statewide Crash Rate (2014-2018)
1.SR 442 west of I-95 Off-Ramp	0	0%	0.0	200	0.00	6.11
2.I-95 SB Off-Ramp	3	14%	0.6	4,700	1.32	-
3.SR 442 /SB Ramp Intersection	1	5%	0.2	5,600	0.10	1.73
4.I-95 SB On-Ramp	0	0%	0.0	800	2.21	-
5.SR 442/NB Ramp Intersection	3	14%	0.6	11,500	0.14	1.73
6. I-95 NB On-Ramp	3	14%	0.6	5,200	0.99	-
7. I-95 NB Off-Ramp	3	14%	0.6	1,000	6.09	-
8.btw SR 442 NB Ramp Intersection and Old Mission Rd	7	32%	1.4	11,500	0.39	6.11
9.SR 442/Old Mission Rd	2	9%	0.4	15,500	0.07	1.73
Total	**22**	**100%**	**4.4**			

Table 3-6. Crash Summary by Field Conditions

Condition		No. of Crashes	% of Total Crashes
Lighting Conditions	Dark-Lighted	4	18%
	Dark-Not Lighted	3	14%
	Daylight	14	64%
	Dusk	1	5%
	Total	**22**	**100%**
Weather Conditions	Clear	13	59%
	Cloudy	2	9%
	Fog, Smog, Smoke	1	5%
	Rain	6	27%
	Total	**22**	**100%**
Road Surface Conditions	Dry	14	64%
	Wet	8	36%
	Total	**22**	**100%**

3.5.2 Crash Rates

The crash rates for the segments are expressed as the number of crashes per million vehicle-miles traveled, the crash rates for the intersections are expressed as number of crashes per million entering vehicles. The following equation was utilized to develop the crash rates for this study:

$$Crash\ Rate\ of\ Segment = \frac{Total\ Number\ of\ Crashes\ x\ 1{,}000{,}000}{AADT\ x\ 365\ x\ Number\ of\ Years\ x\ Length\ of\ Roadway\ Segment}$$

$$Crash\ Rate\ of\ Intersections = \frac{Total\ Number\ of\ Crashes\ x\ 1{,}000{,}000}{AADT\ x\ 365\ x\ Number\ of\ Years}$$

Crash rates for SR 442 segments and intersections were calculated based on above equations and summarized in **Table 3.5**. Crash rates were compared with statewide average rates on comparable facilities based on the functional classification (Urban minor arterial to the east and urban local to the west). As shown in **Table 3.5**, crash rates are lower than statewide averages for comparable facilities. It should also be noted that only one crash occurred at the I-95 southbound ramp intersection within past five years.

4 Traffic Forecasting

This section discusses the development of traffic forecasts used in the future year operational analyses. The future year volumes were developed using the adopted CFRPM v6.1.

4.1 Subarea Model Development

A subarea model using FDOT's CFRPM v6.1 was developed for use in this IOAR. The subarea model calibration and validation followed the procedures outlined in FDOT's 2019 Project Traffic Forecasting Handbook and Florida Standard Urban Transportation Model Structure (FSUTMS) Model Calibration and Validation Standards. The model validation is performed to ensure the model is accurate enough to reflect year 2019 traffic conditions in the study area. The level of accuracy of the model is checked by percent error by volume groups, percent error by facility types, and the percent root mean square error (RMSE) for the study area.

The year 2019 AADT counts for individual roadway segments were obtained from traffic counts collected during December 2019, FDOT 2019 Florida Traffic Online, and 2018 Volusia County Counts. The peak season weekday average daily traffic (PSWADT) obtained from CFRPM6.1 was converted to AADT using the model output conversion factor (MOCF) of 0.96 for Volusia County.

The CFRPM 6.1 model has a base year of 2010 and a horizon year of 2040. The year 2019 socio-economic (SE) data was interpolated using year 2010 and year 2040 SE data. Some adjustments were made to the 2019 SE data based on 2015 SE data provided by FDOT and available aerial photography. The approved 2015 SE data is part of the next version of CFRPM (version 7) that is currently being developed for FDOT District 5.

The subarea limits (SR 44 to the north, US 1 to the east and Volco Road to the south) are shown in **Figure 4-1**. As part of the validation effort, 21 roadway segments are evaluated for the base year in the vicinity of the study area as shown in **Appendix C**. Centroid connections for Traffic Analysis Zones (TAZs) were adjusted to reflect the available aerials. The following centroid connections were adjusted: 2589, 2590, 2601, 2611, 2616, 2642, and 2644. As part of the roadway network check within the subarea, the following changes were made:

- Changed facility type from 42 to 41 for Old Mission Road from Josephine Street to SR 442.
- Changed posted speed from 45/40 mph to 50 mph for Old Mission Road from SR 44 to SR 442.
- Changed posted speed from 35 mph to 40 mph for SR 442 from Air Park Road to US 1.
- Changed facility type from 46 to 41 for Volco Road from US 1 to Cow Creek Road.
- Changed posted speed from 30 mph to 45 mph for Volco Road from Bacon Light Road to Cow Creek Road.
- Changed facility type from 46 to 41 and posted speed from 30 mph to 40 mph for Bacon Light Road from Volco Road to Maytown Road/W Halifax Avenue.
- Changed facility type from 43 to 41 and posted speed from 35/40 mph to 40/45 mph for South Glencoe Road from SR 44 to Old Mission Road.
- Changed facility type from 43 to 41 for Cow Creek Road from SR 442 to Volco Road.

Figure 4-1. Subarea Model Limits and TAZs

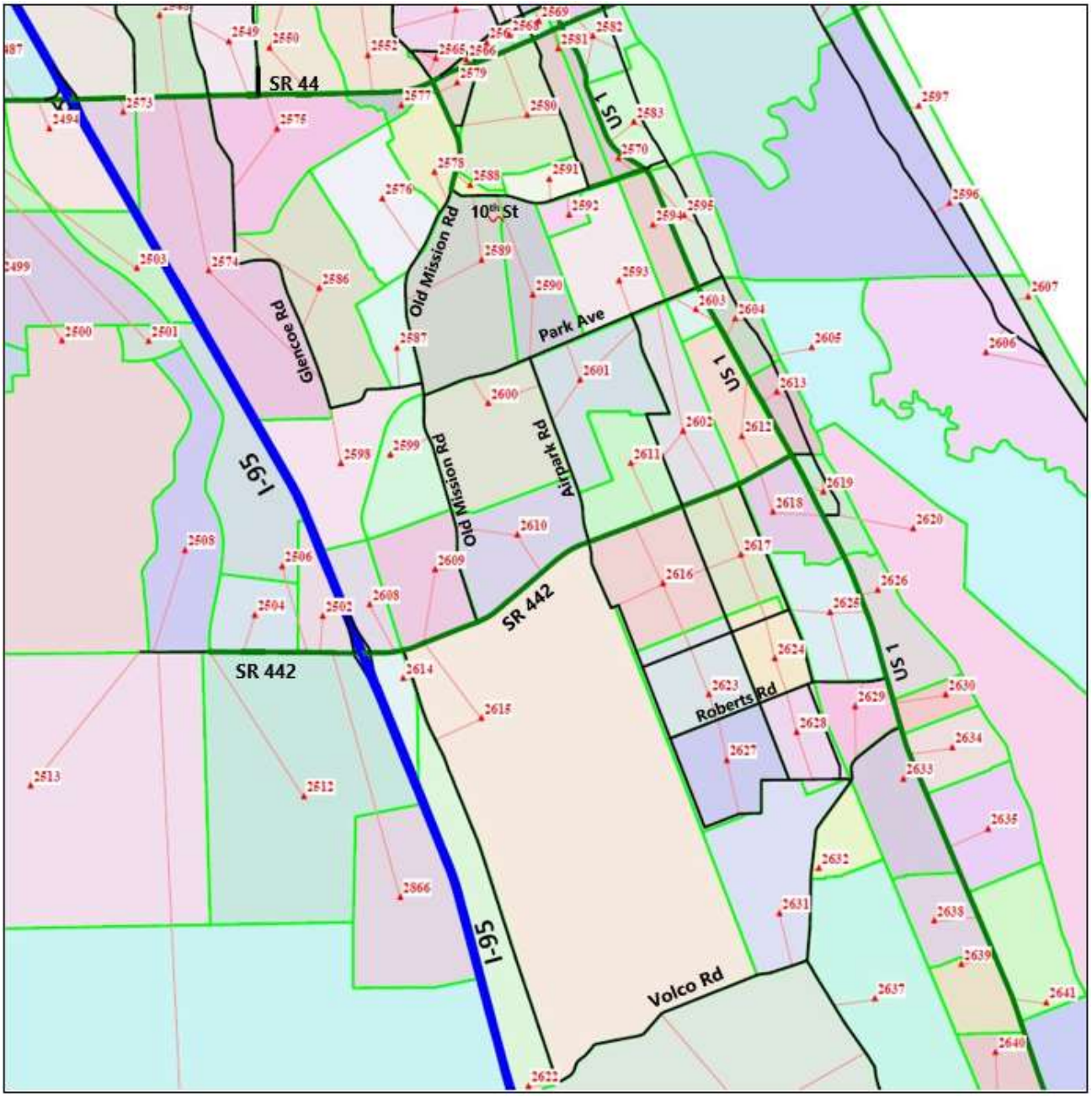


Table 4-1 shows the percent deviation error by facility type. The percent deviation is defined as [(base year model assignment in AADT – base year actual count in AADT)/ (base year actual count in AADT)]. **Table 4-2** shows the percent deviation error by volume group. As shown in **Tables 4-1** and **4-2**, the traffic count percent errors for both facility type and volume groups are within the acceptable FDOT model validation standards. The percent RMSE for the study area is another aggregate measure of how well the model has been validated against the ground counts. The RMSE for the study area comprising the study roadway links is 2.64 percent and usually can be +/-35 percent to 45 percent. **Table 4-3** shows the adjusted network has been revised to replicate the existing traffic counts within study area.

Table 4-1. Volume over Count Ratio by Facility Type & Percent Error

Statistic	Acceptable	Preferable	Before	After
Freeway (FT1X, FT8X, FT9X)	+/- 7%	+/- 6%	-13.83%	5.25%
Divided Arterial (FT2X)	+/- 15%	+/- 10%	-12.49%	-2.33%
Collector (FT 4X)	+/- 25%	+/- 20%	4.38%	6.22%
One Way - Ramps (FT7X)	+/- 25%	+/- 20%	18.61%	9.33%

Source: FSUTMS - Cube Framework Phase II Model Calibration and Validation Standards

Table 4-2. Volume over Count Ratio by Volume Group & Percent Error

Statistic	Acceptable	Preferable	Before	After
LT 10,000 Volume	50%	25%	-9.47%	5.21%
10,000-30,000	30%	20%	-11.53%	-1.37%
30,000-50,000	25%	15%	-13.23%	4.00%
50,000-65,000	20%	10%	-13.85%	-0.47%

Source: FSUTMS - Cube Framework Phase II Model Calibration and Validation Standards

Table 4-3. Root Mean Square Error (RMSE) Model Output

Volume Group	% RMSE	Acceptable %RMSE	Preferable % RMSE
1-5,000	16.14%	100%	45%
5,000-10,000	12.38%	45%	35%
10,000-15,000	13.32%	35%	27%
15,000- 20,000	8.67%	30%	25%
20,000- 30,000	2.23%	27%	15%
30,000- 50,000	7.80%	25%	15%
Areawide	**2.64%**	**45%**	**35%**

Source: FSUTMS - Cube Framework Phase II Model Calibration and Validation Standards

Based on the validation efforts performed, the model is considered acceptable for use in estimating future travel demand within the study area

4.2 Future Traffic Forecasts

To develop future volume forecasts for future year analysis, growth rates from historic data, population-based growth rates from BEBR, and model-based growth rates from CFRPM 6.1 models were reviewed for study segments.

4.2.1 Historical Traffic Trends

The FDOT trends spreadsheet was used to calculate the average annual historical growth rate for the historical AADT reported by FTO count sites for the study roadways. **Table 4-4** summarizes the annual historical growth rates and annual trends growth rate for the FDOT count sites, and the Trends Analysis sheets are included in **Appendix C**.

Table 4-4. Historic Growth Rates

Roadway	Location	FTO Station ID	Existing (2019) AADT	Annual Historical Growth Rate (2004-2019)	Annual Trends Growth Rate (2019-2032)
SR 442	West of I-95	*	200	-	-
	East of I-95	*	14,500	-	-
	West of Old Mission Rd*	790170	13,000	2.56%	1.87%
	East of Old Mission Rd	790505	14,000	1.29%	1.07%
Old Mission Rd	North of SR 442	*	5,500	-	-
I-95 Ramps	SB Off Ramp	792002	5,200	1.54%	1.12%
	SB On Ramp	792003	900	0.95%	0.96%
	NB Off Ramp	792000	1,200	2.50%	0.70%
	NB On Ramp	792001	5,500	1.21%	1.04%

** Source: FSUTMS - Cube Framework Phase II Model Calibration and Validation Standards*
** FDOT counts unavailable for these roadway segments*

4.2.2 BEBR Population Projections

The population projections for Volusia County were obtained from the BEBR Volume 53, Bulletin 186, January 2020. The BEBR bulletin provides three estimates for future year low, medium, and high. **Table 4-5** summarizes the annual population growth rate for Volusia County. The BEBR projections are included in **Appendix C**. Annual growth rates range from approximately 0.03 percent to 1.56 percent. It should be noted that BEBR data does not account for growth or decline of specific roadway segments. It is a countywide estimate and therefore is useful in comparing the growth rates obtained from other sources. The key takeaway here is that the county population is expected to grow and, therefore, there will be growth in the study area in general.

Table 4-5. BEBR Growth Rates

	2019	2020	2025	2030	2035	2040	Annual Trends Growth Rate (2019-2040)
Low	538,763	523,000	534,500	540,000	541,900	542,700	0.03%
Medium		545,200	573,800	595,800	613,600	629,700	0.80%
High		566,600	610,200	650,000	683,300	715,800	1.56%

4.2.3 CFRPM Projections

Future year (2040) subarea model scenario was developed based on 2019 validation efforts to obtain future year volume forecasts. Future year (2040) subarea model includes transportation improvements identified within the River-To-Sea Transportation Planning Organization (R2CTPO) Long Range Transportation Plan including three major planned developments in the vicinity of the I-95 and SR 442 interchange. The three planned developments are:

Farmton DRI

The Farmton DRI is located west of I-95, is bounded by SR 442/Indian River Boulevard to the north and extends south of the Brevard/Volusia County line. The Farmton DRI is comprised of 23,100 residential dwelling units and 4,700,000 square feet of non-residential uses. The Gateway Sustainable Development Area (SDA) of the Farmton DRI is one of the districts that is anticipated to be developed by 2025 and is generally located in the southwest quadrant of the I-95 at SR 442 interchange. The Gateway SDA is planned to contain 4,692 residential dwelling units and 820,217 square feet of non-residential uses.

Restoration DRI

The Restoration DRI is located west of I-95 and is bounded by SR 442/Indian River Boulevard to the south and by SR 44 to the north. The DRI is planned by year 2023 to contain 8,500 residential dwelling units and 3,300,000 square feet of non-residential uses.

Deering Creek Community Center District

Deering Park Center Community Development District is generally located in the southwest quadrant of the interchange and is planned to contain 1,362 residential dwelling units and approximately 1,500,000 square feet on non-residential uses.

It should be noted that DRIs are currently in early planning stages. DRI land uses were compared with CFRPM land uses and it was noted that the DRI development intensity is on par with the CFRPM 6.1 SE data. Therefore, for the modeling purposes of the IOAR, the 2040 land use included in the approved CFRPM 6.1 was utilized for 2040 subarea model. Both 2019 and 2040 CFRPM 6.1 traffic projections for study roadways are summarized in **Table 4-6** along with the estimated annual growth rates. The 2019 and 2040 CFRPM 6.1 model plots are included in **Appendix C**.

Table 4-6. CFRPM Growth Rates

Roadway	Location	CFRPM 6.1		
		2019 Volumes	2040 Volumes	Annual Growth Rate (2019 - 2040)
SR 442	West of I-95	218	32,479	704.70%
	East of I-95	17,873	27,109	2.46%
	West of Old Mission Rd*	17,378	25,933	2.34%
	East of Old Mission Rd	15,824	17,067	0.37%
Old Mission Rd	North of SR 442	2,924	11,798	14.45%
I-95 Ramps	SB Off Ramp	8,379	13,470	2.89%
	SB On Ramp	432	402	-0.33%
	NB Off Ramp	473	382	-0.92%
	NB On Ramp	8,625	13,600	2.75%

4.2.4 Recommended Growth Rates

The growth rates obtained from the trends analysis, BEBR projections, and CFRPM model were summarized in **Table 4-7** to determine the recommended growth rates for the study corridors. As shown in **Table 4-7**, model-derived growth rates were selected as the basis for projecting 2022 and 2032 traffic volumes with a minimum annual growth rate of one percent (1%) utilized if the model growth rate is less than 1%.

Table 4-7. Growth Rate Summary

Roadway	Location	FTO Station ID	Existing (2019) AADT	Historical Growth Rate (2004-2019)	Trends Growth Rate (2019-2032)	CFRPM 6.1			BEBR Medium Growth	Applied Growth Rate	Notes	2032 AADT
						2019 Volumes	2040 Volumes	Annual Growth Rate (2019 - 2040)				
SR 442	West of I-95	*	200	-	-	218	32,479	704.70%	0.80%	500.0%	*	13,000
	East of I-95	*	14,500	-	-	17,873	27,109	2.46%		2.4%	Average model growth rate east of I-95	19,000
	West of Old Mission Rd	790170	13,000	2.56%	1.87%	17,378	25,933	2.34%		2.4%		17,000
	East of Old Mission Rd	790505	14,000	1.29%	1.07%	15,824	17,067	0.37%		1.00%	Minimum 1 % growth rate	16,000
Old Mission Rd	North of SR 442	*	5,500	-	-	2,924	11,798	14.45%		14.5%	Model growth rate	16,000
I-95 Ramps	SB Off Ramp	792002	5,200	1.54%	1.12%	8,379	13,470	2.89%		2.8%	Average model growth rate for north Ramps	7,100
	SB On Ramp	792003	900	0.95%	0.96%	432	402	-0.33%		1.0%	Minimum 1 % growth rate	1,000
	NB Off Ramp	792000	1,200	2.50%	0.70%	473	382	-0.92%		1.0%	Minimum 1 % growth rate	1,400
	NB On Ramp	792001	5,500	1.21%	1.04%	8,625	13,600	2.75%		2.8%	Average model growth rate for north Ramps	7,500

* As discussed in Section 4.2.3, the majority of planned developments west of I-95 do not occur until 2025 and later. Therefore, a 500% growth rate was chosen for SR 442 west of I-95 which results in 2032 AADT approximately 40% (13,000) of 2040 CFRPM roadway volume.

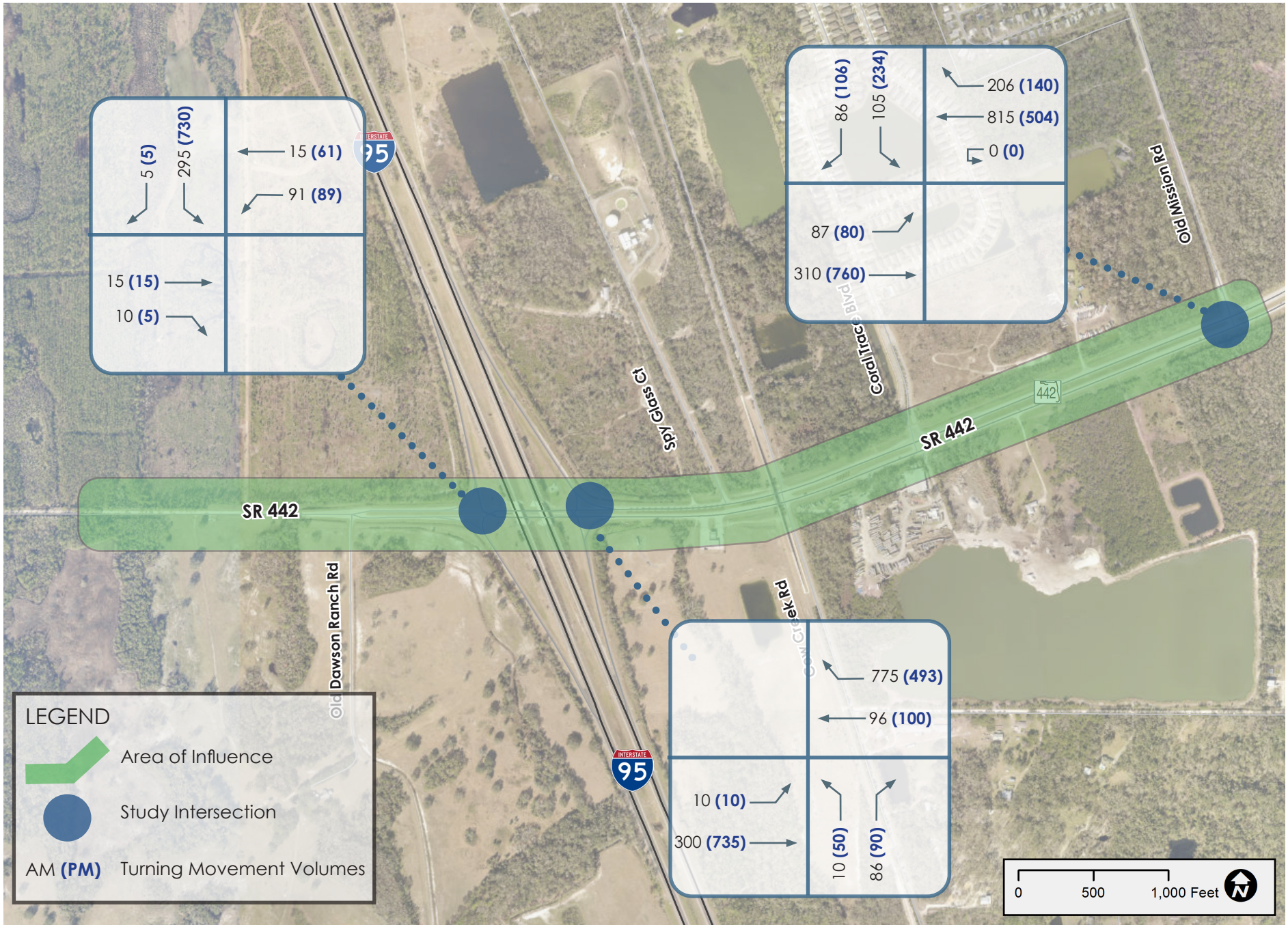
4.2.5 Future Turning Movement Volumes

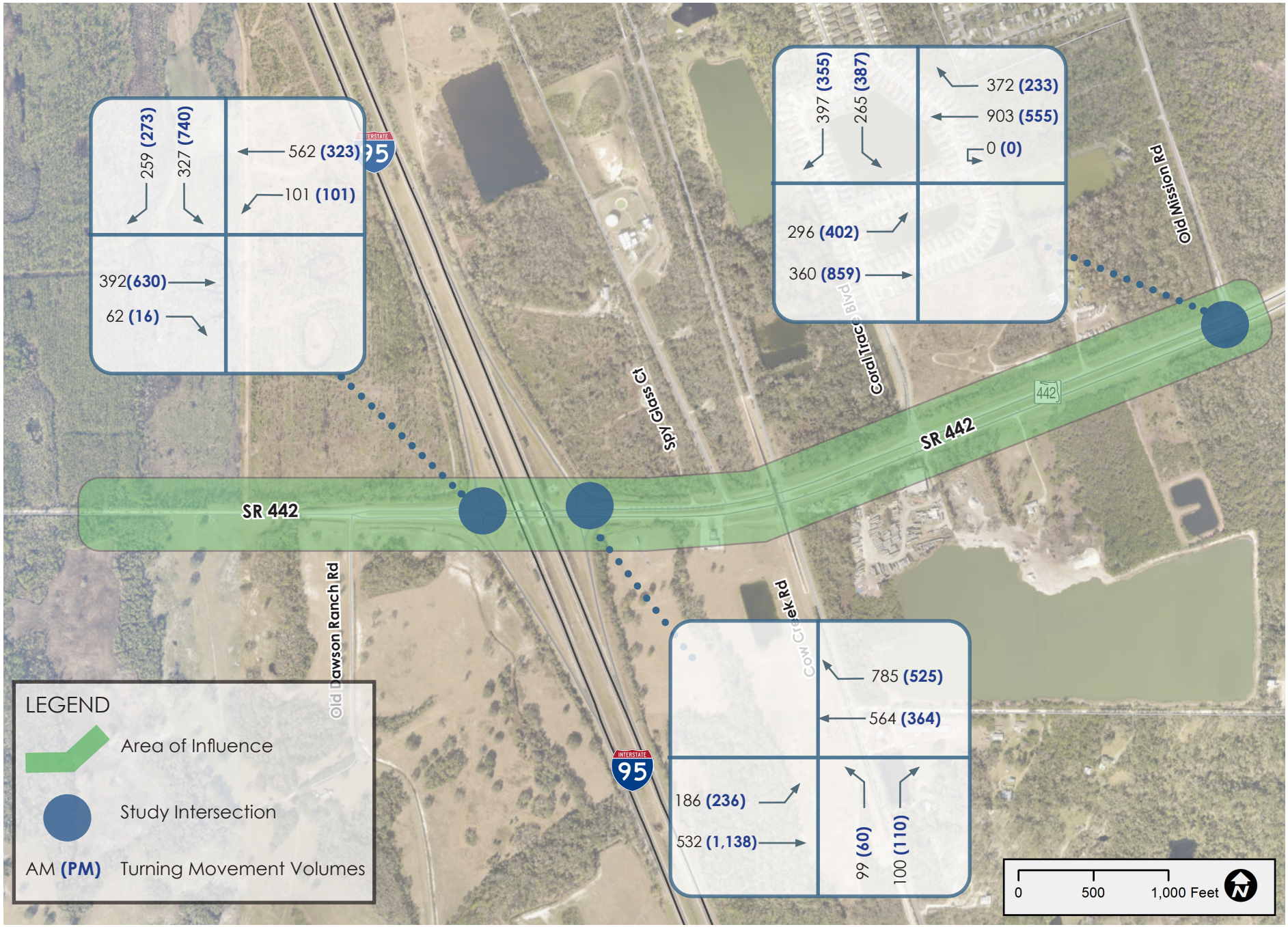
Future intersection turning movement volumes were developed using the TM Tool software, a recommended tool from the FDOT's 2019 Project Traffic Forecasting Handbook. The TM Tool software utilizes existing (2019) TMCs and AADTs, recommended traffic factors, and growth rates to develop intersection turning movement volumes for the Opening Year (2022) and Design Year (2032). The TM Tool software utilizes the following assumptions in turning movement volume development:

- K-Factor: The urban K-factor, 9.0 percent, consistent with the 2019 Project Traffic Forecasting Handbook, was utilized for the Design Year (2032).
- D-factor: The D-factors were calculated from the existing turning movement counts. D-factor was verified to ensure they are within the acceptable ranges as defined within the 2019 Project Traffic Forecasting Handbook.
- Opening Year (2022) Turning Movement Volumes: As discussed in Section 4.2.3, proposed DRIs west of the interchange are currently in early stages of planning and traffic from these developments will not occur by the Opening Year. Therefore, of TM Tool peak hour turning volume projections were further modified to show a very minimal growth for the Opening Year.

After the TM Tool performs calculations, the peak-hour volume outputs were checked for reasonableness with existing traffic data and manual adjustments were made and balanced using engineering judgment to better reflect existing travel demand and patterns. The balanced 2022 and 2032 peak-hour intersection turning movement volumes are depicted in **Figure 4-2** and **Figure 4-3**, respectively. It should be noted that forecasted turning movement volumes for the Opening Year and Design Year were utilized for both No-Build and Build Alternatives as there are no anticipated changes in travel patterns in the Build Alternative.

As discussed in section 4.2.3, the proposed developments west of the interchange have a mix of residential and non-residential (commercial, industrial, and service) land uses. These developments are anticipated to attract traffic from east and north of the SR 442 interchange. Therefore, a significant increase in traffic volumes for eastbound through, westbound through and southbound right turn movements at the I-95 southbound ramp terminal and eastbound left turn movements at the I-95 northbound ramp terminal.





5 Future Conditions

This section presents the results of the traffic and safety analysis for the No-Build and Build Alternatives for the Opening Year (2022) and Design Year (2032). As discussed in Section 4.2.5, forecasted turning movement volumes developed for the No-Build Alternative were used for the Build Alternative as there are no anticipated changes in travel patterns in the Build Alternative.

5.1 No-Build Analysis

The No-Build analysis utilizes existing geometry as shown in Figure 3-3 and traffic volumes presented Figure 4-2 and Figure 4-3.

5.1.1 Intersection Analysis

As discussed in Section 4.4.1, HCM 6 methodology implemented in Synchro 10 was used to analyze the intersection operations with optimized splits for the SR 442 and Old Mission Road intersection. Synchro intersection results are summarized in **Table 5-1** with LOS E or worse highlighted in red and analysis outputs are included in **Appendix D**. Synchro intersection operational results indicate the following:

- The SR 442 and I-95 southbound ramp terminal intersection continues to operate deficiently at LOS F in both 2022 and 2032 PM peak hours and operates deficiently at LOS F in the 2032 AM peak hour primarily due to the heavy volume southbound left-turn movement unable find gaps because of heavy east-west through volumes.
- SR 442 and Old Mission Road intersection operates at LOS E in the 2032 AM peak hour. The southbound right-turn and eastbound left-turn movements operate at LOS F and E, respectively in 2032 AM peak hour. The V/C is greater than one (1) for the southbound right-turn and nearing one (1) for the eastbound left-turn movement.
- The SR 442 and I-95 northbound ramp terminal intersection operates at LOS A through 2032 in both AM and PM peak hours. The low volume northbound left-turn movement operates at LOS F as this movement unable find gaps because of heavy east-west through volumes.

5.1.2 Queue Summary

Table 5-2 summarizes queue results for turn lanes from Synchro, and available storage for both AM and PM peak hours and detailed outputs are included in **Appendix D**. The queue results indicate the following:

- The SR 442 southbound left-turn movement backs up into the I-95 mainline in the 2032 PM peak hour. This queue backup will impact right turn vehicles.
- Although the low volume northbound left-turn movement at the SR 442 and I-95 northbound ramp intersection is expected to operate at LOS F in 2032 AM and PM, this movement is not anticipated to cause backup into the I-95 mainline.

Table 5-1. No-Build Opening Year (2022) and Design Year (2032) Intersection Analysis Summary

SR 442 Intersection	Signal Control	Movement	Movement Delay (s/veh)		Movement LOS		Movement V/C		Intersection Delay (s/veh)		Intersection Delay (LOS)	
			2022	2032	2022	2032	2022	2032	2022	2032	2022	2032
AM Peak Hour												
I-95 SB Ramps	Stop	SBL	14.1	499.1	B	**F**	0.441	1.967	11.4*	113.6	B	**F**
		SBR	0.0	0.0	A	A	-	-				
		WBL	7.5	8.7	A	A	0.063	0.098				
I-95 NB Ramps	Stop	NBL	11.4	176.6	B	**F**	0.018	1.032	0.1	8.9	A	A
		NBR	0.0	0.0	A	A	-	-				
		EBL	7.4	9.6	A	A	0.007	0.199				
Old Mission Rd	Signal	SBL	28.0	45.9	C	D	0.58	0.74	15.3	71.6	B	**E**
		SBR	30.6	271.9	C	**F**	0.63	1.47				
		EBL	47.0	59.2	D	**E**	0.78	0.89				
		EBT	4.2	7.3	A	A	0.15	0.17				
		WBT	13.7	35.5	B	D	0.59	0.81				
		WBR	11.9	36.1	B	D	0.34	0.75				
PM Peak Hour												
I-95 SB Ramps	Stop	SBL	88.6	1488.7	**F**	**F**	1.1	4.197	72.6	611.6	**F**	**F**
		SBR	0	0	A	A	-	-				
		WBL	7.4	9.5	A	A	0.059	0.115				
I-95 NB Ramps	Stop	NBL	18.2	62.3	C	**F**	0.156	0.505	0.7	2.5	A	A
		NBR	0	0	A	A	-	-				
		EBL	7.4	8.8	A	A	0.007	0.2				
Old Mission Rd	Signal	SBL	22.0	41.6	C	D	0.69	0.82	14.6	34.5	B	C
		SBR	18.4	48.6	B	D	0.36	0.87				
		EBL	38.5	49.2	D	D	0.71	0.89				
		EBT	8.0	12.2	A	B	0.44	0.44				
		WBT	16.3	40.9	B	D	0.54	0.78				
		WBR	15.3	42.9	B	D	0.34	0.74				

** I-95 SB ramp delay is lower than existing because a PHF of 0.95 utilized in future conditions and a PHF of 0.79 in existing conditions.*

Table 5-2. No-Build Opening Year (2022) and Design Year (2032) Queue Summary

SR 442 Intersection	Signal Control	Movement	Available Storage (ft.)	AM 95th Percentile Queue (ft.)[5]		PM 95th Percentile Queue (ft.)[5]	
				2022	2032	2022	2032
I-95 SB Ramps	Stop	SBL[1]	1,400	50	650	550	**1,925**
		SBR[2]	250	0	0	0	0
		WBL[3]	120	0	0	0	0
I-95 NB Ramps	Stop	NBL[1]	1,400	0	175	25	50
		NBR[2]	210	0	0	0	0
		EBL[3]	120	0	25	0	25
Old Mission Rd	Signal	SBL[4]	-	75	300	125	375
		SBR[3]	240	50	1,000	50	375
		EBL[3]	620	75	350	50	400
		WBR[3]	620	75	350	50	250

1. *Storage measured from the stop bar to the painted nose of the gore*
2. *Storage measured from the painted nose for channelization to the painted nose for the through movement*
3. *Storage measured from the stop bar to the end of taper*
4. *Through lane converts into an SBL and hence available storage is not listed*
5. *An assumed 25-feet per vehicle was used to calculate the 95th % queue length*

5.1.3 Ramp Capacity Analysis

The ramp capacity analysis summarized in **Table 5-3** for I-95 and SR 442 interchange ramps that all four ramps provide sufficient capacity through the Design Year (2032).

Table 5-3. No-Build Ramp Capacity Summary

SR 442 Ramp	Number of Lanes	Speed Limit (mph)	Ramp Capacity (pc/h)[1]	Peak Hour Demand Volume (vph)		Peak Hour Demand Flow Rate (pc/h)[2]		Ramp Capacity Sufficient
				AM	PM	AM	PM	
Opening Year (2022)								
NB Off-Ramp	1	35	2,000	96	140	106	154	Yes
NB On-Ramp	1	50	2,200	785	503	865	554	Yes
SB Off-Ramp	1	30	2,000	300	735	330	810	Yes
SB On-Ramp	1	50	2,200	101	94	111	104	Yes
Design Year (2032)								
NB Off-Ramp	1	35	2,000	199	170	219	187	Yes
NB On-Ramp	1	50	2,200	971	761	1070	838	Yes
SB Off-Ramp	1	30	2,000	586	1013	646	1116	Yes
SB On-Ramp	1	50	2,200	163	117	180	129	Yes

1. *Ramp Capacity is based of HCM 6th Exhibit 14-12*
2. *Flow rate in pc/h is estimated based on Exhibits 14-12, and 12-25 and Equations 14-1 and 12-10.with a PHF of 0.95 and 4.65 % for trucks using 2019 FDOT FTO T-factor of 9.3 for all SR 442 ramps*

5.2 Build Alternative Development

A Build Alternative was developed to improve deficient stop control at the I-95 and SR 442 southbound ramp terminal intersection. FDOT CAP-X tool was utilized if other traffic control alternatives should be given preference over the existing stop-controlled intersection that does not require additional ROW. As discussed earlier, this IOAR is providing a solution via FDOT pushbutton contract without acquiring an additional ROW or any major modification to existing interchange. CAP-X analysis was conducted for the Design Year 2032. The results from CAP-X analysis are displayed below in **Table 5-4** and CAP-X outputs are included in **Appendix D**. Based on the analysis provided in the **Appendix D** and CAP-X results summarized in **Table 5-4**, the "Traffic Signal" has the lowest V/C ratio in both AM and PM peak hours in Design Year 2032. Therefore, the Traffic Signal was selected as a viable alternative for the I-95 at SR 442 southbound ramp terminal intersection.

Table 5-4. Summary of 2045 CAP-X Volume-to-Capacity Ratios

Type of Intersection	2032 AM Peak	2032 PM Peak
Traffic Signal	**0.69**	**0.83**
2 X 2	0.76	0.90
1 X 2	0.87	1.13
1 X 1	1.36	1.21
All-Way Stop Control	1.50	1.59
75 ICD	1.83	3.12
50 ICD	1.93	4.38
Two-way Stop Control	24.56	23.77

Additionally, as future land use developments occur to the west of the interchange (and potentially with commercial land uses), there is a potential need for pedestrian facilities which will be a part of the project approval process. Hence, all additional needs including pedestrian and bikes will be evaluated and required improvements and studies will be coordinated with FDOT and local agencies as part of new projects approval process.

5.3 Build Analysis

The Build Alternative (shown in **Figure 5-1**) is created to improve traffic flow at the deficient I-95 southbound ramp terminal intersection. Except for the traffic signal at the I-95 southbound ramp terminal intersection, traffic controls and geometry remain the same as No-Build for all study intersections. As discussed previously, forecasted turning movement volumes developed for the No-Build Alternative were used for the Build Alternative, as travel patterns remains same as the No-Build Alternative.

5.3.1 Intersection Analysis

Synchro intersection results for the Build Alternative are summarized in **Tables 5-5 and 5-6** and analysis outputs are included in **Appendix D**. Synchro intersection operational results indicate the following:

- The intersection of SR 442 and I-95 southbound ramps improves from overall intersection LOS F in No-Build Alternative to D or better in Build Alternative in 2032 in both AM and PM peak hours. The deficient southbound left-turn movement delay is significantly improved (approximately 1500%) from No-Build Alternative (greater than 1,000 seconds per vehicles) to Build Alternative (approximately 74 seconds per vehicles).
- The LOS for the rest of the SR 442 intersections within the AOI is same as the No-Build Alternative.
- As discussed in Section 5.1.1 (No-Build intersection analysis), the low volume northbound left-turn movement at the I-95 and SR 442 northbound ramp intersection continues to operate at LOS F in the Design Year. However, this movement is not anticipated to cause back-ups to the I-95 mainline. The failure of this movement is primarily due to proposed new land use developments which are in early planning stages.

As discussed previously, the Build Alternative is a short-term solution to solve existing deficiencies at the I-95 and SR 442 southbound ramp intersection. The need for improvements at the I-95 and SR 442 northbound ramp intersection location will be monitored closely at the time of the approval of the comprehensive land use amendments due to land use changes west of the interstate and required improvements and studies will be part of those approvals through FDOT, Department of Economic Opportunity (DEO) and local agencies.

5.3.2 Off-Ramp Queue Summary

Table 5-7 summarizes queue results for turn lanes from Synchro and available storage for both AM and PM peak hours; detailed outputs are included in **Appendix D**. The queue results indicate the following:

- The SR 442 southbound left-turn movement does not back-up into the I-95 mainline through the Design Year.

5.3.3 Ramp Capacity Analysis

The ramp capacity provided in Section 6.1.3 for the No-Build Alternative is still applicable to the Build Alternative, as number of lanes and demand stays the same.

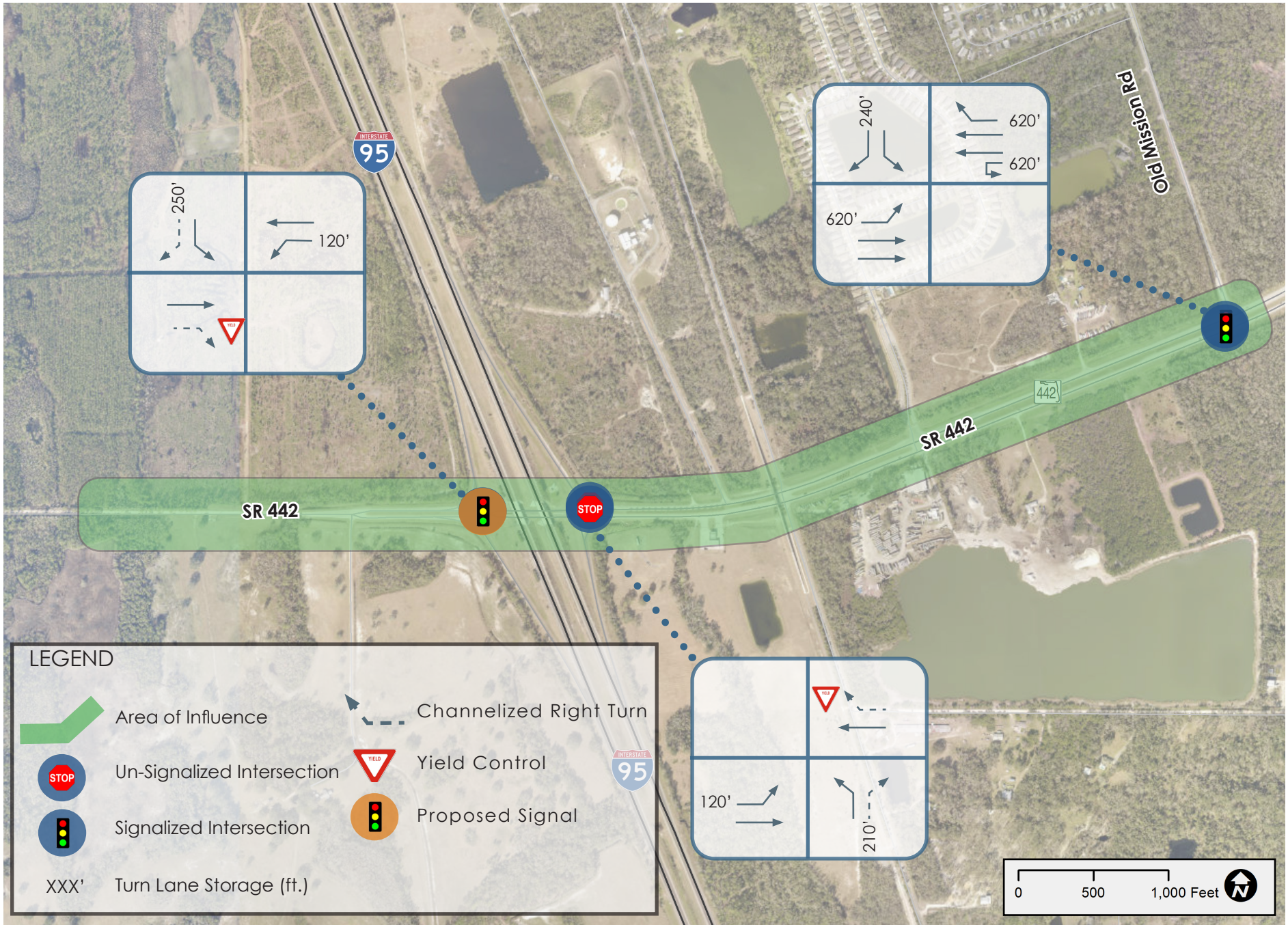


Table 5-5. Build Opening Year (2022) and Design Year (2032) AM Peak Hour Intersection analysis Summary

SR 442 Intersection	Signal Control	Movement	Movement Delay (s/veh)		Movement LOS		Movement V/C		Intersection Delay (s/veh)		Intersection Delay (LOS)	
			2022	2032	2022	2032	2022	2032	2022	2032	2022	2032
I-95 SB Ramps	Signal	SBL	13.0	18.8	B	B	0.74	0.8	11.3	11.9	B	B
		SBR	0.0	0.0	A	A	0.00	0.00				
		WBL	7.4	12.2	A	B	0.15	0.24				
		WBT	6.7	10.3	A	A	0.03	0.69				
		EBT	6.7	8.6	A	A	0.03	0.48				
		EBR	0.0	0.0	A	A	0.00	0.00				
I-95 NB Ramps	Stop	NBL	11.4	176.6	B	**F**	0.018	1.032	0.1	8.9	A	A
		NBR	0.0	0.0	A	A	-	-				
		EBL	7.4	9.6	A	A	0.007	0.199				
Old Mission Rd	Signal	SBL	28.0	37.5	C	D	0.58	0.74	15.3	**57.7**	B	**E**
		SBR	30.6	122.3	C	**F**	0.63	1.47				
		EBL	47.0	73.9	D	**E**	0.78	0.89				
		EBT	4.2	10.9	A	B	0.15	0.17				
		WBT	13.7	51.5	B	D	0.59	0.81				
		WBR	11.9	51.6	B	D	0.34	0.75				

Table 5-6. Build Opening Year (2022) and Design Year (2032) PM Peak Hour Intersection Analysis Summary

SR 442 Intersection	Signal Control	Movement	Movement Delay (s/veh)		Movement LOS		Movement V/C		Intersection Delay (s/veh)		Intersection Delay (LOS)	
			2022	2032	2022	2032	2022	2032	2022	2032	2022	2032
I-95 SB Ramps	Signal	SBL	18.8	45.1	B	D	0.9	0.96	18.1	36.5	B	D
		SBR	0.0	0.0	A	A	0.00	0.00				
		WBL	15.3	53.0	B	D	0.17	0.68				
		WBT	14.5	19.2	B	B	0.1	0.43				
		EBT	14.0	32.4	B	C	0.02	0.85				
		EBR	0.0	0.0	A	A	0.00	0.00				
I-95 NB Ramps	Stop	NBL	23.6	294.9	C	F*	0.207	1.144	1.7	8.5	A	A
		NBR	0.0	0.0	A	A	-	-				
		EBL	7.7	8.8	A	A	0.098	0.2				
Old Mission Rd	Signal	SBL	22.0	41.6	C	D	0.69	0.82	14.6	34.5	B	C
		SBR	18.4	48.5	B	D	0.36	0.87				
		EBL	38.5	49.2	D	D	0.71	0.89				
		EBT	8.0	12.2	A	B	0.44	0.44				
		WBT	16.3	40.9	B	D	0.54	0.78				
		WBR	15.3	42.9	B	D	0.34	0.74				

**NBL movement at I-95 NB ramps intersection in 2032 PM peak hour is operating at V/C greater than 1 with 60 vph. The queue for this movement as shown in Table 5-7 is approximately 125 ft. The failure of this movement is dependent on new land use developments to the west of the interstate. The need for improvements at this location will be monitored closely at the time of the approval of the comprehensive land use amendments for the same and required improvements and studies will be part of those approvals through FDOT, DEO and local agencies.*

Table 5-7. Build Opening Year (2022) and Design Year (2032) Queue Summary

SR 442 Intersection	Signal Control	Movement	Available Storage (ft.)	AM 95th Percentile Queue (ft.)[5]		PM 95th Percentile Queue (ft.)[5]	
				2022	2032	2022	2032
I-95 SB Ramps	Signal	SBL[1]	1,400	75	150	350	650
		SBR[2]	250	0	0	0	0
		WBL[3]	120	0	25	50	125
		WBT	-	0	125	25	200
		EBT	-	0	75	0	475
		EBR	-	0	0	0	0
I-95 NB Ramps	Stop	NBL[1]	1,400	0	175	25	125
		NBR[2]	210	0	0	0	0
		EBL[3]	120	0	25	0	25
Old Mission Rd	Signal	SBL[4]	-	75	275	100	375
		SBR[3]	240	50	700	50	375
		EBL[3]	620	75	425	50	400
		WBR[3]	620	75	425	50	250

1. *Storage measured from the stop bar to the painted nose of the gore*
2. *Storage measured from the painted nose for channelization to the painted nose for the through movement*
3. *Storage measured from the stop bar to the end of taper*
4. *Through lane converts into an SBL and hence available storage is not listed*
5. *An assumed 25-feet per vehicle was used to calculate the 95th % queue length*

5.4 Safety Analysis

The proposed improvement at the I-95 and SR 442 southbound ramp terminal intersection is a low-cost, short-term improvement that requires no ROW acquisition. The historical crash data and crash rate presented in Section 3.5 does not show a historical crash problem within the AOI.

Federal Highway Administration (FHWA) Crash Modification Factors (CMFs) were reviewed to quantify safety benefits of converting a stop-controlled intersection to a traffic signal-controlled intersection. A CMF (included in **Appendix D**) of 0.716 value is recommended for converting a stop sign to a signal-controlled intersection. The safety analysis was performed by applying CMFs to the existing crashes to estimate crash reduction and does not include the safety performance functions (SPFs) or the empirical-Bayes (E-B) method as this IOAR includes minor modifications to the existing interchange. The safety analysis summarized in **Table 5-8** shows a total crash reduction of approximately 0.06 (28%) crashes per year is estimated due to the proposed improvement. These numbers were calculated by comparing the crash frequencies before and after the implementation of the proposed improvement at the I-95 and SR 442 southbound ramp terminal intersection.

Table 5-8. Crash Reduction

Location	Total Crashes	Crash Frequency (crashes/year)	CMF	Proposed Crash Frequency (crashes/year)	Reduction in Crashes (crashes/year)
1.SR 442 west of I-95 Off-Ramp	0	0.0	-		
2.I-95 SB Off-Ramp	3	0.6			
3.SR 442 /SB Ramp Intersection	1	0.2	0.72*	0.14	0.06
4.I-95 SB On-Ramp	0	0.0	-		
5.SR 442/NB Ramp Intersection	3	0.6			
6. I-95 NB On-Ramp	3	0.6			
7. I-95 NB Off-Ramp	3	0.6			
8.btw SR 442 NB Ramp Intersection and Old Mission Rd	7 0	1.4			
9.SR 442/Old Mission Rd	2	0.4			
Total	**22**	**4.4**			

** CMF value is rounded to 0.72. 0.716 CMF was used in calculations.*

5.5 Year of Failure

While the proposed improvements are anticipated to work through the IOAR Design Year of 2032, a preliminary year of failure analysis was performed to provide an approximation of when the improvements will begin to experience failing conditions. A year of failure analysis was conducted for the PM peak hour as this is the critical hour for the I-95 at SR 442 southbound ramp terminal intersection.

To determine the year of failure for the PM peak hour conditions, straight line interpolation of volumes between 2032 and 2042 was performed for critical movements. The Southbound movement traffic volumes was kept the same value due to low growth. Each year beyond 2032 was analyzed in Synchro for the I-95 and southbound ramp terminal intersection. The year of failure for the critical PM peak hour at the I-95 and SR 442 southbound ramps is projected to be between 2036 and 2037.

Additionally, the low volume northbound left-turn movement at the I-95 and SR 442 northbound ramp intersection operates at LOS F in the Design Year. However, this movement is not anticipated to cause back-ups to the I-95 mainline. The failure of this movement is primarily due to proposed new land use developments to the west of the interstate. As mentioned in section 4.2.3, the proposed land use developments are currently in early planning stages. It should be noted that this IOAR is a short-term solution to solve existing deficiencies at the I-95 and SR 442 southbound ramp intersection. As mentioned in earlier sections, the need for improvements at the I-95 and SR 442 northbound ramp intersection and the I-95 and SR 442 interchange will be monitored closely at the time of the approval of the comprehensive land use amendments due to land use changes west of the interstate and required improvements and studies will be part of those approvals through FDOT, DEO and local agencies. Results for the year of failure are included in **Appendix D**.

6 Signing and Pavement Marking Plans

The future signing and pavement markings related to the proposed signal at the I-95 southbound ramps and SR 442 are included in the latest signal schematics for the proposed improvements which are shown in **Appendix E**. There are no proposed signing changes on SR 442 related to access to I-95. No signing or pavement marking changes are proposed to the I-95 mainline, as there are no changes to existing access points.

7 Funding and Schedule

The project is currently under design (completed 90%) and subsequent phases will be under FDOT District Five Traffic Operations Pushbutton contract. The construction letting date is tentatively set for January 2021 with an anticipated construction start approximately two months from the letting date. The proposed improvement (converting a stop-controlled to a traffic signal-controlled intersection) at the I-95 and SR 442 southbound ramp terminal intersection is a low cost, short term improvement that requires no ROW acquisition. **Table 7-1** depicts a snapshot of the FDOT Work Program summary for this project and the LRE estimate for the new signal is $366,815.21. The detailed LRE estimate is included in **Appendix E**.

Table 7-1. FDOT Work Program Snapshot

Project Summary

Transportation System: INTRASTATE STATE HIGHWAY — District 05 - District Wide
Description: PUSHBUTTON CONTRACTOR PROGRAM SIGNAL ENHANCEMENT FY20
Type of Work: TRAFFIC OPS IMPROVEMENT — View Scheduled Activities
Item Number: 238002-6

Construction Contract Information

Notice to Proceed Date	Work Begun Date	Present Contract Days	Contract Days Used	Percent Days Used
04/09/2020	05/05/2020	729	205	28.12%
Vendor Name: POWERCORE, INC.				
12/03/2019		730	0	0.00%
Vendor Name: P & S PAVING, INC.				
06/09/2020		730	0	0.00%
Vendor Name: TRAFFIC CONTROL DEVICES, INC.				
06/09/2020	09/01/2020	730	87	11.92%
Vendor Name: TRAFFIC CONTROL DEVICES, INC.				

Project Detail

Fiscal Year:	**2021**	**2022**	**2023**	**2024**	**2025**
Highways/Construction					***(On-Going)***
Amount:	$250,358				

8 Other Considerations

8.1 Environmental Considerations

No ROW impacts are anticipated as part of the Build Alternative. There are no significant environmental considerations and/or environmental fatal flaws within the project limits that could influence the outcome of the selection process in comparing the Build and No-Build Alternatives.

8.2 Design Exceptions

Per the 60 percent design plans, the project does not require design exceptions or variations.

8.3 Access Management

The access management plan within the AOI will not be changed by the proposed improvements.

9 Federal Highway Administration (FHWA) Policy Points

The Federal Highway Administration (FHWA) regulates the addition and modification of access points along the interstate and has two policy points that must be addressed before a new interchange or modification of access points to the interstate is approved. The following summarizes how the proposed signalization of the I-95 southbound ramp terminal at SR 442 intersections fulfills FHWA requirements.

Policy Point 1: An operational and safety analysis has concluded that the proposed change in access does not have a significant adverse impact on the safety and operation of the interstate facility (which includes mainline lanes, existing, new, or modified ramps, and ramp intersections with crossroads) or on the local street network based on both the current and the planned future traffic projections. The analysis should, particularly in urbanized areas, include at least the first adjacent existing or proposed interchange on either side of the proposed change in access (Title 23, Code of Federal Regulations (CFR), paragraphs 625.2(a), 655.603(d) and 771.111(f)). The crossroads and the local street network, to at least the first major intersection on either side of the proposed change in access, should be included in this analysis to the extent necessary to fully evaluate the safety and operational impacts that the proposed change in access and other transportation improvements may have on the local street network (23 CFR 625.2(a) and 655.603(d)). Requests for a proposed change in access should include a description and assessment of the impacts and ability of the proposed changes to safely and efficiently collect, distribute, and accommodate traffic on the Interstate facility, ramps, intersection of ramps with crossroad, and local street network (23 CFR 625.2(a) and 655.603(d)). Each request should also include a conceptual plan of the type and location of the signs proposed to support each design alternative (23 U.S.C. 109(d) and 23 CFR 655.603(d)).

Response: A detailed operational and safety analysis was conducted in this IOAR to address this policy point.

Operations Analysis

The SR 442 at I-95 southbound ramp terminal is currently operating deficiently at LOS E in the PM peak hour in existing conditions. The heavy southbound left-turn movement is currently experiencing long delays (LOS E) and occasionally the queue extends upstream into the I-95 mainline during the PM peak hour The AM peak hour currently operates at LOS B; therefore, the PM peak hour is the critical hour for the SR 442 at I-95 southbound ramp terminal intersection.

As shown in **Table 9-1** and **Table 9-2**, the signalization of the I-95 southbound ramp terminal at SR 442 improves operational efficiency and will significantly reduce the queue spillback into I-95 mainline in the critical PM peak hour. For the No-Build Alternative, the I-95 southbound ramp terminal is anticipated to operate at LOS F in 2022 and 2032 PM peak hours and the 95th percentile queue is anticipated to spill back to I-95 mainline in 2032 PM peak hours. In the Build Alternative, the intersection operates at LOS D or better through the Design Year with an improvement in delay up to 94%. With a reduction in the queue of up to 66% from No-Build to

Build, the Build queue is not anticipated to spill back into the I-95 mainline. The detailed individual movement delay and LOS are discussed in Chapter 6.

Table 9-1. PM Peak Hour Southbound Ramp Terminal Intersection LOS

Alternative	Target LOS	Delay (s/veh)		LOS	
		PM		PM	
		2022	2032	2022	2032
No-Build	D	72.6	611.6	F	F
Build	D	18.1	36.5	B	D
Percent Improvement	-	**75%**	**94%**	-	-

Table 9-2. PM Peak Hour Southbound Ramp Queue

Alternative	Ramp Storage (ft.)[1]	95th Percentile Queue (ft.)	
		2022	2032
No-Build	1,400	550	1,925
Build	1,400	350	650
Percent Improvement	-	**36%**	**66%**

[1]Ramp storage is measured as the distance from the stop bar to the painted nose of the gore

Safety Analysis

A safety review revealed that there are a relatively low number of crashes reported at this interchange and within the Area of Influence (AOI) including one (1) crash occurred at the I-95 southbound ramp intersection within past five years. The safety analysis indicates a total crash reduction of approximately 0.06 (28%) crashes per year is estimated due to the proposed improvement at the I-95 southbound ramp intersection

Signing and Pavement Marking Plans

No signing or pavement marking changes are proposed to the I-95 mainline, as there are no changes to existing access points. The signing and pavement markings related to the proposed signal are included in **Appendix E** as part of the signal schematics for the proposed improvements.

Policy Point 2: The proposed access connects to a public road only and will provide for all traffic movements. Less than "full interchanges" may be considered on a case-by-case basis for applications requiring special access, such as managed lanes (e.g., transit or high occupancy vehicle and high occupancy toll lanes) or park and ride lots. The proposed access will be designed to meet or exceed current standards (23 CFR 625.2(a), 625.4(a)(2), and 655.603(d)). In rare instances where all basic movements are not provided by the proposed design, the report should include a full-interchange option with a comparison of the operational and safety analyses to the partial-interchange option. The report should also include the mitigation proposed to compensate for the missing movements, including wayfinding signage, impacts on local intersections, mitigation of driver expectation leading to wrong-way movements on-ramps,

etc. The report should describe whether future provision of a full interchange is precluded by the proposed design.

Response: I-95 is a public facility and the SR 442 interchange within the AOI provides full access. The interchange improvements will occur at the I-95 and SR 442 southbound ramp terminal intersection. All basic movements are currently provided at the I-95 and SR 442 interchange. The proposed improvements at the I-95 and SR 442 interchange will continue to provide full access.

10 Recommendation

Analysis results presented in this IOAR conclude that the signalization of the I-95 southbound ramp terminal intersection at SR 442 improves operational efficiency, will significantly reduce the queue so there is no spillback into the I-95 mainline in the critical PM peak hour, provides immediate and near-term relief from the recurring traffic congestion within the AOI, and will improve safety for all road users. The proposed signalization of the I-95 southbound ramp terminal intersection meets the two FHWA Policy Point requirements and satisfies the purpose and need.

With this submittal, FDOT is seeking safety, operational and engineering (SO&E) acceptability of the proposed signalization of the I-95 and SR 442 southbound ramp terminal intersection.