

# **Interchange Operational Analysis Report (IOAR)**

**Interstate 95 at SR-46  
FPID # 448849-1**

Brevard County, Florida

Prepared For:



August 2021

# Interchange Operational Analysis Report (IOAR)



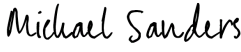

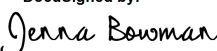

## I-95 at SR-46

### I-95 at SR-46 IOAR

## 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.

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	Central Office	Date

SYSTEMS IMPLEMENTATION OFFICE

QUALITY CONTROL CERTIFICATION FOR INTERCHANGE ACCESS REQUEST SUBMITTAL

Submittal Date: Click or tap to enter a date.

FM Number: FPID # 448849-1

Project Title: I-95 at SR-46 IOAR

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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 Michael Sanders, PE

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## PROFESSIONAL ENGINEERING CERTIFICATION

I hereby certify that I am a Professional Engineer properly registered in the State of Florida practicing with LTG, Inc., a corporation authorized to operate as an engineering business, EB 0009227, by the State of Florida Department of Professional Regulation, Board of Professional Engineers, and that I have prepared or approved the evaluations, findings, opinions, conclusions, or technical advice attached hereto for:

**PROJECT:** I-95 at SR-46 IOAR

**COUNTY:** Brevard, Florida

**FDOT District:** Five

**JOB #:** 4607.10

I hereby acknowledge that the procedures and references used to develop the results contained in these computations are standard to the professional practice of Transportation Engineering as applied through professional judgment and experience.

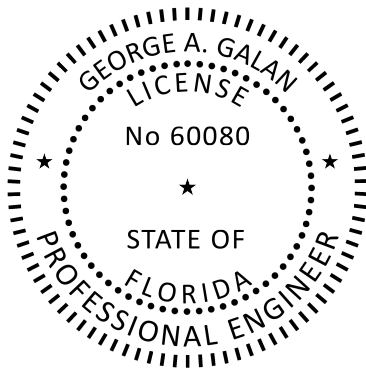
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## EXECUTIVE SUMMARY

The objective of this Interchange Operational Analysis Report (IOAR) is to provide technical documentation for review and approval of the proposed improvements at the I-95 / SR-46 interchange located in Mims, Brevard County, Florida. This IOAR has been conducted with the intention of documenting and ensuring that the proposed improvement will not create operational deficiencies or safety concerns for the Opening and Design Years. The proposed improvement includes signalization of the intersection of SR-46 and I-95 Southbound Ramps and signalization of the southbound right yield condition.

The interchange is a tight diamond and has a total of four ramps with two off-ramps and two on-ramps. Both the Northbound and Southbound Off-Ramps have a yield control right-turn movement onto SR-46. The Southbound Off-Ramp is stop controlled and the Northbound Off-Ramp is signal controlled.

The I-95 / SR-46 interchange serves as an access point for directional rush hour traffic during the AM and PM peak hours. Land directly adjacent to the interchange is currently semi-developed with a gas /convenience store in the northwest and southwest quadrants. The northeastern quadrant serves residential land-uses and the southeast quadrant serves residential as well as fast food land-uses.

I-95 currently experiences an Annual Average Daily Traffic (AADT) of 36,000 north of SR-46 and an AADT of 45,000 south of SR-46. The Southbound On-Ramp is currently experiencing an AADT of 7,400, the largest of all ramps. Existing AADT data for the I-95 mainline and SR-46 interchange ramps as well as for SR-46 within the influence area were obtained from FDOT's FTO 2019 database and SCTPO Interactive Traffic Count Database. TMC data was collected on October 10, 2018 for the intersections of SR-46 at North Carpenter Road, at I-95 Southbound Ramps, and at I-95 Northbound Ramps; and on November 13, 2018 for the intersections of SR-46 at Hammock Trail / Australian Way and at Holder Road / Pine Avenue. All data used in this report was collected prior to the COVID-19 pandemic; therefore, adjustments to the existing traffic counts to account for a presumed decrease in traffic volumes were not necessary. Growth within the interchange is expected due to population increase as well as an addition of commercial establishments in the immediate northwestern quadrant of the interchange.

The proposed Southbound Off-Ramp improvement is recommended due to the anticipated delays to the southbound left-turn movement, to provide better progression along SR-46, and to better accommodate the southbound right traffic entering the westbound SR-46 traffic stream.

There will be two alternatives studied in this IOAR. The two alternatives will be referred to as the No-Build Alternative and the Build Alternative. The No-Build Alternative will be analyzed as representative of build-out of the Love's Travel Plaza Development without the Southbound Off-Ramp improvements. The Build Alternative will be analyzed as representative of the Southbound Off-Ramp improvements in place. These alternatives have been evaluated in an Opening Year of 2021 and a Design Year of 2031.

The Love's Travel Plaza development will be located in the northwest quadrant of the intersection of SR-46 and North Carpenter Road and the anticipated opening date is July 2021. At ultimate Build-Out, in addition to super convenience market/gas station, tire super store, and fast food restaurant with drive-through land-uses, the development will also consist of a hotel. Access to the Love's Travel Plaza will be via a full access driveway on the northern leg of the SR-46 at Carpenter intersection. A certain portion of project trips are expected to remain internal to the site and a portion of the new trips, known as pass-by or diverted trips, will be attracted to the project from the existing traffic on the adjacent roadways and interstate.

The Build Opening Year 2021 and Design Year 2031 analyses do not show LOS deficiencies at the Southbound Ramps intersection, ramp approaches, or other study intersections. The Build Alternative also shows an improvement for the southbound left-turn movement on the I-95 Southbound Off-Ramp LOS versus the No-Build Alternative. The anticipated LOS for the southbound left-turn movement for the Build Opening Year 2021 is D during the AM and PM peak hours; the anticipated LOS for the Build Design Year 2031 AM and PM peak hours is D.

Crash analyses conducted with the last five years of data indicate that the calculated crash rates on SR-46 west of I-95 and between the southbound and northbound interstate ramps are higher than the statewide average. Intersection crash rates at the study intersections are lower than the statewide average for



comparable facilities. Additionally, per results of the anticipated crash reductions analysis, installation of a new traffic signal is anticipated to reduce the number of crashes by 1.638 crashes/year.

FDOT Policy No. 000-525-015 (Approval of New or Modified Access to Limited Access Highways on the State Highway System/SHS), FDOT Procedure No. 525-030-160 (New or Modified Interchanges), and FDOT Procedure No. 525-030-120 (Project Traffic Forecasting) were utilized in the development of this IOAR.

### **FHWA Policy Points**

Per Federal Highway Administration (FHWA) general requirements and the 2020 FDOT Interchange Access Request User's Guide, the following two FHWA policy points with respective responses have been provided to demonstrate IOAR compliance.

***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 crossroad) 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)).*

The operation needs being addressed by this IOAR can only be addressed by adding a signal to the I-95 Southbound Ramps intersection with SR-46. The Southbound Off-Ramp is operating below the target LOS and the southbound left-turn is experiencing high delays due to the existing stop control condition. Expected growth of traffic and proposed developments in the northwest quadrant of the interstate will increase the anticipated delays for the southbound left movement. Improvements will alleviate the anticipated delays. A crash modification factor (CMF) corresponding to the installation of a new traffic signal on a two-lane road (rural and suburban) countermeasure applicable to all crash types and severities was identified and applied to the existing crash rates and crash frequencies. Per results of the anticipated crash reductions analysis, installation of a new traffic signal is anticipated to reduce the number of crashes by 1.638 crashes/year.

A detailed operational analysis for 2020 Existing Year, 2021 Opening Year, and 2031 Design Year was conducted in this IOAR to address this policy point. As indicated in Table E-1, the future No-Build analyses show that delays and LOS at the Southbound Off-Ramp will continue to worsen without signalization; and the future Build analyses show anticipated improvements in delays and LOS at the Southbound Off-Ramp. The analyses show a decrease in delay from 2021 to 2031 for the southbound left-turn movement. Traffic is being metered at the Northbound Ramps and SR-46 intersection. This can result in the signal phases on SR-46 at the Southbound Ramps intersection gaping out, and the unused green time being inherited by the southbound approach. Therefore, even though the splits remain unchanged, there is a reduction in delay from 2021 to 2031. The delay decrease from 2021 to 2031 for the southbound left-turn movement is shown in Table E-1.

Table E-2 shows an increase in 95<sup>th</sup> percentile queue lengths; this is anticipated due to the replacement of yield/free-flow conditions with signalized conditions, however, even with an increase in queue lengths, the queues do not extend to the mainline. The ramp lengths of the I-95 Southbound and Northbound Off-Ramps are approximately 1,625 feet and 1,825 feet, respectively. The total ramp lengths are measured as the distance from the stop bar to the painted nose of the gore. Storage for the turn lanes was measured from the stop bar to the point where the ramp narrows to less than 24-ft wide.

**Table E-1  
Operational Analysis Results  
I-95 at SR-46 IOAR**

Intersection	Movement/ Intersection	2020		2021				2031			
		Existing Year		Opening Year				Design Year			
		Delay (sec.) <sup>1</sup>	LOS <sup>1</sup>	No-Build		Build		No-Build		Build	
		Delay (sec.) <sup>1</sup>	LOS <sup>1</sup>	Delay (sec.) <sup>1</sup>	LOS <sup>1</sup>	Delay (sec.) <sup>1</sup>	LOS <sup>1</sup>	Delay (sec.) <sup>1</sup>	LOS <sup>1</sup>	Delay (sec.) <sup>1</sup>	LOS <sup>1</sup>
<b>AM Peak-Hour</b>											
I-95 Southbound Ramps at SR-46	SBL	30.0	D	41.0	E	39.2	D	122.6	F	39.0	D
	Intersection <sup>2</sup>	2.9	--	3.3	--	6.1	A	5.6	--	6.3	A
<b>PM Peak-Hour</b>											
I-95 Southbound Ramps at SR-46	SBL	39.3	E	57.4	F	40.8	D	103.5	F	40.5	D
	Intersection <sup>2</sup>	2.6	--	3.7	--	6.4	A	5.2	--	6.5	A

Notes:

- 1) Signalized intersection results from Synchro HCM 6<sup>th</sup> Edition Signalized Report. Unsignalized intersection results from Synchro HCM 6<sup>th</sup> Edition TWSC Report.
- 2) HCM 6<sup>th</sup> Edition TWSC methodology does not support LOS analysis for the intersection.

**Table E-2  
I-95 Southbound Off-Ramp 95<sup>th</sup> Percentile Length  
I-95 at SR-46 IOAR**

Intersection	Existing Turn Lane Storage (ft.) <sup>1</sup>		Ramp Length (ft.) <sup>2</sup>	95 <sup>th</sup> Percentile Queue Length (ft.)				
	Southbound Left	Southbound Right		2020 Existing	2021 Opening Year		2031 Design Year	
					No-Build	Build	No-Build	Build
<b>AM Peak-Hour</b>								
I-95 Southbound Off-Ramps	100	130	1,625	25	50	200	100	225
<b>PM Peak-Hour</b>								
I-95 Southbound Off-Ramps	100	130	1,625	50	75	175	100	200

Notes:

- 1) Turn lane storage is measured from the stop bar to the point where the ramp narrows to less than 24-ft wide.
- 2) The total ramp lengths are measured as the distance from the stop bar to the painted nose of the gore.

**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.

Existing access points to/from I-95 will remain, no change is proposed and it only connects to a public road. The proposed improvements do not have a negative impact on the mainline or ramp operations and meet FHWA policy points, purpose, and need.

# 1. GENERAL PROJECT INFORMATION

## 1.1 Introduction

The Florida Department of Transportation (FDOT) District Five (D5) has prepared this Interchange Operational Analysis Report (IOAR) for the proposed ramp improvements to the I-95 interchange at SR-46 located in Brevard County. Love's Travel Plaza, a private developer, is coordinating the proposed improvements with D5. FDOT Policy No. 000-525-015 (Approval of New or Modified Access to Limited Access highways on the State Highway System/SHS), FDOT Procedure No. 525-030-160 (New or Modified Interchanges), and FDOT Procedure No. 525-030-120 (Project Traffic Forecasting) have been utilized in this report.

Preparation of this IOAR results from a Traffic Impact Analysis (TIA) for a proposed Love's Travel Center located at the intersection of SR-46 and North Carpenter Road approximately 800 feet west of the I-95 Southbound Off-Ramp. The TIA identified the need to signalize the project access at North Carpenter Road and the I-95 Southbound Off-Ramp. Due to the signal spacing not meeting access management standards, the TIA was reviewed by the Access Management Review Committee (AMRC) and the spacing variance was approved in January of 2020. As part of the approval, an IOAR was required to determine if the addition of the signal would be operationally sound; this report provides the results of the analysis.

Per FDOT's Interchange Access Request User's Guide (IARUG) section 1.5.4, an IOAR is required for "Replacement of an unsignalized free-flow, right-turn lane on an off-ramp with a signalized right-turn or installation of a signal or roundabout to a stop-controlled ramp terminal intersection". As a result, this report has been completed in order to satisfy FDOT guidelines.

## 1.2 Purpose and Need

The purpose and need of this report is to evaluate the safety and operation for the proposed I-95 Southbound Off-Ramp modification due to the installation of a traffic signal that will also bring the southbound right-turn under signal control at the I-95 Southbound Ramps / SR-46 intersection. Signalization is a result of approved development access improvements to address existing delays for the southbound left-turn movement from the ramp. Additionally, signalization of the Southbound Off-Ramp will provide better progression along SR-46 and better accommodate traffic generated by the Love's Travel Plaza development.

In order to sufficiently address the impact of the proposed ramp modification, the analyses of Existing Year (2020), Opening Year (2021), and Design Year (2031) conditions of the influence area intersections are required. Analysis elements include LOS, delay, and queues. Respective technical documentation pertaining to these analyses is to be provided for approval of the proposed ramp modification.

I-95 accommodates the heavy peak-hour traffic due to daily commuters and also provides non-local drivers passage to and from their destination. The interchange serves as an access point to Seminole and Volusia County to the west on SR-46 for the eastbound morning rush hour traffic and westbound afternoon rush hour traffic. It also serves the City of Titusville to the east with westbound morning rush hour traffic and eastbound afternoon rush hour traffic.

Currently, both existing signalized intersections within the influence area of the I-95 / SR-46 interchange operate at the target LOS. The unsignalized intersection of SR-46 at North Carpenter Road is not meeting target LOS on its minor approach, and the intersection of I-95 at Southbound Ramps is not meeting target LOS on the southbound approach. As previously identified, the southbound left-turn movement at the Southbound Off-Ramp experiences high delays and does not meet the target LOS of D. The movement is currently stop-sign controlled.

Accordingly, the proposed Southbound Off-Ramp modification is recommended to reduce the delay for the southbound left-turn movement at the off-ramp intersection. The proposed modification consists of the elimination of the yield control merge, and the addition of a signal to control the southbound left and right turns at the Southbound Off-Ramp. Under the Build Alternative, it is anticipated that the ramp modification will provide a smoother transition for I-95 southbound exiting traffic onto SR-46.

The western unsignalized intersection in the influence area, SR-46 / North Carpenter Road, is expected to be under construction for signalization and roadway improvements by February of 2021. In addition to signalization, improvements include construction of eastbound and northbound left-turn lanes, a westbound right-turn lane, dual southbound left-turn lanes, and a southbound shared through-right turn lane. The improvements mentioned above have been incorporated into the No-Build and Build analyses.

Additionally, land uses within the immediate influence area of the study interchange will remain essentially the same in the southwest, southeast, and northeast quadrants. However, the land use in the northwest quadrant is being developed as Love's Travel Plaza, truck parking, truck tire facility and a future hotel.

### **1.3 Project Location**

The study interchange of I-95 / SR-46 is located in Brevard County and FDOT District 5. The interchange is located within unincorporated Brevard County and it is located approximately 3.62 miles north of the I-95 / SR-406 interchange and approximately 7.60 miles south of the I-95 / Dearing Parkway interchange. The location of the study interchange is depicted in Figure 1.

### **1.4 Methodology**

#### **1.4.1 Overview**

Per the 2020 FDOT Interchange Access Request User's Guide section 1.5.1 regarding the Methodology Letter of Understanding (MLOU), "The MLOU is optional for an Interchange Operational Analysis Report (IOAR) and is determined on a case-by-case basis." Accordingly, an MLOU was deemed unnecessary by FDOT personnel as agreed to at the January 23, 2020 District 5 Interchange Coordination meeting due to the scope of the interchange modification. Although a formal MLOU was not necessary, Love's Travel Plaza and D5 agreed to follow the general methodology as shown in the methodology letter included as Appendix A.

#### **1.4.2 Analysis Years**

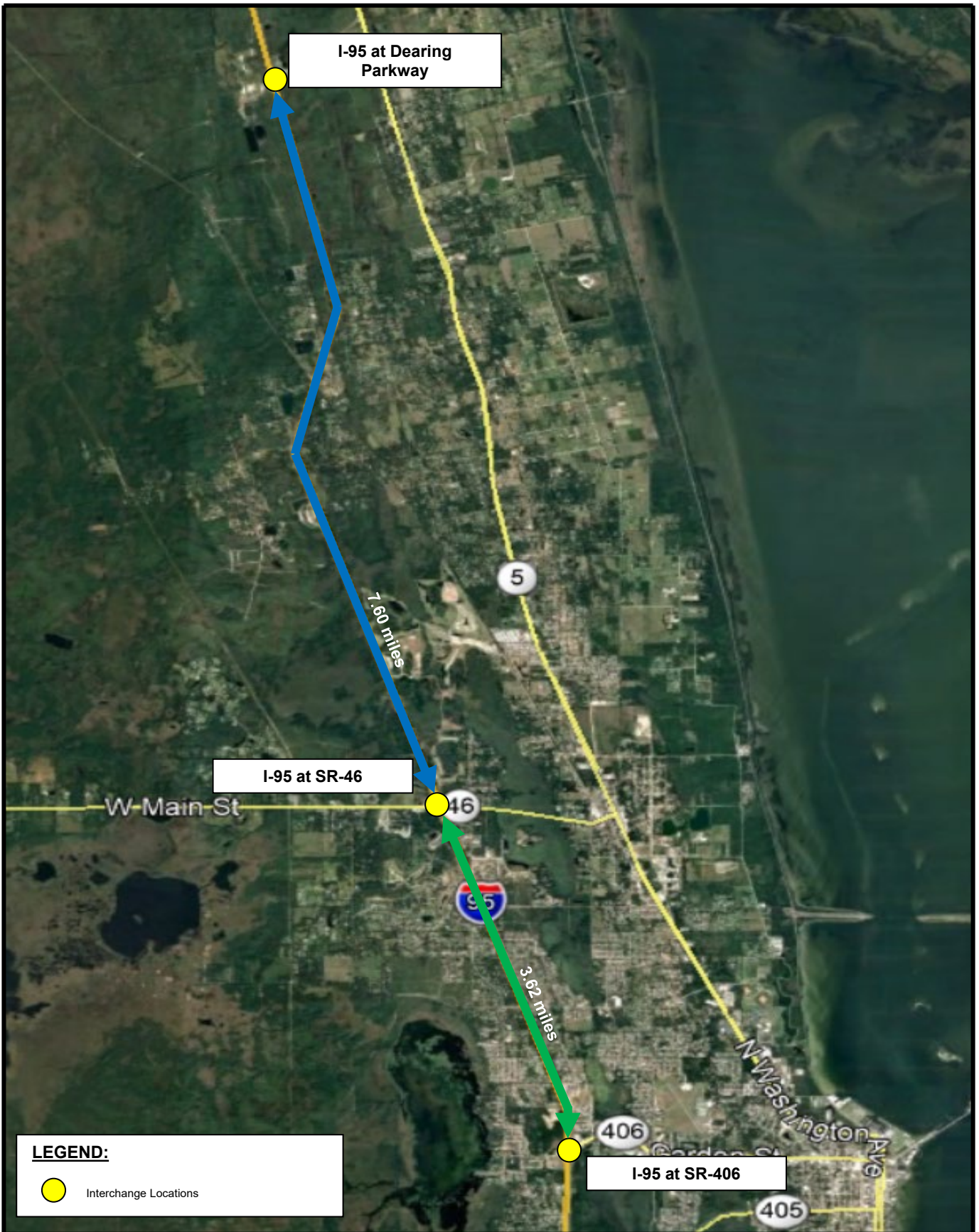
Section 2.4.3 of the 2020 FDOT IARUG requires at least three (3) analysis years for any Interchange Access Report (IAR). This section also requires a minimum IOAR design year of 10 years beyond the opening year. The years of analysis were determined based on a meeting held on October 6, 2020. A copy of the email correspondence is included in Appendix B. Analysis years for the IOAR are provided below. It should be noted that the No-Build and Build Alternatives were analyzed in the Opening and Design Years.



- Existing Year: 2020
- Opening Year: 2021
- Design Year: 2031

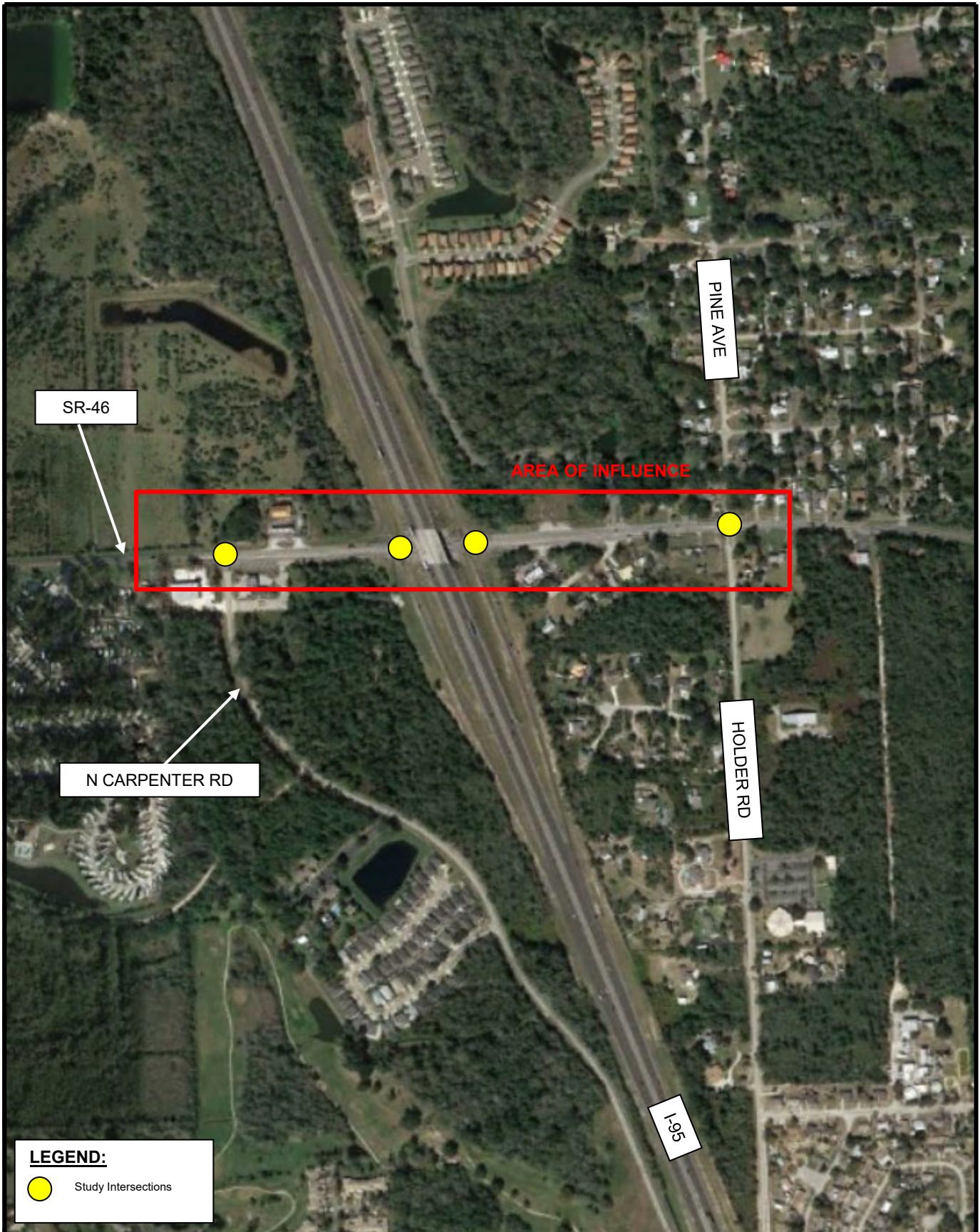
### **1.5 Area of Influence**

The I-95 / SR-46 interchange is located within unincorporated Brevard County. The nearest interchanges are I-95 / Dearing Parkway 7.60 miles to the north and I-95 / SR 406 3.62 miles to the south. Due to the distance, they are not included in the area of influence (AOI). The intersection of SR-46 at Australian Way / Hammock Trail is shown in the figures throughout this report for the purpose of balancing the volumes along the corridor. However, local residents have not expressed any traffic concerns and observations during the data collection phase did not yield any operational concerns. Therefore, it was negotiated in the methodology phase to not include this intersection as part of the analysis. Figure 2 graphically denotes the AOI. The following is a list of interchange components and immediate area intersections to be analyzed within the AOI:



- SR-46 at North Carpenter Road
- I-95 at SR-46 Southbound Ramps
- I-95 at SR-46 Northbound Ramps
- SR-46 at Pine Avenue / Holder Road



<b>I-95 at SR-46 IOAR</b>	 NTS	<b>Study Location</b>		
		Project No.: 4607.10	Figure: 1	



**LEGEND:**  
● Study Intersections

<b>I-95 at SR-46 IOAR</b>	 NTS	<b>Area of Influence</b>		
		Project No.: 4607.10	Figure: 2	

## 2. EXISTING CONDITIONS

An evaluation of 2020 existing conditions was conducted and has been compiled in this IOAR. Existing conditions evaluated within the I-95 / SR-46 interchange area of influence include existing land uses, transportation systems data, existing traffic data, and existing operating conditions.

### 2.1 Existing Land Use

Land uses in the northeast quadrant of the study interchange are primarily classified as commercial with smaller parcels classified as residential. Currently there are single family dwelling units in the northeast quadrant. The southeast quadrant consists of mainly residential land use with smaller parcels classified as commercial. There is currently a convenience store and a fast food restaurant in the southeast quadrant.

Land uses in the northwestern and southwestern quadrants are classified as commercial. There is a coffee and donut shop with drive-through in the northwest quadrant. In the southwest quadrant there is a retail establishment and a gas station with convenience store. See existing land use map in Figure 3.

### 2.2 Existing Transportation Network

North and south of the influence area, the existing transportation network is composed of a six-lane interstate highway. The interchange cross street, SR-46, is a two-lane arterial. Table 1 below provides a summary of the functional classifications and number of lanes for the area roadways and the existing intersection and lane configuration are graphically depicted in Figure 4. Table 2 shows the existing turn lane storage lengths. The ramp lengths of the I-95 Southbound and Northbound Off-Ramps are approximately 1,625 feet and 1,825 feet, respectively. The total ramp lengths are measured as the distance from the stop bar to the painted nose of the gore. Storage for the turn lanes was measured from the stop bar to the point where the ramp narrows to less than 24-ft wide.

**Table 1**  
**Functional Classification of Influence Roadways**  
**I-95 at SR-46 IOAR**

Roadway	From	To	Functional Classification	Number of Lanes
I-95	SR-406	SR-46	Urban Principal Arterial (Interstate) <sup>1</sup>	6
	SR-46	Deering Parkway	Rural Principal Arterial (Interstate) <sup>1</sup>	6
SR-46	Fawn Lake Boulevard	North Carpenter Road	Rural Principal Arterial <sup>1</sup>	2
	North Carpenter Road	US-1	Urban Principal Arterial <sup>1</sup>	2
North Carpenter Road	Dairy Road	SR-46	Urban Major Collector <sup>2</sup>	2
Pine Avenue / Holder Road	Dairy Road	SR-46	Urban Major Collector <sup>2</sup>	2

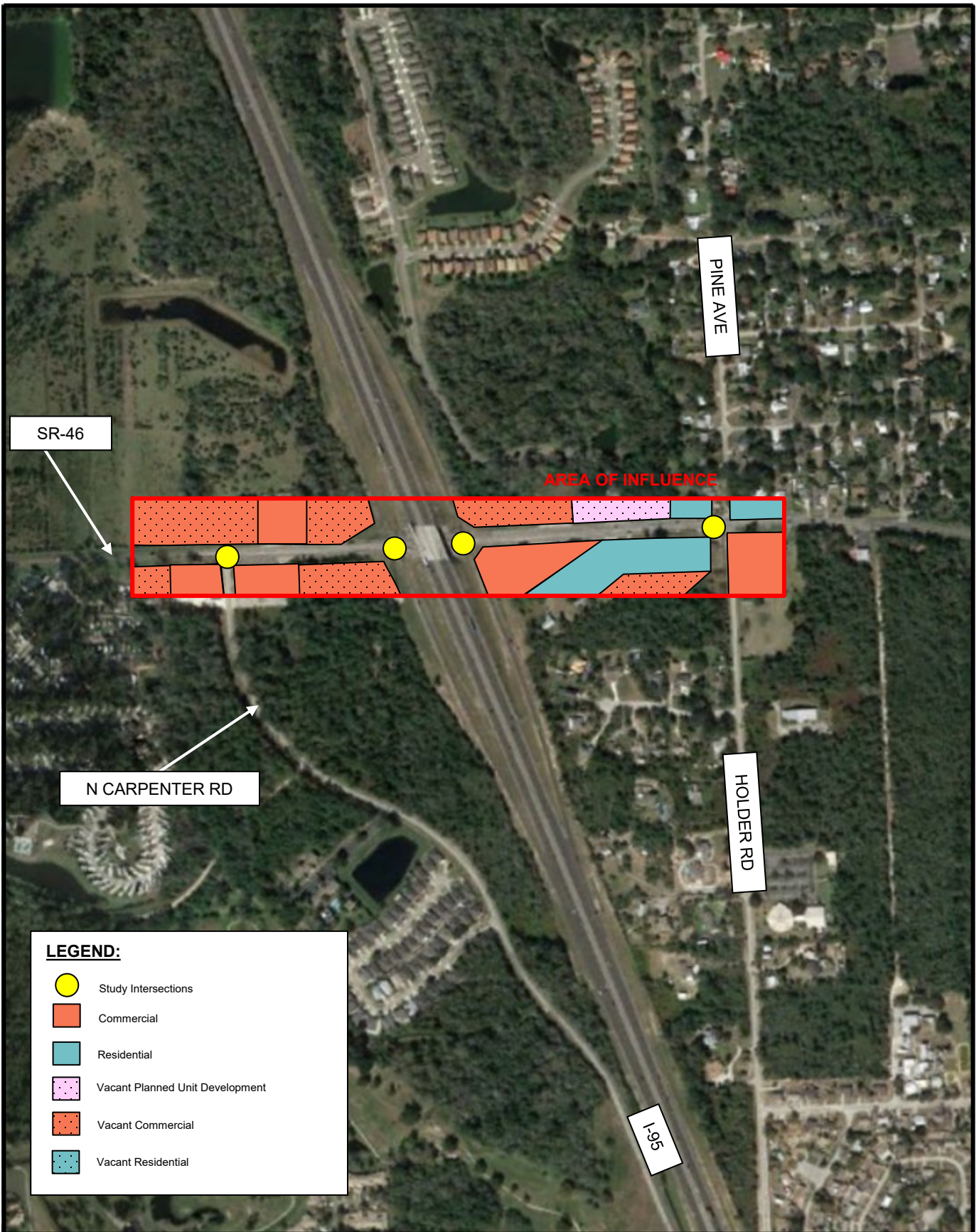
Notes:



1) Per Florida Department of Transportation (FDOT) Straight-Line Diagrams (See Appendix C).

2) Per Space Coast Transportation Planning Organization (SCTPO).

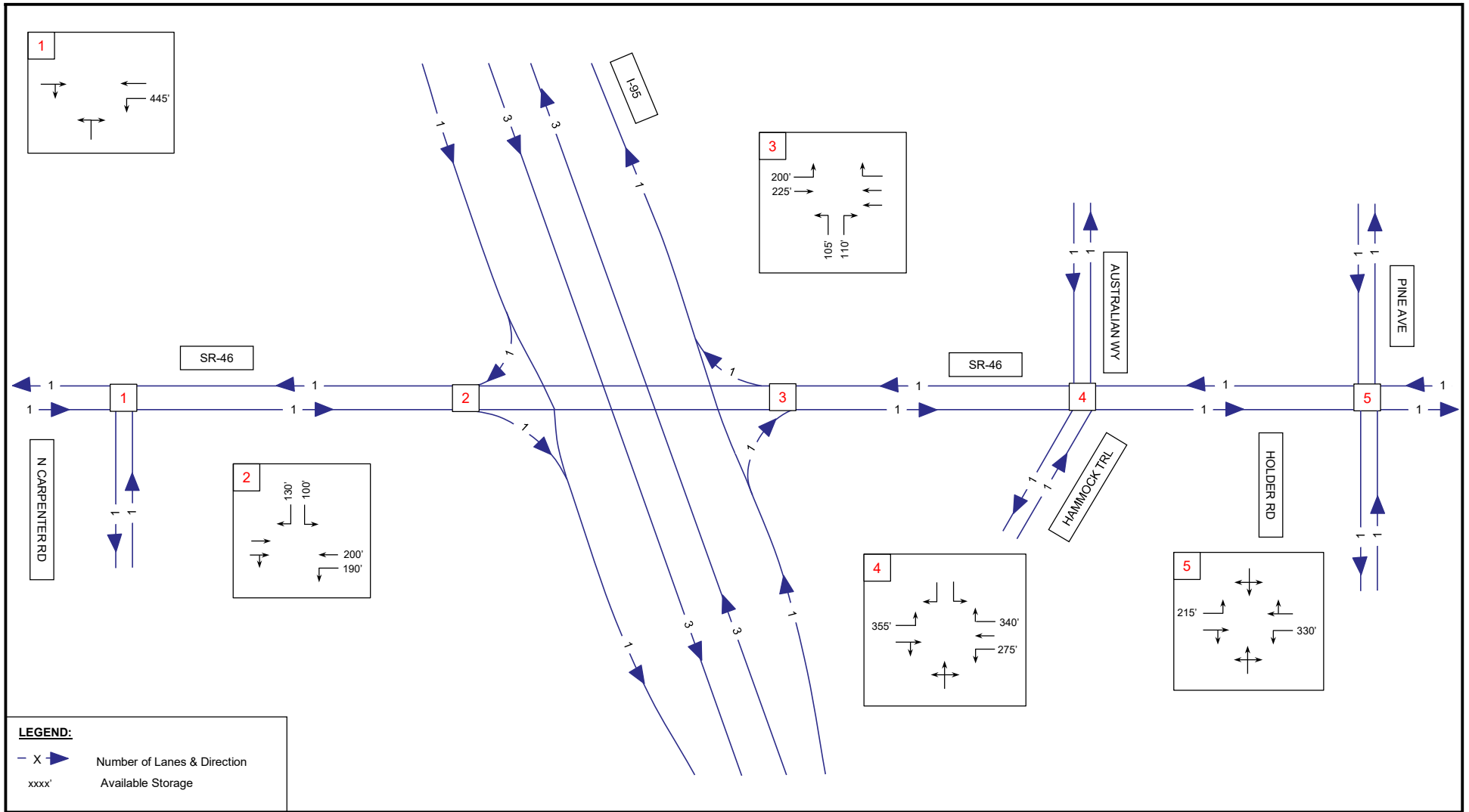
I-95 is a six-lane north-south limited access freeway with a 30 feet paved concrete median within the study limits. North and south of the interchange's on and off-ramps, an auxiliary lane is present in each direction, bringing the total lanes to eight. The Northbound and Southbound Off-Ramps terminate at SR-46. The Southbound On-Ramp terminates in the southbound direction at I-95 approximately 1,611 feet south of the interchange and the Northbound On-Ramp terminates in the northbound direction at I-95 approximately 2,049 feet north of the interchange. There are no interchanges within the immediate area of the study interchange. It should be noted that the study interchange is a tight diamond.

SR-46 is an urban principal arterial within the study limits. West of its intersection with North Carpenter Road, the roadway is two-lane undivided urban arterial. The median width of this two-lane segment is approximately 5 feet.



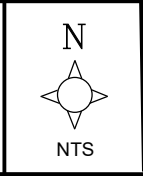
<b>I-95 at SR-46 IOAR</b>	 NTS	<b>Existing Land Uses</b>		
		Project No.: 4607.10	Figure: 3	





**LEGEND:**  
 - X -> Number of Lanes & Direction  
 xxxx' Available Storage

**I-95 & SR-46 IOAR**



**Existing Intersection and Lane Configuration**

Project No.: 4607.10      Figure: 4



**Table 2  
Existing Turn Lane Storage  
I-95 at SR-46 IOAR**

<b>Intersection</b>	<b>Movement</b>	<b>Storage (ft.)</b>	<b>Ramp Length (ft.)</b>
SR-46 at North Carpenter Road	WBL	445	--
I-95 Southbound Ramps at SR-46	SBL	100	1,625
	SBR	130	
	WBL	190	--
I-95 Northbound Ramps at SR-46	NBL	105	1,825
	NBR	110	
	EBL	200	--
SR-46 at Holder Road / Pine Avenue	EBL	215	--
	WBL	330	--

## 2.3 Existing Traffic Characteristics

### 2.3.1 Data Collection

Data compiled for this IOAR included:



- Turning Movement Counts (TMCs) from the November 2019 TIA
- Florida Traffic Online (FTO) 2019
- Space Coast Transportation Planning Organization (SCTPO) Interactive Traffic Count Database
- Crash Data from FDOT CAR

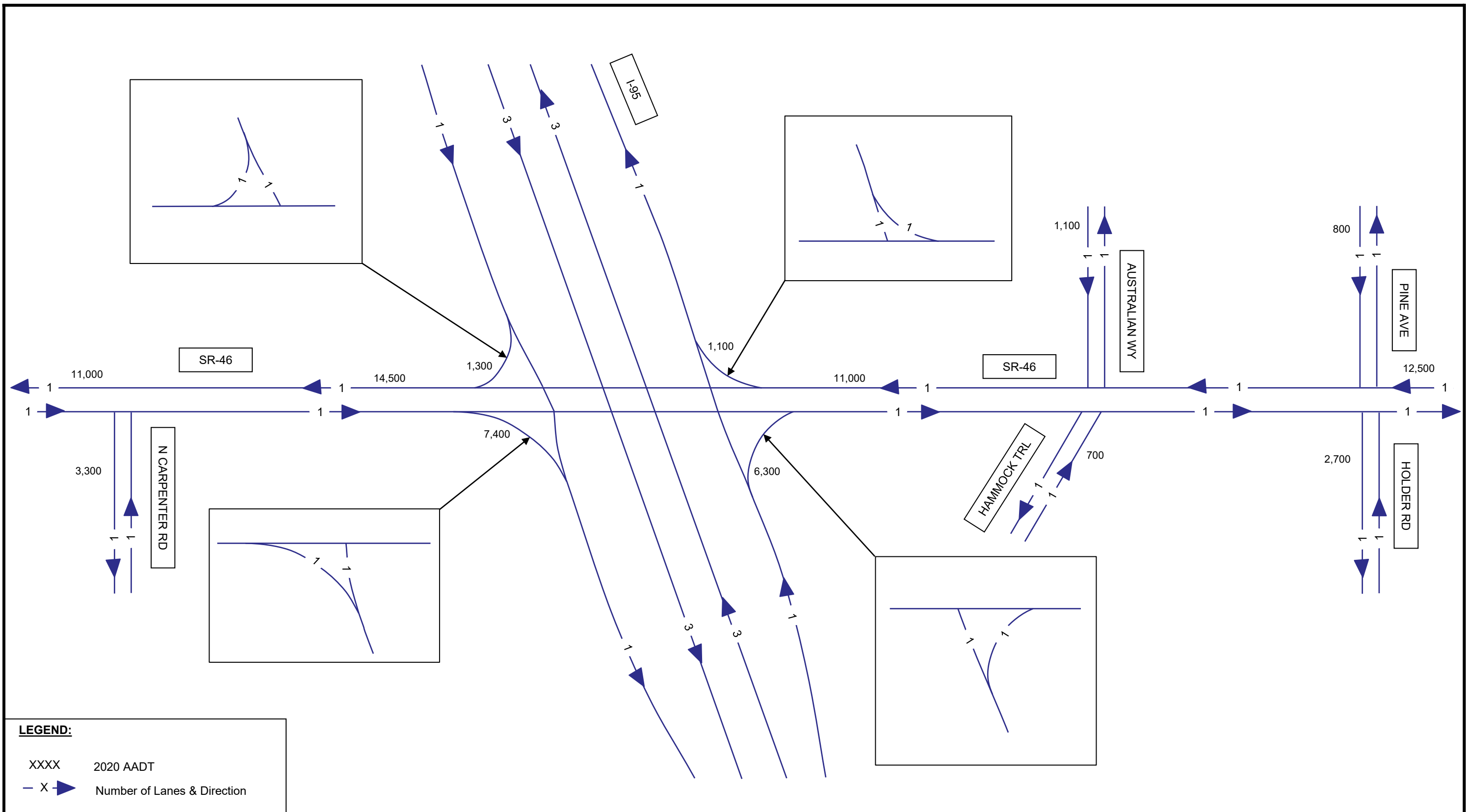
The data collection locations are illustrated in Figure 5. TMC data was collected on October 10, 2018 for the intersections of SR-46 at North Carpenter Road, at I-95 Southbound Ramps, and at I-95 Northbound Ramps; and on November 13, 2018 for the intersections of SR-46 at Hammock Trail / Australian Way and at Holder Road / Pine Avenue. All data used in this report was collected prior to the COVID-19 pandemic; therefore, adjustments to the existing traffic counts to account for a presumed decrease in traffic volumes were not necessary. 2018 AADT data was derived based on 2017 AADT data obtained from SCTPO station 199 and compared with the collected counts in order to verify them. The raw 2018 TMCs and existing signal timings are included in Appendix D, and the raw crash data is included in Appendix E.

### 2.3.2 Existing Traffic Data

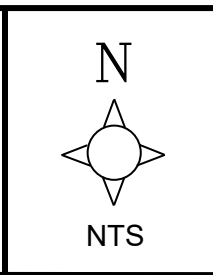
Existing AADT data for the I-95 mainline and SR-46 interchange ramps as well as for SR-46 within the influence area were obtained from FDOT's FTO 2019 database and SCTPO Interactive Traffic Count Database. These existing AADTs and intersection TMCs were approved for use in the methodology letter for this report. Although a formal MLOU was not necessary, Love's Travel Plaza and D5 agreed to follow the general methodology as shown in the methodology letter. The TMC data used in this report was obtained from the approved Love's Travel Plaza Development TIA, and the counts were collected in 2018. Table 3 presents the existing AADT volumes and Figure 6 graphically depicts the volumes. Collected TMCs were used to derive existing AADT on the Southbound Off Ramp. The AADT of 1,192 presented in the methodology letter was grown to 2020 by applying the approved growth rate of 5.87%. 2018 TMC data was used to project existing 2020 Turning Movement Volumes (TMVs). The derived 2020 existing TMVs were subsequently balanced along the study corridor. Figure 7 and Figure 8 graphically depict the existing AM and PM peak-hour TMV volumes, respectively. Graphical depictions of the 2018 TMCs, the growth, and the unbalanced 2020 TMVs are included in Appendix F.



<b>I-95 at SR-46 IOAR</b>	 NTS	<b>Data Collection Locations</b>		
		Project No.: 4607.10	Figure: 5	



**I-95 at SR-46 IOAR**



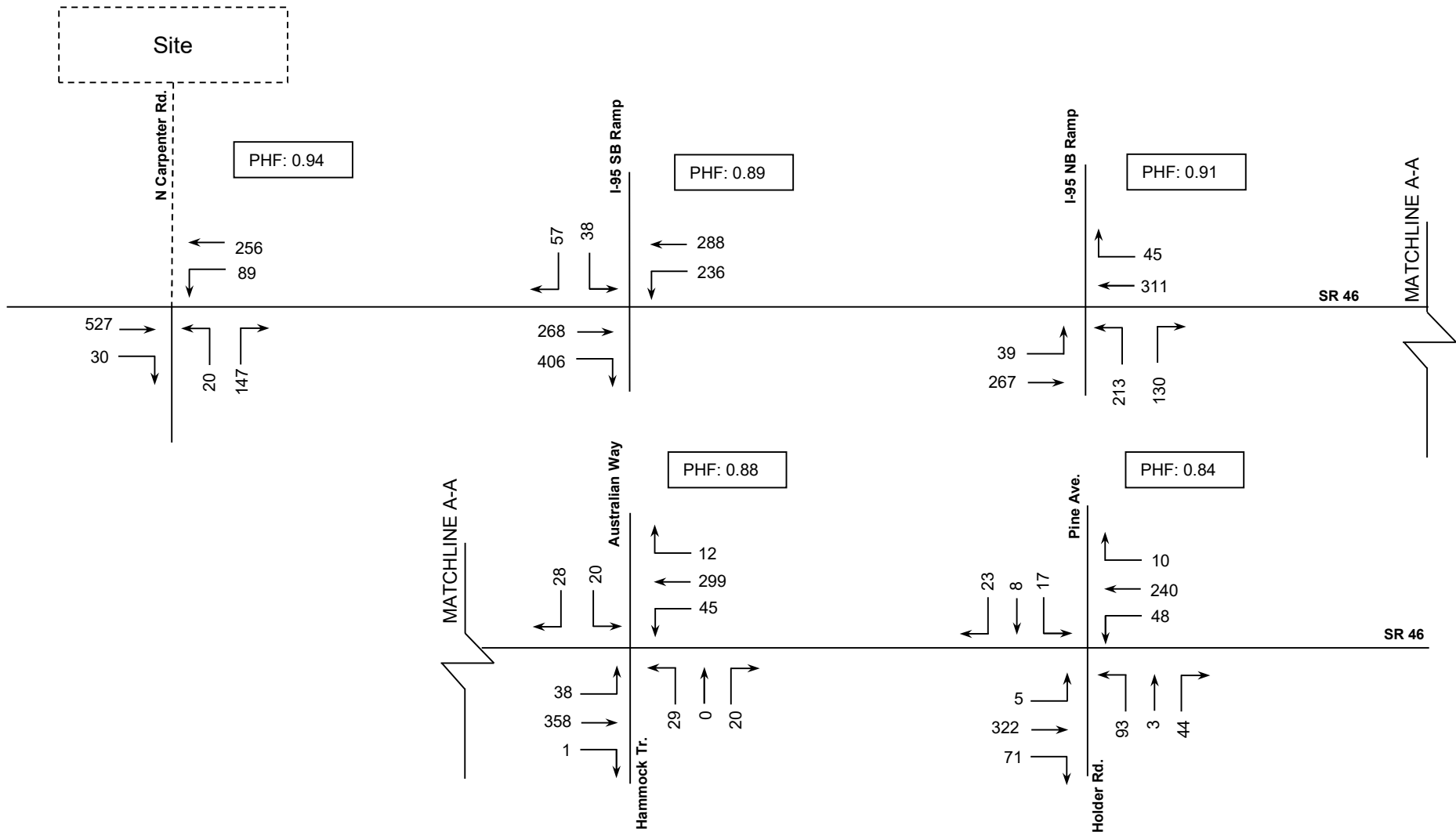
**Existing AADT**

Project No.: 4607.10      Figure: 6

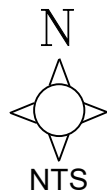


**Notes:**

1. Turning Movement Volumes manually adjusted for balance along the corridor.



I-95 at SR-46 IOAR



**Existing AM Peak-Hour  
Turning Movement Volumes**

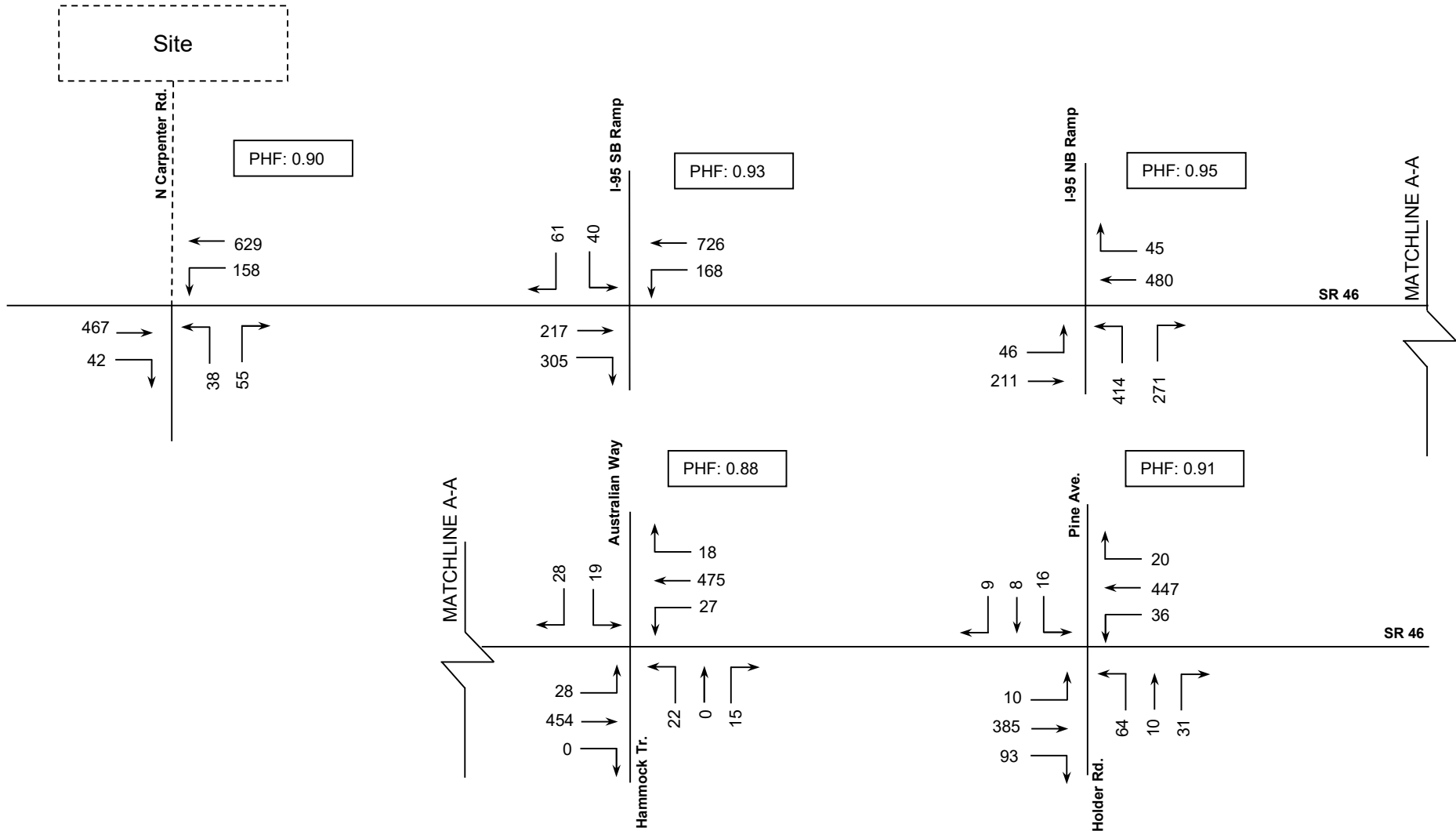
Project No.: 4607.10

Figure: 7

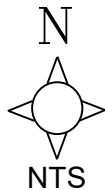


**Notes:**

1. Turning Movement Volumes manually adjusted for balance along the corridor.



**I-95 at SR-46 IOAR**



**Existing PM Peak-Hour  
Turning Movement Volumes**

Project No.: 4607.10

Figure: 8



**Table 3  
Existing AADT  
I-95 at SR-46 IOAR**

Roadway	Segment		2020 AADT
	From	To	
SR-46	Fawn Lake Boulevard <sup>3</sup>	North Carpenter Road	11,000
	North Carpenter Road <sup>1</sup>	I-95	14,500
	I-95 <sup>1</sup>	Pine Avenue / Holder Road	11,000
	Pine Avenue / Holder Road <sup>2</sup>	Palm Avenue	12,500
I-95 Ramps <sup>3</sup>	Southbound Off-Ramp		1,300
	Southbound On-Ramp		7,400
	Northbound Off-Ramp		6,300
	Northbound On-Ramp		1,100
North Carpenter Road <sup>1</sup>	South of SR-46		3,300
Pine Avenue / Holder Road <sup>1</sup>	North of SR-46		800
	South of SR-46		2,700

Notes:

1) AADTs derived by growing 2018 TMCs to 2020 and subsequently applying a K factor of 0.9. TMCs from the 2019 TIA.

2) Derived from 2017 AADT.

3) Derived from 2018 AADT.

## 2.4 Existing Traffic Operations

An evaluation of 2020 existing operating conditions was conducted and has been compiled in this IOAR.

### 2.4.1 Measures of Effectiveness

The measures of effectiveness (MOEs) considered in the analyses are existing peak-hour LOS, intersection and approach delays, 95<sup>th</sup> percentile queue lengths, and delays for each movement.

### 2.4.2 Existing Ramp Capacity Analysis

An existing ramp capacity analysis was conducted based on HCM 6<sup>th</sup> Edition methodology. As indicated in Table 4, all the ramps have sufficient capacity under existing conditions.

**Table 4  
Existing Ramp Capacity Analysis  
I-95 at SR-46 IOAR**

Ramp	Number of Lanes	Speed Limit (mph)	Ramp Capacity (pc/h) <sup>1</sup>	PHF		Peak Hour Demand Volume (vph) <sup>2</sup>		Peak Hour Demand Flow Rate (pc/h) <sup>3</sup>		V/C <sup>4</sup>		Ramp Capacity Sufficient
				AM	PM	AM	PM	AM	PM	AM	PM	
I-95 Southbound Off-Ramp	1	35	2,000	0.84	0.81	95	101	129	132	0.06	0.07	Yes
I-95 Southbound On-Ramp	1	35	2,000	0.91	0.86	642	473	741	565	0.37	0.28	Yes
I-95 Northbound Off-Ramp	1	35	2,000	0.82	0.94	343	685	454	752	0.23	0.38	Yes
I-95 Northbound On-Ramp	1	35	2,000	0.89	0.82	84	91	99	113	0.05	0.06	Yes

Notes:

1) Ramp Capacity based on HCM 6<sup>th</sup> Edition, Exhibit 14-12.

2) Truck Percentages used in the calculation are obtained from the existing TMCs. They are as follows:

a. I-95 Southbound Off-Ramp: AM: 14%, PM: 6%

b. I-95 Southbound On-Ramp: AM: 5%, PM: 3%

c. I-95 Northbound Off-Ramp: AM: 8%, PM: 3%

d. I-95 Northbound On-Ramp: AM: 5%, PM: 2%

3) Flow rate in pc/h is estimated based on HCM 6<sup>th</sup> Edition Equations 12-10, 12-25, and 14-1.

4) V/C determined by dividing Peak Hour Demand Flow Rate/Ramp Capacity.

### 2.4.3 Existing Intersection Operations and Queue Analysis

An existing year intersection and queue analysis was performed for the intersections within the influence area. All intersections were analyzed with existing geometry and traffic control conditions. Turn lane storage is measured from the stop bar to the end of taper as shown in FDOT Design Manual Exhibit 212-1. Ramp turn lane storage is measured from the stop bar to the point where the ramp narrows to less than 24-ft wide. The findings presented in Table 5 show that the southbound left-turn movement on the I-95 Southbound Off-Ramp at SR-46 operates below the target LOS during the PM peak-hour. Additionally, at the intersection of SR-46 / North Carpenter Road, the northbound approach includes movements that do not operate at the target LOS during the PM peak-hour; however, the overall intersection delay is of 4.1 seconds. All other movements, approaches, and intersections are currently operating at the target LOS. The northbound left-turn movement on the Northbound Off-Ramp exceeds the available storage during the AM and PM peak hours, however, the queues do not extend to the mainline. As indicated in the table, all other existing queues do not exceed existing storage during the AM and PM peak hours. The Synchro intersection and timing reports are included in Appendix G.

### 2.4.4 Existing Ramp Queue Analysis

A queue analysis under existing conditions was performed for the intersection movements at the I-95 / SR-46 Southbound and Northbound Off-Ramps. The analysis identifies the highest of the maximum 95<sup>th</sup> percentile queues and determines the excess available length on the ramp. The queues were derived from Synchro's HCM 6<sup>th</sup> Edition Signalized Intersection Summary reports and Synchro's HCM 6<sup>th</sup> Edition TWSC Summary reports. The ramp lengths of the I-95 Southbound and Northbound Off-Ramps are approximately 1,625 feet and 1,825 feet, respectively. The total ramp lengths are measured as the distance from the stop bar to the painted nose of the gore. Storage for the turn lanes was measured from the stop bar to the point where the ramp narrows to less than 24-ft wide. Excess available ramp length is defined as the length of ramp available to provide for vehicle deceleration and to store additional queues before extending to the I-95 mainline. As indicated in Table 6 and Table 7, all existing queues do not extend to the I-95 mainline during the AM and PM peak hours.



**Table 5  
Existing Peak-Hour MOE's  
I-95 at SR-46 IOAR**

Intersection	Control Type	Movement	AM			PM			Storage Length (ft.) <sup>5</sup>
			Delay (sec.)	LOS	95 <sup>th</sup> Percentile Queue (ft.)	Delay (sec.)	LOS	95 <sup>th</sup> Percentile Queue (ft.)	
SR-46 at North Carpenter Road	Unsig. <sup>1</sup>	NBL/NBT/NBR	18.2	C	50	45.3	E	75	--
		NB Approach	18.2	C	--	45.3	E	--	--
		EBT/EBR	Free-flow <sup>3</sup>						--
		EB Approach <sup>2</sup>	0.0	--	--	0.0	--	--	--
		WBL	9.2	A	25	9.3	A	25	445
		WBT	Free-flow <sup>3</sup>						--
		WB Approach <sup>2</sup>	2.4	--	--	1.9	--	--	--
<b>Intersection</b>	<b>3.6</b>	<b>--</b>	<b>--</b>	<b>4.1</b>	<b>--</b>	<b>--</b>	<b>--</b>		
I-95 Southbound Ramps at SR-46	Unsig. <sup>1</sup>	SBL	30.0	D	25	39.3	E	50	100
		SBR	10.8	B	25	16.2	C	25	130
		SB Approach	18.5	C	--	25.3	D	--	--
		EBT	Free-flow <sup>3</sup>						--
		EBR	Yield <sup>4</sup>						--
		EB Approach <sup>2</sup>	0.0	--	--	0.0	--	--	--
		WBL	8.7	A	25	8.2	A	25	190
WBT	Free-flow <sup>3</sup>						200		
WB Approach <sup>2</sup>	3.9	--	--	1.5	--	--	--		
<b>Intersection</b>	<b>2.9</b>	<b>--</b>	<b>--</b>	<b>2.6</b>	<b>--</b>	<b>--</b>	<b>--</b>		
I-95 Northbound Ramps at SR-46	Sig. <sup>1</sup>	NBL	21	C	125	30.4	C	275	105
		NBR	Yield <sup>4</sup>						--
		NB Approach	13.1	B	--	18.4	B	--	--
		EBL	8.5	A	25	11.4	B	25	200
		EBT	6.6	A	75	8.8	A	75	225
		EB Approach	6.8	A	--	9.2	A	--	--
		WBT	13.5	B	75	18.4	B	125	--
WBR	Yield <sup>4</sup>						--		
WB Approach	11.8	B	--	16.9	B	--	--		
<b>Intersection</b>	<b>10.7</b>	<b>B</b>	<b>--</b>	<b>16.2</b>	<b>B</b>	<b>--</b>	<b>--</b>		
SR-46 at Holder Road / Pine Avenue	Sig. <sup>1</sup>	NBL/NBT/NBR	32.8	C	150	41.2	D	125	--
		NB Approach	32.8	C	--	41.2	D	--	--
		SBL/SBT/SBR	26	C	50	37.5	D	50	--
		SB Approach	26	C	--	37.5	D	--	--
		EBL	10	B	25	5.9	A	25	--
		EBT/EBR	16.1	B	250	9.4	A	200	--
		EB Approach	16	B	--	9.4	A	--	215
		WBL	10.2	B	25	5.9	A	25	--
		WBT/WBR	11.3	B	125	8.1	A	175	--
WB Approach	11.1	B	--	7.9	A	--	330		
<b>Intersection</b>	<b>17.6</b>	<b>B</b>	<b>--</b>	<b>12.5</b>	<b>B</b>	<b>--</b>	<b>--</b>		

## Notes:

- 1) Signalized intersection results from Synchro HCM 6<sup>th</sup> Edition Signalized Report. Unsignalized intersection results from Synchro HCM 6<sup>th</sup> Edition TWSC Report.
- 2) HCM 6<sup>th</sup> Edition TWSC Report does not support LOS analysis for non-critical approaches and/or intersections.
- 3) HCM 6<sup>th</sup> Edition TWSC methodology does not support delay/LOS analysis for the intersection and for yield/free-flow conditions on the major street.
- 4) HCM 6<sup>th</sup> Edition Signalized methodology does not support delay/LOS analysis for yield conditions.
- 5) All storage lengths are existing.

**Table 6**  
**Existing Southbound Off-Ramp 95<sup>th</sup> Percentile Queue Analysis**  
**I-95 at SR-46 IOAR**

	AM Peak-Hour		PM Peak-Hour	
	SB Left	SB Right	SB Left	SB Right
95 <sup>th</sup> Percentile Turn Lane Queues (ft.)	25	25	50	25
Existing Turn Lane Storage (ft.)	100	130	100	130
Additional Required Storage (ft.)	0	0	0	0
Maximum Potential 95 <sup>th</sup> Percentile Queue for Off-Ramp (ft.)	25		50	
Ramp Length (ft.)	1,625			
Excess Available Ramp Length (ft.)	1,600		1,575	

**Table 7**  
**Existing Northbound Off-Ramp Queue Analysis**  
**I-95 at SR-46 IOAR**

	AM Peak-Hour		PM Peak-Hour	
	NB Left	NB Right	NB Left	NB Right
95 <sup>th</sup> Percentile Turn Lane Queues (ft.)	125	0	275	0
Existing Turn Lane Storage (ft.)	105	110	105	110
Additional Required Storage (ft.)	20	0	170	0
Maximum Potential 95 <sup>th</sup> Percentile Queue for Off-Ramp (ft.)	125		275	
Ramp Length (ft.)	1,825			
Excess Available Ramp Length (ft.)	1,700		1,550	

## 2.5 Historical Crash Analysis

A crash analysis was conducted based on the last five years of FDOT certified crash data, collected from January 1, 2014 to December 31, 2018 using CAR. Data was collected along SR-46 between mileposts 5.660 and 5.997, and for the Southbound and Northbound On and Off-Ramps at SR-46. The crash data analysis for each of these roadways is described in this section. The roadway classifications used in the crash analyses were obtained from the Department's Straight-Line Diagrams (See Appendix C).

### 2.5.1 Crash Rates

The crash rates for the segments are expressed as the number of crashes per million miles travelled. The following equation was utilized to develop the crash rates for this study:

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

Crash data and crash rates are summarized in Table 8. Crash rates along SR-46 were compared to the published statewide averages for comparable facilities based on the functional classification. As shown in Table 8, segment crash rates along SR-46 are higher than the statewide average for comparable facilities. This may be attributed to the widening of I-95 which was under construction at the time of crash data collection. There are no published average crash rates for interstate ramps and, therefore, a comparison could not be made.

Crash rates were calculated separately for the intersection of SR 46 with Carpenter Road as well as both of the Interstate Ramps using the following equation:

$$\text{Crash Rate of Intersection} = \frac{\text{Total Number of Crashes} * 1,000,000}{\text{AADT} * 365 * \text{Number of Years}}$$

These calculations considered only the crashes reported as being within close proximity of the intersecting roadway and the resultant crash rates are shown in Table 9. As shown in Table 9, intersection crash rates at the study intersections are lower than the statewide average for comparable facilities.

**Table 8  
Crash Statistics  
I-95 at SR-46 IOAR**

Location	Segment Length (miles)	Crash Severity	Number of Crashes	Average AADT	Crash Rate	Statewide Crash Average			
<b>Mainline</b>									
I-95 Southbound On-Ramp	0.301	Fatality	0	7,400	1.968	N/A			
		Injury	2						
		PDO	6						
I-95 Northbound Off-Ramp	0.276	Fatality	1	6,300	2.836		N/A		
		Injury	3						
		PDO	5						
I-95 Southbound Off-Ramp	0.24	Fatality	0	1,300	3.512			N/A	
		Injury	1						
		PDO	1						
I-95 Northbound On-Ramp	0.279	Fatality	0	1,100	3.571				N/A
		Injury	1						
		PDO	1						
<b>Crossroad</b>									
SR-46, west of I-95 Southbound Ramps	0.185	Fatality	0	14,500	2.860	6.403			
		Injury	3						
		PDO	11						
SR-46, east of I-95 Northbound Ramps	0.105	Fatality	0	11,000	3.321		6.403		
		Injury	5						
		PDO	2						

**Table 9  
Crash Statistics - Intersections  
I-95 at SR-46 IOAR**

Intersection	Crash Severity	Number of Crashes	Average AADT <sup>1</sup>	Crash Rate	Statewide Crash Average <sup>2</sup>		
SR-46 at Carpenter Road <sup>3</sup>	Fatality	0	16,000	0.479	1.731		
	Injury	3					
	PDO	11					
SR-46 at I-95 Southbound Ramps <sup>4</sup>	Fatality	0	16,000	0.719		1.731	
	Injury	11					
	PDO	10					
SR-46 at I-95 Northbound Ramps <sup>5</sup>	Fatality	1	17,500	0.689			1.731
	Injury	8					
	PDO	13					

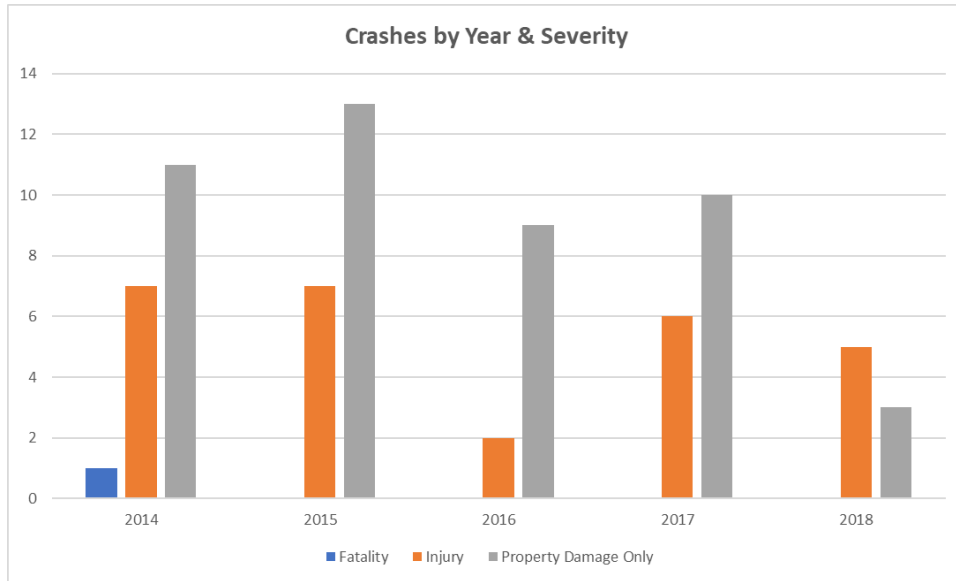
## Notes:

- 1) AADT rounded per the FDOT Project Traffic Forecasting Handbook Section 1.6.
- 2) Statewide crash rate for a 4-leg urban ramps intersection.
- 3) AADTs derived by growing 2018 TMCs to 2020 and subsequently applying a K factor of 0.9. TMCs from the 2019 TIA. Average AADT is the sum of the AADT on SR-46 west of I-95 (14,500) and the AADT on North Carpenter Road by two (3,300/2).
- 4) Average AADT is the sum of the AADT on SR-46 west of I-95 (14,500) and the AADT on the Southbound Off-Ramp (1,300).
- 5) Average AADT is the sum of the AADT on SR-46 east of I-95 (11,000) and the AADT on the Northbound Off-Ramp (6,300).

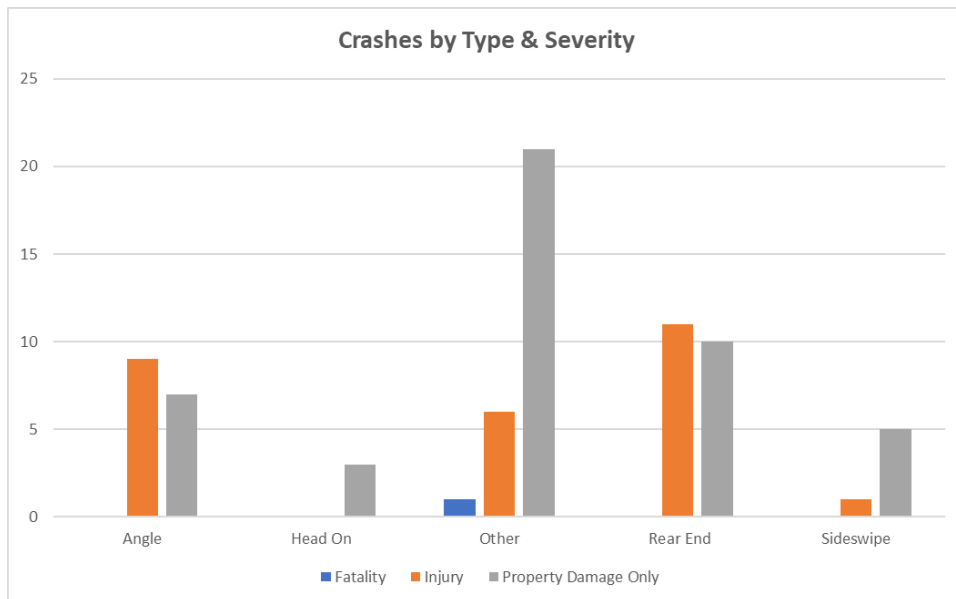
### 2.5.2 Crash Frequency and Severity

During the five-year period, there were 74 reported crashes within the area of influence. There was 1 crash resulting in fatality and 27 crashes that resulted in injury. The most commonly identified crash-type was rear ends, at 21 crashes. Angle crashes were the second most commonly reported crash-type, at 16 crashes. A review of the crash data indicated that four of the reported angle crashes occurred in the vicinity of SR-46 / Carpenter Road and six at SR-46 / Southbound Ramps.

Figure 9 and Figure 10 illustrate the yearly crashes by severity and by crash type, respectively. It should be noted that the manner of collision of the crash that resulted in fatality was not coded as one of the default available crash types.



**Figure 9: Crashes by Year and Severity**

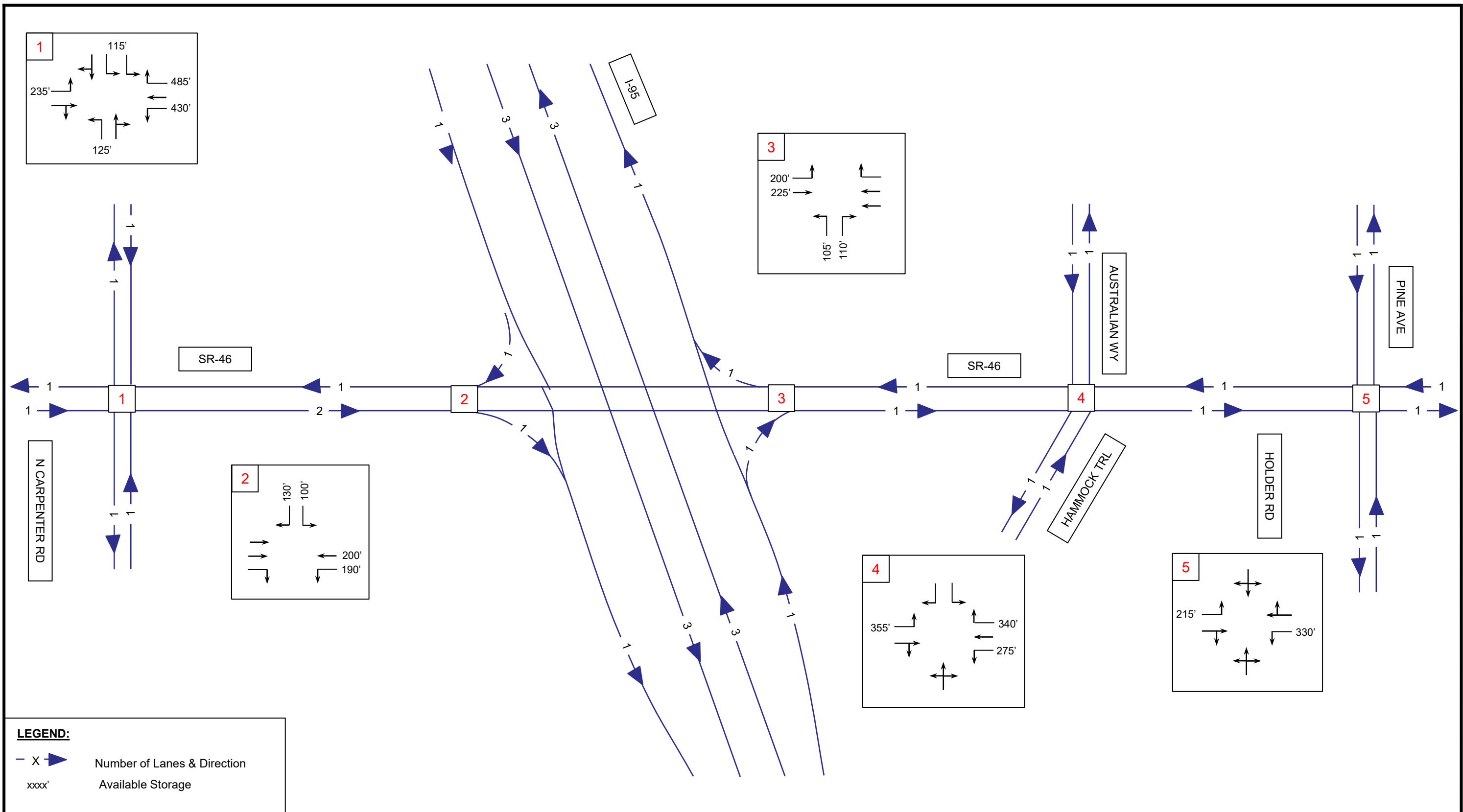


**Figure 10: Crashes by Type and Severity**

### **3. PROPOSED IMPROVEMENTS**

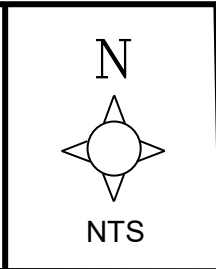
There are no modifications proposed for the I-95 mainline. The proposed improvements aim to mitigate the existing and anticipated operational deficiencies, provide better progression along SR-46, and to better accommodate the southbound right traffic entering the westbound SR-46 traffic stream. Figure 11 illustrates the proposed lane and intersection configuration. The conceptual plans are included in Appendix H. The proposed improvements are summarized below:

- Signalization of the I-95 Southbound Ramps
- Signalization of the southbound right-turn movement on the Southbound Off-Ramp
- Modifying SR-46 to transition east of North Carpenter Road to a three-lane road with one lane in the westbound direction and two lanes with a lane drop at the I-95 Southbound On-Ramp



**LEGEND:**  
 — X —▶ Number of Lanes & Direction  
 xxxx' Available Storage

**I-95 & SR-46 IOAR**



**Proposed Intersection Configurations**

Project No.: 4607.10      Figure: 11



## 4. FUTURE TRAFFIC DEVELOPMENT

### 4.1 Traffic Factors

Factors applied in the development of design traffic volumes are the Standard K, D, and Annual Trends Growth Rates derived from 10 years of historical AADT data using FDOT Traffic Trends. The Standard K is described as the proportion of the AADT that occurs during the design year's peak-hour and it is dependent on the facility type and the area type. The D factor is the percentage of volume that is distributed in the peak direction during peak-hour conditions on a two-way facility. A Standard K of nine percent (9%) has been identified per Table 2.1 of FDOT's 2019 Project Traffic and Forecasting Handbook recommendation for "Other Urbanized Areas" freeways, arterials, and highways. The D factors, derived from existing TMV data and presented in Table 10, were obtained from the Department's TM Tool. TM Tool inputs and outputs are included in Appendix I. All D factors are within acceptable low and high values as defined in Table 2.2 of the Project Traffic and Forecasting Handbook. For an Urban Arterial roadway, the lowest and highest D factor values are 50.8 and 67.1, respectively.

Factors applied in the analysis include the truck factor ( $T_f$ ) and the peak hour factor (PHF) derived from existing TMV data. The  $T_f$  is the percentage of truck traffic during peak-hour conditions. When existing  $T_f$  values fall below the two percent (2%) threshold, a minimum factor of two percent (2%) was used. The PHF is defined as the hourly volume of the analysis hour divided by four times the peak 15-minute flow rate of the analysis hour and is a measure of traffic demand fluctuation. The PHF values used for existing analyses are within the 0.84-0.95 range. For future conditions, all analyses utilized a PHF of 0.95. All PHF values used in the analysis fall within the 0.75-0.95 range.

**Table 10**  
**Traffic Factors**  
**I-95 at SR-46 IOAR**

Facility	Segment		Standard K	D
	From	To		
SR-46	West of North Carpenter Road	North Carpenter Road	9.0%	67% (AM) 51% (PM)
	North Carpenter Road	I-95		51% (AM) 60% (PM)
	I-95	West of Pine Avenue / Holder Road		53% (AM) 51% (PM)
	Pine Avenue / Holder Road	East of Pine Avenue / Holder Road		51% (AM) 54% (PM)

### 4.2 Growth Rates

Annual growth rates were selected based on a comparison of historical trends growth rates and the Central Florida Regional Planning Model (CFRPM), version 6.1 growth rates. Historical trends growth rates were selected as agreed upon in the methodology letter. Although a formal MLOU was not necessary, Love's Travel Plaza and D5 agreed to follow the general methodology as shown in the methodology letter.

#### 4.2.1 Historical Trends Growth Trends

FDOT Traffic Trends software was used to determine trends growth rates for the I-95 ramps and the adjacent SR-46 segments based on 10 years of historical data. The trends growth rates were determined using the last ten years of historical traffic data identified in FDOT Traffic Online and the Space Coast TPO Transportation Data Management System Websites. The Traffic Trends spreadsheets are attached as Appendix J and the summary of traffic sites is included as Appendix K. The trends growth rates are summarized in Table 11.

**Table 11**  
**Summary of Historical Traffic Trends Growth Rate**  
**I-95 at SR-46 IOAR**

Roadway	Segment		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Growth Rate
	From	To											
SR-46	Fawn Lake Blvd.	I-95	8,700	8,600	9,000	8,600	9,000	9,100	9,500	9,900	10,400	10,400	2.07%
	I-95	Palm Ave.	9,900	9,800	9,900	9,900	9,700	9,700	10,000	11,000	11,500	11,500	1.85%
I-95 Ramps	Southbound Off-Ramp		800	850	800	850	850	900	1,000	1,100	1,200	1,200	3.79%
	Southbound On-Ramp		5,000	4,800	4,400	4,300	4,400	4,600	4,900	9,500	10,000	6,400	5.87%
	Northbound Off-Ramp		5,000	4,500	3,500	4,000	4,100	4,300	4,600	5,600	6,000	5,700	3.22%
	Northbound On-Ramp		750	700	700	700	700	750	800	850	900	1,000	3.33%

#### 4.2.2 CFRPM Growth Rates

The latest CFRPM, version 6.1, was initially used to develop the travel demand forecasts for this study for future years 2025 and 2035, including the proposed Love's Travel Plaza Development. No other modifications were made to the model. The 2025 and 2035 model runs provided AADT volume forecasts for the subject ramps and adjacent segments of SR-46. The Department provided 2010 and 2040 model AADT information for the I-95 ramps. This information was used to develop linear model growth rates for the study area. The resulting model growth rates are presented in Table 12 below:

**Table 12**  
**CFRPM Growth Rates**  
**I-95 at SR-46 IOAR**

Roadway	Segment		CFRPM - Love's Background AADT			FDOT CFRPM		
	From	To	2025 CFRPM AADT	2035 CFRPM AADT	Annual Growth Rate	2010 CFRPM AADT	2040 CFRPM AADT	Annual Growth Rate
SR-46	Fawn Lake Blvd.	I-95	20,000	21,000	0.16%	15,500	23,500	1.68%
	I-95	Palm Ave.	9,900	10,800	0.31%	8,500	11,000	0.90%
I-95 Ramps	Southbound Off-Ramp		850	1,800	3.62%	550	1,800	7.74%
	Southbound On-Ramp		9,900	9,700	-0.07%	7,900	10,000	0.95%
	Northbound Off-Ramp		800	1,500	3.13%	450	1,400	6.98%
	Northbound On-Ramp		10,000	9,600	-0.14%	7,900	10,000	0.99%

#### 4.2.3 Recommended Growth Rates

Trends growth rates and model growth rates were compared in order to adopt recommended growth rates. When comparing the projected SR-46 2010 CFRPM segment volumes to the existing 2018 AADT volumes, the model is significantly overestimating traffic volumes west of I-95. This is due to a regional issue, as noted from reviewing the volumes into Seminole County, requiring extensive model calibration across county lines which goes beyond the scope of this operational analysis. Additionally, applying the 2010-2040 linear growth to the 2010 Model AADT volumes to project 2018 AADT's for the SR-46 segment east of I-95 shows that the projected model volumes are underestimating future volumes. Additionally, the model growth predicted on the ramps is questionable because models typically have difficulty accurately estimating growth for low volume roadways. Based on the information provided above, the trends growth rates based on 10 years of historical data were applied to TMVs and AADT's.

##### I-95 Ramps Growth Rates:

Historical AADT volumes on the ramps north and south of SR-46 were analyzed. To derive AADT volumes north of SR-46, the Southbound Off-Ramp and Northbound On-Ramp's AADT's were combined. Similarly, for volumes south of SR-46, the Southbound On and Northbound Off-Ramps' AADT's were combined.



Growth rates were recalculated after combining volumes. Some irregularities exist with the collected AADT on the Southbound On and Northbound Off-Ramps between 2016 to 2018 that could have possibly skewed the Trends' results. Thus, 2016 and 2017 data was disregarded.

Linear, exponential, and decaying growth were analyzed and compared. South of SR-46, R<sup>2</sup> values were lower than 75%; however, linear and exponential growth factors showed positive growths. The growth rates were subsequently compared with a growth rate of 1.87% derived from Bureau of Economic and Business Research (BEBR) data, and it was concluded that the Trend's linear growth rates are more conservative. The population-based growth rate was based on estimated existing population and 2035 projections. Table 13 presents the growth rates for the I-95 Ramps and Table 14 summarizes the R<sup>2</sup> values.

**Table 13**  
**Summary of Historical Traffic Trends Growth Rates on I-95 Ramps**  
**I-95 at SR-46 IOAR**

Roadway	Segment	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Growth Rate
I-95 Ramps	North of SR-46	1,600	1,600	1,500	1,600	1,600	1,700	1,800	2,000	2,100	2,200	3.66%
	South of SR-46	10,000	9,300	7,900	8,300	8,500	8,900	9,500	15,000	16,000	12,100	2.75%

**Table 14**  
**Summary of Growth Rates and R<sup>2</sup> Values**  
**I-95 at SR-46 IOAR**

Roadway	Segment	Linear Growth Factor		Exponential Growth Factor		Decaying Exponential Growth Factor	
		Growth Rate	R <sup>2</sup>	Growth Rate	R <sup>2</sup>	Growth Rate	R <sup>2</sup>
I-95 Ramps	North of SR-46	3.66%	82.00%	4.01%	82.60%	0.37%	55.30%
	South of SR-46	2.75%	44.90%	2.95%	42.90%	-0.07%	17.60%

#### Side Street Growth Rates:

AADT volumes for the side streets were developed based on derived existing 2020 TMVs. A minimum growth rate of two percent (2%) was used for the side streets. Table 15 presents the derived AADTs.

**Table 15**  
**Side Street Growth Rates**  
**I-95 at SR-46 IOAR**

Roadway	Segment	2020	2021	2031	Growth Rate
North Carpenter Road	North of SR-46	3,300	3,400	4,000	2.00%
Hammock Trail/Australian Way	North of SR-46	1,100	1,100	1,300	2.00%
	South of SR-46	700	750	900	2.00%
Pine Avenue/Holder Road	North of SR-46	800	800	1,000	2.00%
	South of SR-46	2,700	2,800	3,300	2.00%

### 4.3 Future Volume Development

Opening Year 2021 and Design Year 2031 AADT projections, except for the volumes on the ramps, were obtained from the raw TM Tool outputs. AADT projections on the ramps were developed by applying the recommended growth rates to the existing volumes. Figure 12 and Figure 13 graphically depict the Opening Year 2021 and Design Year 2031 AADT, respectively. Table 16 presents the AADTs depicted in these figures along with the percentage changes from the existing to those for Opening Year 2021 and Design Year 2031.

**Table 16  
AADT Percent Change  
I-95 at SR-46 IOAR**

Roadway	Segment		2020 AADT	OY 2021 AADT	OY Percent Change From Existing Year	DY 2031 AADT	DY Percent Change From Existing Year	DY Percent Change From OY
	From	To						
SR-46	Fawn Lake Boulevard <sup>3</sup>	North Carpenter Road	11,000	11,000	0.00%	13,500	22.73%	22.73%
	North Carpenter Road <sup>1</sup>	I-95	14,500	15,000	3.45%	18,000	24.14%	20.00%
	I-95 <sup>1</sup>	Pine Avenue/Holder Road	11,000	11,000	0.00%	13,000	18.18%	18.18%
	Pine Avenue/Holder Road <sup>2</sup>	Palm Avenue	12,500	12,500	0.00%	15,000	20.00%	20.00%
I-95 Ramps <sup>3</sup>	SB Off-Ramp		1,300	1,300	0.00%	1,800	38.46%	38.46%
	SB On-Ramp		7,400	7,800	5.41%	11,500	55.41%	47.44%
	NB Off-Ramp		6,300	6,500	3.17%	8,400	33.33%	29.23%
	NB On-Ramp		1,100	1,100	0.00%	1,400	27.27%	27.27%
North Carpenter Road <sup>1</sup>	South of SR-46	3,300	3,400	3.03%	4,000	21.21%	17.65%	
Hammock Trail/Australian Way <sup>1</sup>	North of SR-46	1,100	1,100	0.00%	1,300	18.18%	18.18%	
	South of SR-46	700	700	0.00%	850	21.43%	21.43%	
Pine Avenue/Holder Road <sup>1</sup>	North of SR-46	800	800	0.00%	1,000	25.00%	25.00%	
	South of SR-46	2,700	2,800	3.70%	3,300	22.22%	17.86%	

Notes:

- 1) Derived from 2020 TMVs.
- 2) Derived from 2017 AADT.
- 3) Derived from 2018 AADT.

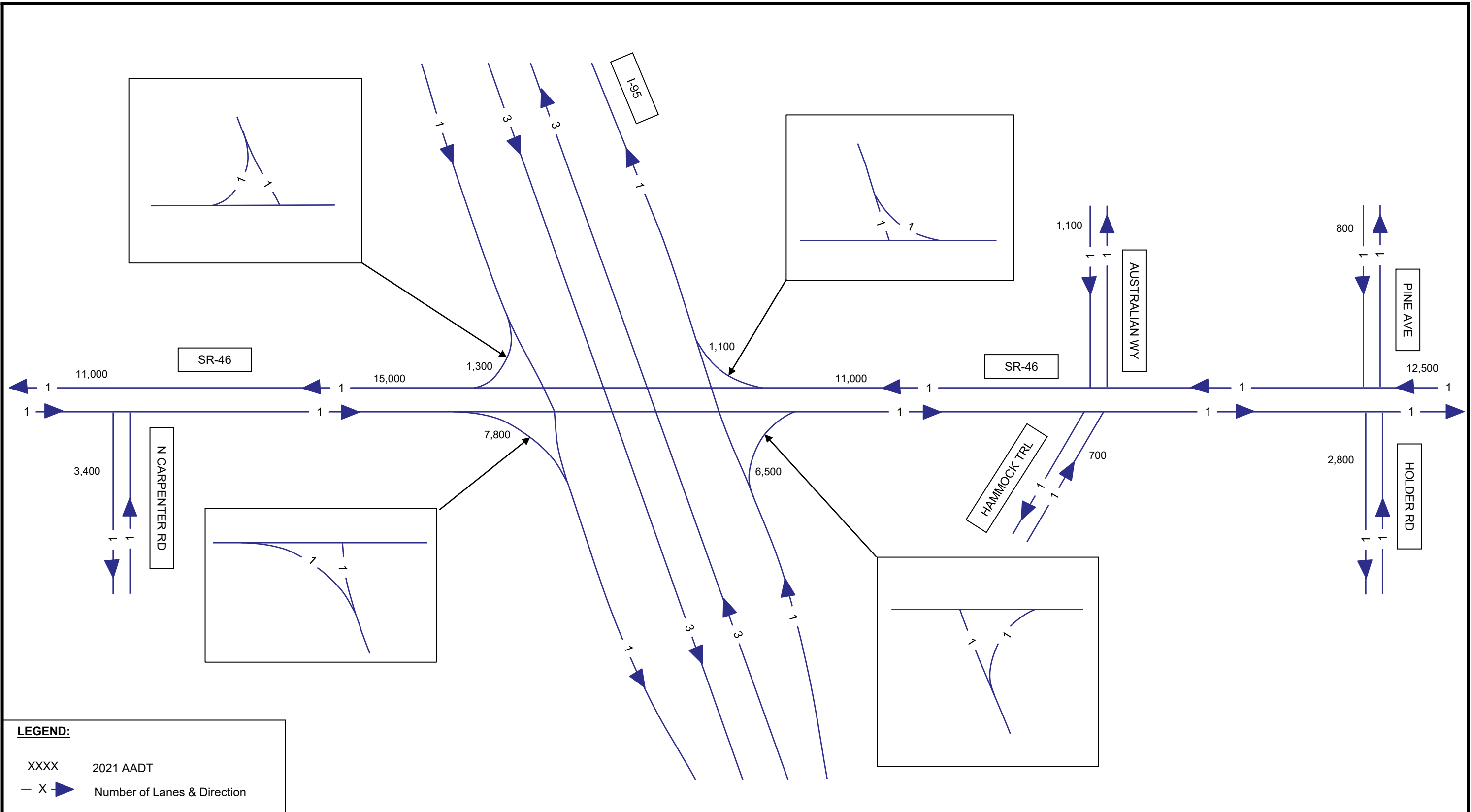
#### 4.3.1 Future Intersection Design Hour Volumes Development

TMC data from 2018 was obtained from the approved TIA for the Love's Travel Plaza Development to project existing 2020 TMVs. The derived existing 2020 TMVs were subsequently balanced along the study corridor and used to develop Design Hour Volumes (DHVs) for the Opening Year 2021 and Design Year 2031 using engineering judgment and the Department's TM Tool. The DHVs are included in Appendix L. The inputs for the TM Tool consisted of the 2020 TMVs, AADT volumes obtained from the Department and SCTPO, and AADT volumes derived from existing 2020 TMVs to supplement those obtained from the agencies. The resulting DHVs obtained from the TM Tool were adjusted to balance volumes along the study corridor.

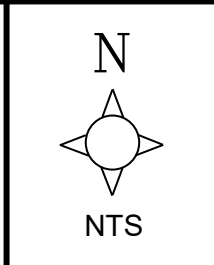
Project traffic was added to the balanced volumes per the project trip distribution from the approved TIA in order to obtain the DHVs used in the analyses. The approved distribution is graphically depicted in the approved TIA included as Appendix M. Figure 14 and Figure 15 graphically depict the Opening Year 2021 DHVs for the AM and PM peak hours, respectively. Figure 16 and Figure 17 illustrate the Design Year 2031 DHVs for the AM and PM peak hours, respectively.

#### Love's Travel Plaza Traffic:

The daily, AM, and PM peak-hour trip generation for the development was determined using the Institute of Transportation Engineers (ITE) 10<sup>th</sup> Edition of the Trip Generation Manual. Due to the nature of the proposed development, a portion of the trips is expected to remain internal to the site. The internal capture rate was calculated based on AM and PM NCHRP Report 684 Internal Trip Capture Estimation Tool. Additionally, a portion of the new trips known as pass-by will be attracted to the project from the existing traffic on the adjacent roadways. These pass-by trips were calculated using procedures outlined in the Trip Generation Handbook, 3<sup>rd</sup> Edition. The AM and PM peak-hour project trips were assigned to the study area roadway network using the approved project trip distribution.



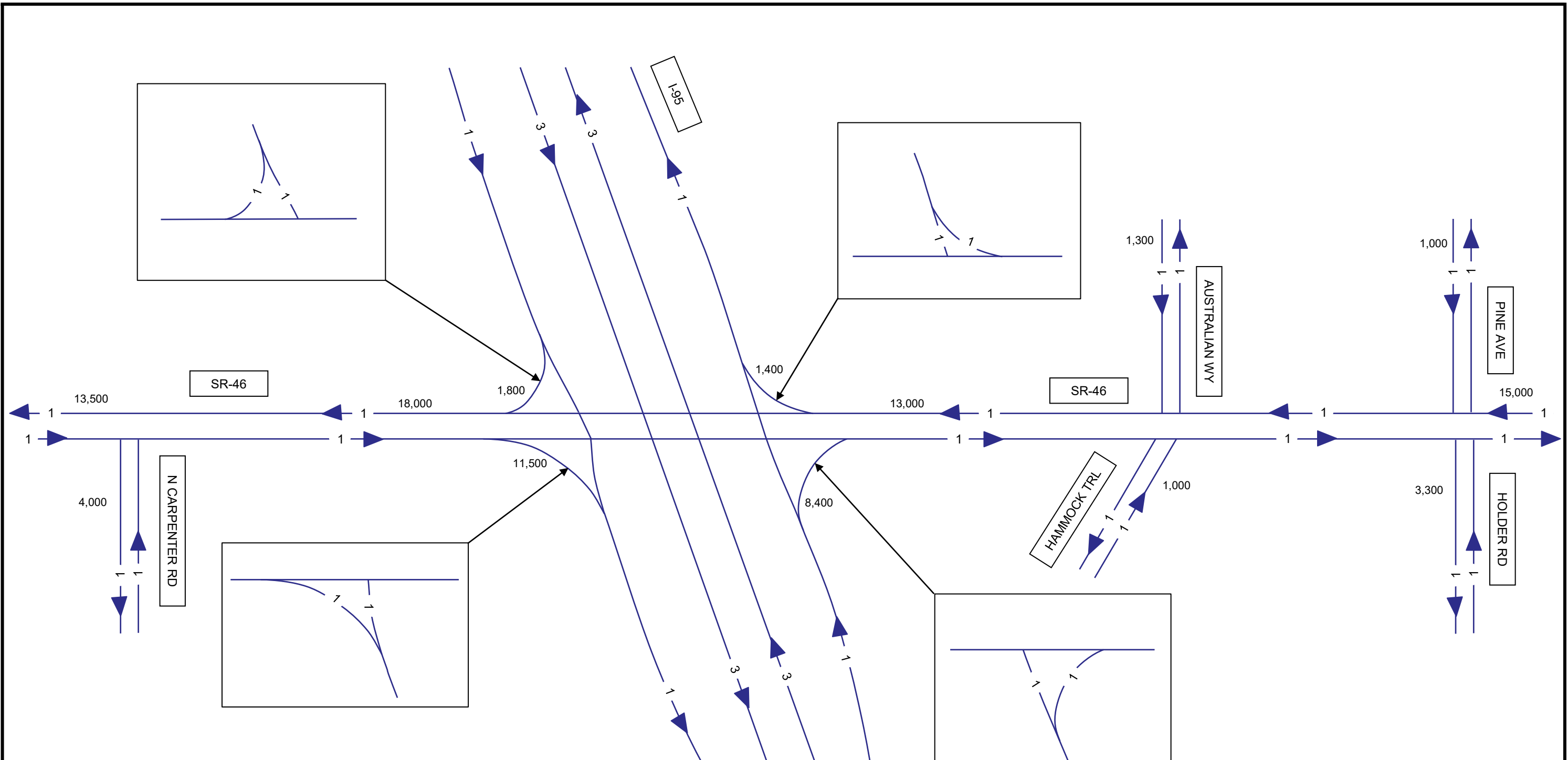
**I-95 at SR-46 IOAR**



**Opening Year 2021 AADT**

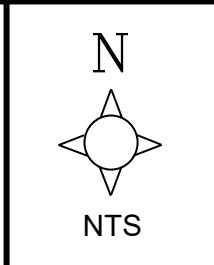
Project No.: 4607.10      Figure: 12





**LEGEND:**  
 XXXX 2031 AADT  
 - X -> Number of Lanes & Direction

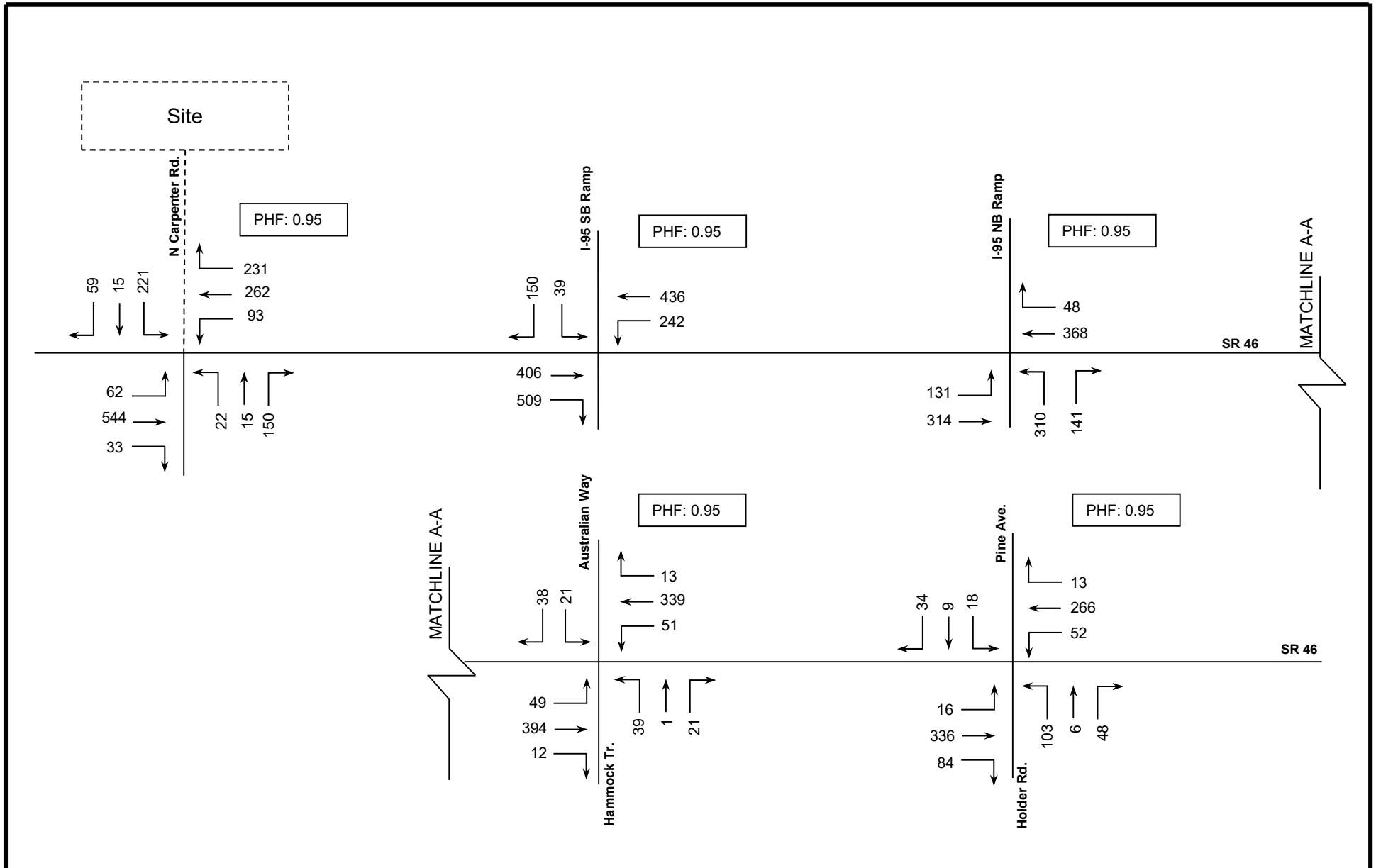
**I-95 at SR-46 IOAR**

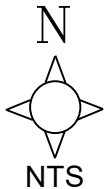



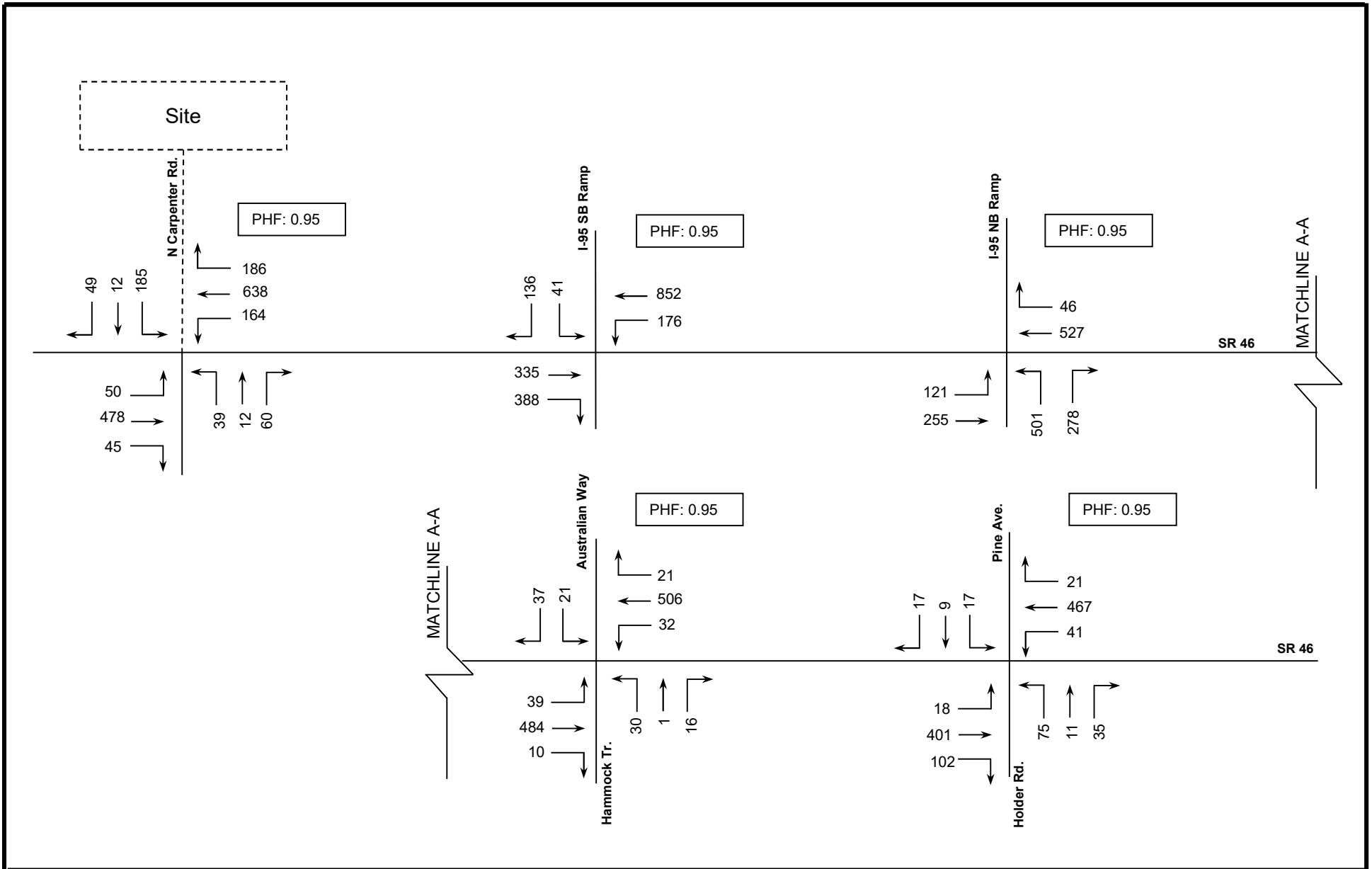
**Design Year 2031 AADT**

Project No.: 4607.10	Figure: 13
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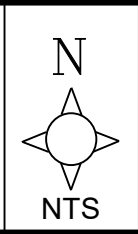




<b>I-95 at SR-46 IOAR</b>		<b>Opening Year 2021 AM Peak-Hour Design Hour Volumes</b>		
		Project No.: 4607.10	Figure: 14	



**I-95 at SR-46 IOAR**

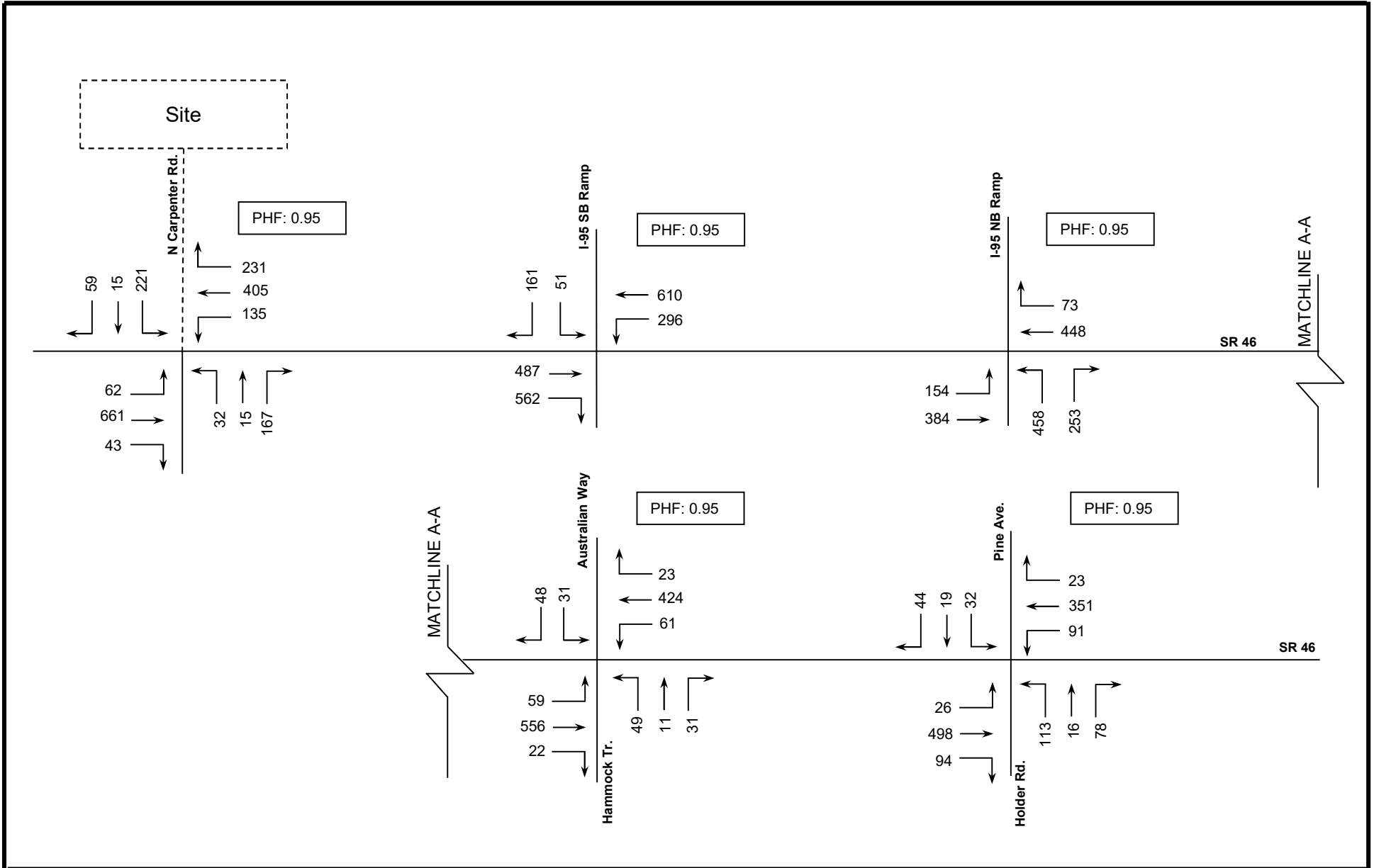


**Opening Year 2021 PM Peak-Hour  
Design Hour Volumes**

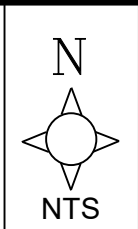
Project No.: 4607.10

Figure: 15





**I-95 at SR-46 IOAR**

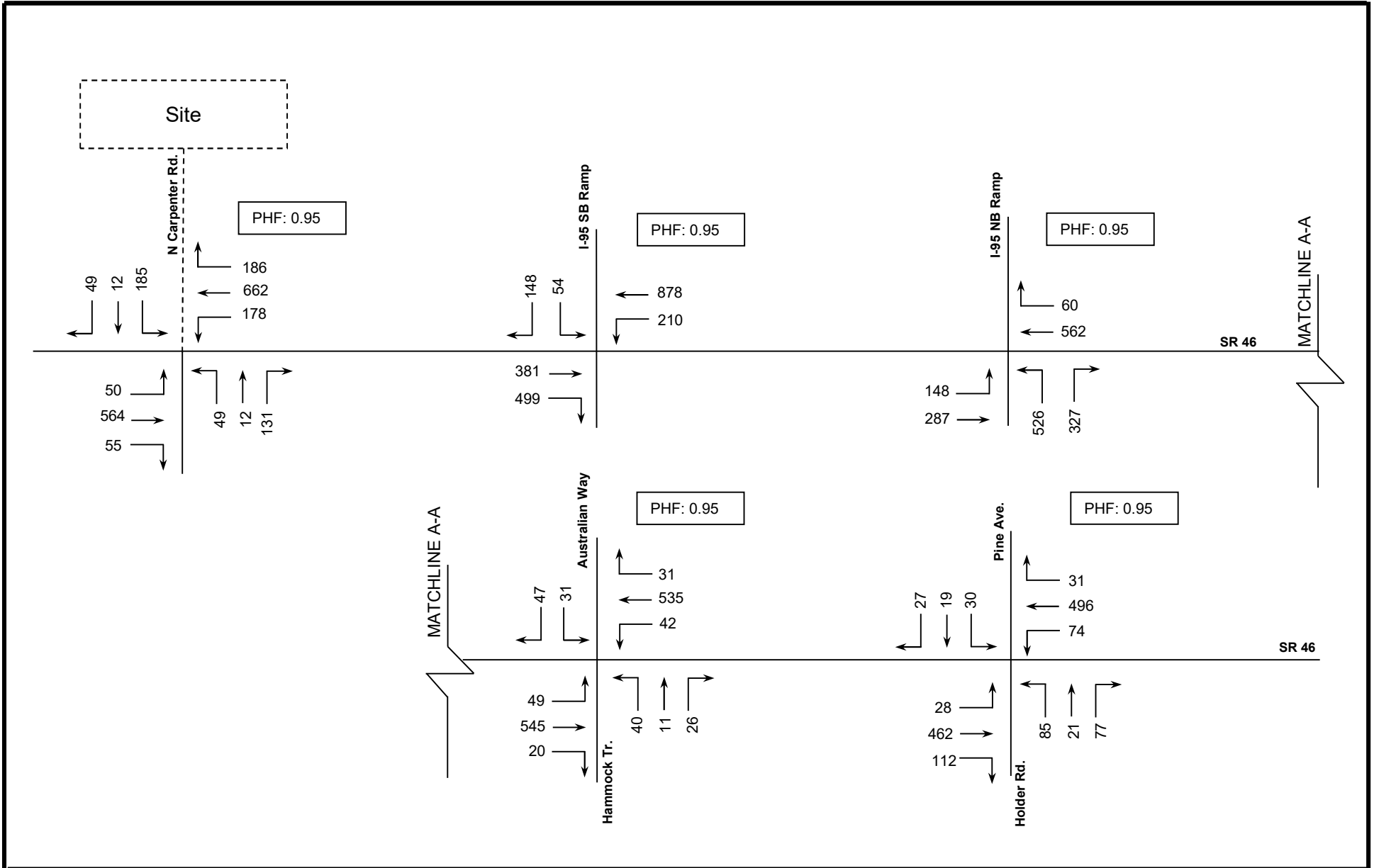


**Design Year 2031 AM Peak Hour  
Design Hour Volumes**

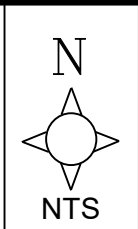
Project No.: 4607.10

Figure: 16





**I-95 at SR-46 IOAR**



**Design Year 2031 PM Peak Hour  
Design Hour Volumes**

Project No.: 4607.10

Figure: 17





## 5. FUTURE OPERATIONAL ANALYSIS

Future conditions within the influence area of the I-95 / SR-46 interchange were analyzed for the No-Build and Build Alternatives. The No-Build Alternative retains the existing unsignalized control type for the Southbound Ramps. The Build Alternative analysis incorporates the signalization of the Southbound Ramps and signalization of the southbound right-turn movement at the Southbound Ramps recommended in the previous TIA. Analysis years under the No-Build and Build Alternatives are Opening Year 2021 and Design Year 2031. Analyses were conducted for intersection operating conditions, and queues.

### 5.1 Alternatives

The following alternatives have been researched and analyzed in this IOAR:

- **No-Build Alternative:** The No-Build Alternative is the existing conditions alternative. Future traffic projections are applied to the No-Build Alternative in order to provide an analysis for comparison to the Build Alternative. Both Opening and Design Years have been analyzed under the No-Build Alternative.
- **Build Alternative:** The Build Alternative has been developed as a result of future traffic projections and anticipated delays due to the existing Southbound Off-Ramp's right-turn yield control. The Build Alternative includes signalization of the I-95 Southbound Off-Ramps / SR-46 intersection and removal of the Southbound Off-Ramp's right-turn yield control. There are no mainline modifications and no ramp modifications. There are also no design variations expected for the proposed signal.

### 5.2 No-Build Operational Analysis

Future conditions within the influence area of the I-95 / SR-46 interchange were analyzed under the No-Build Alternative. The No-Build Alternative retains the existing unsignalized control type for the Southbound Ramps intersection. Analysis years for the No-Build Alternative are Opening Year 2021 and Design Year 2031. Analyses were conducted for intersection operating conditions and queues.

#### 5.2.1 No-Build Opening Year 2021 Intersection Operations and Queue Analysis

The Opening Year 2021 intersection and queue analysis was performed for the intersections within the influence area. All intersections were analyzed with existing geometry and traffic control type, with the exception of SR-46 at North Carpenter Road, which was analyzed as plus signalized intersection. All signalized intersections were analyzed in coordination and with optimized signal timings. Turn lane storage is measured from the stop bar to the end of taper as shown in FDOT Design Manual Exhibit 212-1. Ramp turn lane storage is measured from the stop bar to the point where the ramp narrows to less than 24-ft wide.

The findings presented in Table 17 show that the southbound left-turn movement on the I-95 Southbound Off-Ramp at SR-46 intersection is anticipated to operate below the target LOS during the AM and PM peak hours. All other movements, approaches, and intersections are anticipated to operate at the target LOS. The northbound left-turn movement on the Northbound Off-Ramp exceeds the available storage during the AM and PM peak hours, however, the queues do not extend to the mainline. As indicated in the table, all other anticipated queues do not exceed existing storage during the AM and PM peak hours. The Synchro intersection and timing reports are included in Appendix G.

#### 5.2.2 No-Build Opening Year 2021 Ramps Capacity and Queue Analysis

An Opening Year 2021 queue analysis was performed for the intersection movements at the I-95 / SR-46 Southbound and Northbound Off-Ramps. The analysis identifies the highest of the maximum 95<sup>th</sup> percentile queues and determines the excess available length on the ramp. The queues were derived from Synchro's HCM 6<sup>th</sup> Edition Signalized Intersection Summary reports and Synchro's HCM 6<sup>th</sup> Edition TWSC Summary reports. The ramp lengths of the I-95 Southbound and Northbound Off-Ramps are approximately 1,625 feet and 1,825 feet, respectively. The total ramp lengths are measured as the distance from the stop bar to the painted nose of the gore. Storage for the turn lanes was measured from the stop bar to the point where the ramp narrows to less than 24-ft wide. Excess available ramp length is defined as the length of ramp available to provide for vehicle deceleration and to store additional queues before extending to the I-

95 mainline. As indicated in Table 18 and Table 19, all anticipated queues are not expected to extend to the I-95 mainline during the AM and PM peak hours.

**Table 17**  
**No-Build Opening Year 2021 Peak-Hour MOE's**  
**I-95 at SR-46 IOAR**

Intersection	Control Type	Movement	AM			PM			Storage Length (ft.) <sup>5</sup>	
			Delay (sec.)	LOS	95 <sup>th</sup> Percentile Queue (ft.)	Delay (sec.)	LOS	95 <sup>th</sup> Percentile Queue (ft.)		
SR-46 at North Carpenter Road	Sig. <sup>1</sup>	NBL	47.5	D	50	44.1	D	50	125	
		NBT/NBR	51.7	D	225	54.0	D	100	--	
		NB Approach	51.2	D	--	50.5	D	--	--	
		SBL	50.8	D	150	53.1	D	125	230	
		SBT/SBR	35.6	D	75	54.7	D	100	--	
		SB Approach	47.0	D	--	53.5	D	--	--	
		EBL	12.7	B	50	24.9	C	50	235	
		EBT/EBR	10.1	B	150	27.9	C	300	--	
		EB Approach	10.4	B	--	27.6	C	--	--	
		WBL	13.8	B	50	24.6	C	125	430	
		WBT	3.4	A	50	46.5	D	425	--	
		WBR	3.7	A	50	3.0	A	75	485	
WB Approach	5.2	A	--	34.7	C	--	--			
<b>Intersection</b>			<b>19.4</b>	<b>B</b>	--	<b>35.9</b>	<b>D</b>	--	--	
I-95 Southbound Ramps at SR-46	Unsig. <sup>1</sup>	SBL	41.0	E	50	57.4	F	50	100	
		SBR	13.7	B	50	24.0	C	75	130	
		SB Approach	19.3	C	--	31.7	D	--	--	
		EBT	Free-flow <sup>3</sup>						--	--
		EBR	Yield <sup>3</sup>						--	--
		EB Approach <sup>2</sup>	0.0	--	--	0.0	--	--	--	
		WBL	9.2	A	25	8.6	A	25	190	
		WBT	Free-flow <sup>3</sup>						200	
		WB Approach <sup>2</sup>	3.3	--	--	1.5	--	--	--	
		<b>Intersection</b>	<b>3.3</b>	--	--	<b>3.7</b>	--	--	--	--
I-95 Northbound Ramps at SR-46	Sig. <sup>1</sup>	NBL	45.9	D	350	44.6	D	500	105	
		NBR	Yield <sup>4</sup>						130	
		NB Approach	31.6	C	--	28.7	C	--	--	
		EBL	7.9	A	50	25.1	C	100	200	
		EBT	0.6	A	25	10.2	B	100	225	
		EB Approach	2.7	A	--	15.0	B	--	--	
		WBT	1.2	A	25	39.3	D	250	--	
		WBR	Yield <sup>4</sup>						--	
		WB Approach	1.1	A	--	36.2	D	--	--	
		<b>Intersection</b>	<b>12.1</b>	<b>B</b>	--	<b>28.2</b>	<b>C</b>	--	--	--
SR-46 at Holder Road / Pine Avenue	Sig. <sup>1</sup>	NBL/NBT/NBR	43.5	D	200	46.1	D	150	--	
		NB Approach	43.5	D	--	46.1	D	--	--	
		SBL/SBT/SBR	33.7	C	75	41.7	D	50	--	
		SB Approach	33.7	C	--	41.7	D	--	--	
		EBL	22.6	C	25	4.5	A	25	215	
		EBT/EBR	46.5	D	350	0.3	A	25	--	
		EB Approach	45.6	D	--	0.4	A	--	--	
		WBL	25.8	C	50	4.6	A	25	330	
		WBT/WBR	20.3	C	175	1.1	A	25	--	
		WB Approach	21.1	C	--	1.4	A	--	--	
<b>Intersection</b>	<b>36.3</b>	<b>D</b>	--	<b>6.9</b>	<b>A</b>	--	--	--		

Notes:

- 1) Signalized intersection results from Synchro HCM 6<sup>th</sup> Edition Signalized Report. Unsignalized intersection results from Synchro HCM 6<sup>th</sup> Edition TWSC Report.
- 2) HCM 6<sup>th</sup> Edition TWSC Report does not support LOS analysis for non-critical approaches and/or intersections.
- 3) HCM 6<sup>th</sup> Edition TWSC methodology does not support delay/LOS analysis for the intersection and for yield/free-flow conditions on the major street.
- 4) HCM 6<sup>th</sup> Edition Signalized methodology does not support delay/LOS analysis for yield conditions.
- 5) All storage lengths are existing except for lengths at SR-46 and North Carpenter Road. The lengths presented will be existing upon signalization of the intersection.
- 6) Dual left-turn lanes.

**Table 18**  
**No-Build Opening Year 2021 Southbound Off-Ramp 95<sup>th</sup> Percentile Queue Analysis**  
**I-95 at SR-45 IOAR**

	AM Peak-Hour		PM Peak-Hour	
	SB Left	SB Right	SB Left	SB Right
95 <sup>th</sup> Percentile Turn Lane Queues (ft.)	50	50	50	75
Existing Turn Lane Storage (ft.)	100	130	100	130
Additional Required Storage (ft.)	0	0	0	0
Maximum Potential 95 <sup>th</sup> Percentile Queue for Off-Ramp (ft.)	50		75	
Ramp Length (ft.)	1,625			
Excess Available Ramp Length (ft.)	1,575		1,550	

**Table 19**  
**No-Build Opening Year 2021 Northbound Off-Ramp 95<sup>th</sup> Percentile Queue Analysis**  
**I-95 at SR-45 IOAR**

	AM Peak-Hour		PM Peak-Hour	
	NB Left	NB Right	NB Left	NB Right
95 <sup>th</sup> Percentile Turn Lane Queues (ft.)	350	0	500	0
Existing Turn Lane Storage (ft.)	105	110	105	110
Additional Required Storage (ft.)	245	0	395	0
Maximum Potential 95 <sup>th</sup> Percentile Queue for Off-Ramp (ft.)	350		500	
Ramp Length (ft.)	1,825			
Excess Available Ramp Length (ft.)	1,475		1,325	

### 5.2.3 No-Build Design Year 2031 Intersection Operations and Queue Analysis

The Design Year 2031 intersection and queue analysis was performed for the intersections within the influence area. All intersections were analyzed with existing geometry and traffic control type, with the exception of SR-46 at North Carpenter Road, which was analyzed as plus signalized intersection. All signalized intersections were analyzed in coordination and with 2021 No-Build scenario signal timings. Turn lane storage is measured from the stop bar to the end of taper as shown in FDOT Design Manual Exhibit 212-1. Ramp turn lane storage is measured from the stop bar to the point where the ramp narrows to less than 24-ft wide.

As indicated in Table 20, on the I-95 Southbound Off-Ramp at SR-46 intersection, the southbound left-turn movement and southbound approach are anticipated to operate below the target LOS during the AM and PM peak hours. At the SR-46 and North Carpenter Road intersection, the eastbound and westbound approaches include movements that do not operate at the target LOS during the AM and PM peak hours; however, the overall intersection operates at the target LOS. All other movements, approaches, and intersections are anticipated to operate at the target LOS. The northbound left-turn movement on the Northbound Off-Ramp exceeds the available storage during the AM and PM peak hours, however, the queues do not extend to the mainline. As indicated in the table, all other anticipated queues do not exceed existing storage during the AM and PM peak hours. The Synchro intersection and timing reports are included in Appendix G.

### 5.2.4 No-Build Design Year 2031 Ramps Capacity and Queue Analysis

A Design Year 2031 queue analysis was performed for the intersection movements at the I-95 / SR-46 Southbound and Northbound Off-Ramps. The analysis identifies the highest of the maximum 95<sup>th</sup> percentile queues and determines the excess available length on the ramp. The queues were derived from Synchro's HCM 6<sup>th</sup> Edition Signalized Intersection Summary reports and Synchro's HCM 6<sup>th</sup> Edition TWSC Summary reports. The ramp lengths of the I-95 Southbound and Northbound Off-Ramps are approximately 1,625 feet and 1,825 feet, respectively. The total ramp lengths are measured as the distance from the stop bar to the painted nose of the gore. Storage for the turn lanes was measured from the stop bar to the point where the ramp narrows to less than 24-ft wide. Excess available ramp length is defined as the length of ramp available to provide for vehicle deceleration and to store additional queues before extending to the I-

95 mainline. As indicated in Table 21 and Table 22, all anticipated queues are not anticipated to extend to the I-95 mainline during the AM and PM peak hours.

**Table 20  
No-Build Design Year 2031 Peak-Hour MOE's  
I-95 at SR-46 IOAR**

Intersection	Control Type	Movement	AM			PM			Storage Length <sup>5</sup> (ft.)
			Delay (sec.)	LOS	95 <sup>th</sup> Percentile Queue (ft.)	Delay (sec.)	LOS	95 <sup>th</sup> Percentile Queue (ft.)	
SR-46 at North Carpenter Road	Sig. <sup>1</sup>	NBL	49.2	D	50	39.4	D	75	125
		NBT/NBR	53.7	D	250	53.4	D	200	--
		NB Approach	53.0	D	--	49.8	D	--	--
		SBL	50.8	D	150	53.1	D	150	230
		SBT/SBR	34.6	C	75	54.2	D	100	--
		SB Approach	46.7	D	--	53.4	D	--	--
		EBL	13.5	B	50	20.1	C	50	235
		EBT/EBR	26.6	C	300	30.2	C	350	--
		EB Approach	25.5	C	--	29.5	C	--	--
		WBL	22.3	C	100	28.4	C	125	430
		WBT	4.9	A	75	27.9	C	300	--
		WBR	4.5	A	50	2.3	A	50	485
		WB Approach	7.8	A	--	23.3	C	--	--
<b>Intersection</b>	<b>24.8</b>	<b>C</b>	<b>--</b>	<b>31.1</b>	<b>C</b>	<b>--</b>	<b>--</b>	<b>--</b>	
I-95 SB Ramps at SR-46	Unsig. <sup>1</sup>	SBL	122.6	F	100	103.5	F	100	100
		SBR	17.9	C	50	26.7	D	75	130
		SB Approach	43.1	E	--	47.2	E	--	--
		EBT	Free-flow <sup>3</sup>						--
		EBR	Yield <sup>4</sup>						--
		EB Approach <sup>2</sup>	0.0	--	--	0.0	--	--	--
		WBL	10.0	A	50	8.9	A	25	190
		WBT	Free-flow <sup>3</sup>						--
		WB Approach <sup>2</sup>	3.3	--	--	1.7	--	--	--
		<b>Intersection</b>	<b>5.6</b>	<b>--</b>	<b>--</b>	<b>5.2</b>	<b>--</b>	<b>--</b>	<b>--</b>
I-95 NB Ramps at SR-46	Sig. <sup>1</sup>	NBL	48.5	D	500	44.8	D	525	105
		NBR	Yield <sup>4</sup>						130
		NB Approach	31.3	C	--	27.7	C	--	--
		EBL	12.5	B	100	26.0	C	125	200
		EBT	1.1	A	25	9.6	A	100	225
		EB Approach	4.4	A	--	15.2	B	--	--
		WBT	7.7	A	75	39.1	D	250	--
		WBR	Yield <sup>4</sup>						--
		WB Approach	6.6	A	--	35.3	D	--	--
		<b>Intersection</b>	<b>15.8</b>	<b>B</b>	<b>--</b>	<b>27.3</b>	<b>C</b>	<b>--</b>	<b>--</b>
SR-46 at Holder Road/Pine Avenue	Sig. <sup>1</sup>	NBL/NBT/NBR	46.4	D	250	44.5	D	225	--
		NB Approach	46.4	D	--	44.5	D	--	--
		SBL/SBT/SBR	30.4	C	100	39.2	D	100	--
		SB Approach	30.4	C	--	39.2	D	--	--
		EBL	17.0	B	25	5.8	A	25	215
		EBT/EBR	38.8	D	350	0.6	A	25	--
		EB Approach	37.9	D	--	0.9	A	--	--
		WBL	23.7	C	75	6.0	A	25	330
		WBT/WBR	10.4	B	125	1.6	A	25	--
WB Approach	13.0	B	--	2.1	A	--	--		
<b>Intersection</b>	<b>30.3</b>	<b>C</b>	<b>--</b>	<b>8.8</b>	<b>A</b>	<b>--</b>	<b>--</b>		

- Notes:
- 1) Signalized intersection results from Synchro HCM 6<sup>th</sup> Edition Signalized Report. Unsignalized intersection results from Synchro HCM 6<sup>th</sup> Edition TWSC Report.
  - 2) HCM 6<sup>th</sup> Edition TWSC Report does not support LOS analysis for non-critical approaches and/or intersections.
  - 3) HCM 6<sup>th</sup> Edition TWSC methodology does not support delay/LOS analysis for the intersection and for yield/free-flow conditions on the major street.
  - 4) HCM 6<sup>th</sup> Edition Signalized methodology does not support delay/LOS analysis for yield conditions.
  - 5) All storage lengths are existing except for lengths at SR-46 and North Carpenter Road. The lengths presented will be existing upon signalization of the intersection.
  - 6) Dual left-turn lanes.

**Table 21**  
**No-Build Design Year 2031 Southbound Off-Ramp 95<sup>th</sup> Percentile Queue Analysis**  
**I-95 at SR-46 IOAR**

	AM Peak-Hour		PM Peak-Hour	
	SB Left	SB Right	SB Left	SB Right
95 <sup>th</sup> Percentile Turn Lane Queues (ft.)	100	50	100	75
Existing Turn Lane Storage (ft.)	100	130	100	130
Additional Required Storage (ft.)	0	0	0	0
Maximum Potential 95 <sup>th</sup> Percentile Queue for Off-Ramp (ft.)	100		100	
Ramp Length (ft.)	1,625			
Excess Available Ramp Length (ft.)	1,525		1,525	

**Table 22**  
**No-Build Design Year 2031 Northbound Off-Ramp 95<sup>th</sup> Percentile Queue Analysis**  
**I-95 at SR-46 IOAR**

	AM Peak-Hour		PM Peak-Hour	
	NB Left	NB Right	NB Left	NB Right
95 <sup>th</sup> Percentile Turn Lane Queues (ft.)	500	0	525	0
Existing Turn Lane Storage (ft.)	105	110	105	110
Additional Required Storage (ft.)	395	0	420	0
Maximum Potential 95 <sup>th</sup> Percentile Queue for Off-Ramp (ft.)	500		525	
Ramp Length (ft.)	1,825			
Excess Available Ramp Length (ft.)	1,325		1,300	

### 5.3 Build Operational Analysis

Future conditions within the influence area of the I-95 / SR-46 interchange were analyzed for the Build Alternative. The Build Alternative analysis incorporates the signalization of the Southbound Ramps intersection and signalization of the southbound right-turn movement at the Southbound Off-Ramp recommended in the previous TIA. Analysis years for the Build Alternative are Opening Year 2021 and Design Year 2031. Analyses were conducted for intersection operating conditions, and queues.

#### 5.3.1 Build Opening Year 2021 Intersection Operations and Queue Analysis

The Opening Year 2021 intersection and queue analysis was performed for the intersections within the influence area. All intersections were analyzed with existing geometry and traffic control type with the exception of SR-46 at North Carpenter Road, which was analyzed as plus signalized intersection, and the intersection of I-95 Southbound Ramps at SR-46 which was analyzed as signalized and incorporating signalization of the southbound right-turn movement recommended in the previous TIA. All intersections were analyzed in coordination and with 2021 No-Build scenario signal timings. Turn lane storage is measured from the stop bar to the end of taper as shown in FDOT Design Manual Exhibit 212-1. Ramp turn lane storage is measured from the stop bar to the point where the ramp narrows to less than 24-ft wide.

The findings presented in Table 23 show that the southbound left-turn movement on the I-95 Southbound Off-Ramp at SR-46 intersection is anticipated to operate at the target LOS during the AM and PM peak hours. All other movements, approaches, and intersections are anticipated to operate at the target LOS. The southbound right-turn movement on the Southbound Off-Ramp and the northbound left-turn movement on the Northbound Off-Ramp exceed the available storage during the AM and PM peak hours, however, the queues do not extend to the mainline. As indicated in the table, all other existing queues do not exceed existing storage during the AM and PM peak hours. The Synchro intersection and timing reports are included in Appendix G.

**Table 23**  
**Build 2021 Opening Year Peak-Hour MOE's**  
**I-95 at SR-46 IOAR**

Intersection	Control Type	Movement	AM			PM			Storage Length (ft.) <sup>3</sup>	
			Delay (sec.)	LOS	95 <sup>th</sup> Percentile Queue (ft.)	Delay (sec.)	LOS	95 <sup>th</sup> Percentile Queue (ft.)		
SR-46 at North Carpenter Road	Sig. <sup>1</sup>	NBL	47.5	D	50	44.1	D	50	125	
		NBT/NBR	51.7	D	225	54.0	D	100	--	
		NB Approach	51.2	D	--	50.5	D	--	--	
		SBL	50.8	D	150	53.1	D	125	230	
		SBT/SBR	35.6	D	75	54.7	D	100	--	
		SB Approach	47.0	D	--	53.5	D	--	--	
		EBL	12.7	B	50	24.9	C	50	235	
		EBT/EBR	10.1	B	150	27.9	C	300	--	
		EB Approach	10.4	B	--	27.6	C	--	--	
		WBL	13.8	B	50	24.6	C	125	430	
		WBT	3.4	A	50	46.5	D	425	--	
		WBR	3.7	A	50	3.0	A	75	485	
WB Approach	5.2	A	--	34.7	C	--	--			
<b>Intersection</b>		<b>19.4</b>	<b>B</b>	--	<b>35.9</b>	<b>D</b>	--	--		
I-95 Southbound Ramps at SR-46	Sig. <sup>1</sup>	SBL	39.2	D	50	40.8	D	50	100	
		SBR	52.6	D	200	52.3	D	175	130	
		SB Approach	49.8	D	--	49.7	D	--	--	
		EBT	0.2	A	25	0.2	A	25	--	
		EBR	Yield <sup>2</sup>							--
		EB Approach	0.1	A	--	0.1	A	--	--	
		WBL	5.3	A	75	7.5	A	75	190	
		WBT	0.1	A	25	2.5	A	50	200	
		WB Approach	2.0	A	--	3.4	A	--	--	
		<b>Intersection</b>	<b>6.1</b>	<b>A</b>	--	<b>6.4</b>	<b>A</b>	--	--	
I-95 Northbound Ramps at SR-46	Sig. <sup>1</sup>	NBL	45.9	D	350	44.6	D	500	105	
		NBR	Yield <sup>2</sup>							130
		NB Approach	31.6	C	--	28.7	C	--	--	
		EBL	7.9	A	50	25.1	C	100	200	
		EBT	0.6	A	25	10.2	B	100	225	
		EB Approach	2.7	A	--	15.0	B	--	--	
		WBT	1.2	A	25	39.3	D	250	--	
		WBR	Yield <sup>2</sup>							--
		WB Approach	1.1	A	--	36.2	D	--	--	
		<b>Intersection</b>	<b>12.1</b>	<b>B</b>	--	<b>28.2</b>	<b>C</b>	--	--	
SR-46 at Holder Road/Pine Avenue	Sig. <sup>1</sup>	NBL/NBT/NBR	43.5	D	200	46.1	D	150	--	
		NB Approach	43.5	D	--	46.1	D	--	--	
		SBL/SBT/SBR	33.7	C	75	41.7	D	50	--	
		SB Approach	33.7	C	--	41.7	D	--	--	
		EBL	22.6	C	25	4.5	A	25	--	
		EBT/EBR	46.5	D	350	0.3	A	25	--	
		EB Approach	45.6	D	--	0.4	A	--	215	
		WBL	25.8	C	50	4.6	A	25	--	
		WBT/WBR	20.3	C	175	1.1	A	25	--	
		WB Approach	21.1	C	--	1.4	A	--	330	
<b>Intersection</b>	<b>36.3</b>	<b>D</b>	--	<b>6.9</b>	<b>A</b>	--	--			

## Notes:

- 1) Signalized intersection results from Synchro HCM 6<sup>th</sup> Edition Signalized Report.
- 2) HCM 6<sup>th</sup> Edition Signalized methodology does not support delay/LOS analysis for yield conditions.
- 3) All storage lengths are existing except for lengths at SR-46 and North Carpenter Road. The lengths presented will be existing upon signalization of the intersection.
- 4) Dual left-turn lanes.
- 5) Signal timings were not optimized for 2021 Build PM for SR-46 at North Carpenter Road.

### 5.3.2 Build Opening Year 2021 Ramps Capacity and Queue Analysis

An Opening Year 2021 queue analysis was performed for the intersection movements at the I-95 / SR-46 Southbound and Northbound Off-Ramps. The analysis identifies the highest of the maximum 95th percentile queues and determines the excess available length on the ramp. The queues were derived from Synchro's HCM 6<sup>th</sup> Edition Signalized Intersection Summary reports. The ramp lengths of the I-95 Southbound and Northbound Off-Ramps are approximately 1,625 feet and 1,825 feet, respectively. The total ramp lengths are measured as the distance from the stop bar to the painted nose of the gore. Storage for the turn lanes was measured from the stop bar to the point where the ramp narrows to less than 24-ft wide. Excess available ramp length is defined as the length of ramp available to provide for vehicle deceleration and to store additional queues before extending to the I-95 mainline. As shown in Table 24 and Table 25, all anticipated queues are not anticipated to extend to the I-95 mainline during the AM and PM peak hours.

**Table 24**  
**Build Opening Year 2021 Southbound Off-Ramp 95<sup>th</sup> Percentile Queue Analysis**  
**I-95 at SR-46 IOAR**

	AM Peak-Hour		PM Peak-Hour	
	SB Left	SB Right	SB Left	SB Right
95 <sup>th</sup> Percentile Turn Lane Queues (ft.)	50	200	50	175
Existing Turn Lane Storage (ft.)	100	130	100	130
Additional Required Storage (ft.)	0	70	0	45
Maximum Potential 95 <sup>th</sup> Percentile Queue for Off-Ramp (ft.)	200		175	
Ramp Length (ft.)	1,625			
Excess Available Ramp Length (ft.)	1,425		1,450	

**Table 25**  
**Build Northbound Off-Ramp 95<sup>th</sup> Percentile Queue Analysis**  
**I-95 at SR-46 IOAR**

	AM Peak-Hour		PM Peak-Hour	
	NB Left	NB Right	NB Left	NB Right
95 <sup>th</sup> Percentile Turn Lane Queues (ft.)	350	0	500	0
Existing Turn Lane Storage (ft.)	105	110	105	110
Additional Required Storage (ft.)	245	0	395	0
Maximum Potential 95 <sup>th</sup> Percentile Queue for Off-Ramp (ft.)	350		500	
Ramp Length (ft.)	1,825			
Excess Available Ramp Length (ft.)	1,475		1,325	

### 5.3.3 Build Design Year 2031 Intersection Operations and Queue Analysis

The Design Year 2031 intersection and queue analysis was performed for the intersections within the influence area. All intersections were analyzed with existing geometry and traffic control type with the exception of SR-46 at North Carpenter Road, which was analyzed as plus signalized intersection, and the intersection of I-95 Southbound Ramps at SR-46 which was analyzed as signalized and incorporating signalization of the southbound right-turn movement recommended in the previous TIA. All intersections were analyzed in coordination and with 2021 No-Build scenario signal timings for the AM peak-hour analysis. The PM peak-hour analysis was conducted with optimized signal timings. Turn lane storage is measured from the stop bar to the end of taper as shown in FDOT Design Manual Exhibit 212-1. Ramp turn lane storage is measured from the stop bar to the point where the ramp narrows to less than 24-ft wide.

The findings presented in Table 26 show that the southbound left-turn movement on the I-95 Southbound Off-Ramp at SR-46 intersection is anticipated to operate at the target LOS during the AM and PM peak hours. All other movements, approaches, and intersections are anticipated to operate at the target LOS with the exception of the southbound right-turn movement, which shows an increase in anticipated delays during the AM peak-hour, however, this is anticipated due to the replacement of yield/free-flow conditions with signalized conditions. The southbound right-turn movement on the Southbound Off-Ramp and the northbound left-turn movement on the Northbound Off-Ramp exceed the available storage during the AM and PM peak hours, however, the queues do not extend to the mainline. As indicated in the table, all other existing queues do not exceed existing storage during the AM and PM peak hours. The Synchro intersection and timing reports are included in Appendix G.

Compared to 2021 Build Conditions, some movements show improvements in delays and/or LOS under 2031 Build Conditions. Under Build conditions, for both analysis years, the intersections have been coded to operate under coordination. The need for different cycle lengths results in the intersection with the shorter natural cycle length operating with a cycle longer than needed; thus, increasing delays at the intersection under 2021 Build Conditions. The Synchro intersection and timing reports are included in Appendix G.

**Table 26**  
**Build 2031 Design Year Peak-Hour MOE's**  
**I-95 at SR-46 IOAR**

Intersection	Control Type	Movement	AM			PM			Storage Length (ft.) <sup>3</sup>	
			Delay (sec.)	LOS	95 <sup>th</sup> Percentile Queue (ft.)	Delay (sec.)	LOS	95 <sup>th</sup> Percentile Queue (ft.)		
SR-46 at North Carpenter Road	Sig. <sup>1</sup>	NBL	49.2	D	50	39.4	D	75	125	
		NBT/NBR	53.7	D	250	53.4	D	200	--	
		NB Approach	53.0	D	--	49.8	D	--	--	
		SBL	50.8	D	150	53.1	D	125	230	
		SBT/SBR	34.6	C	75	54.2	D	100	--	
		SB Approach	46.7	D	--	53.4	D	--	--	
		EBL	13.5	B	50	20.1	C	50	235	
		EBT/EBR	26.6	C	300	30.2	C	325	--	
		EB Approach	25.5	C	--	29.5	C	--	--	
		WBL	22.3	C	100	28.4	C	125	430	
		WBT	4.9	A	75	27.9	C	300	--	
		WBR	4.5	A	50	2.3	A	50	485	
		WB Approach	7.8	A	--	23.3	C	--	--	
<b>Intersection</b>	<b>24.8</b>	<b>C</b>	<b>--</b>	<b>31.1</b>	<b>C</b>	<b>--</b>	<b>--</b>	<b>--</b>		
I-95 SB Ramps at SR-46	Sig. <sup>1</sup>	SBL	39.0	D	75	40.5	D	75	100	
		SBR	59.7	E	225	52.7	D	200	130	
		SB Approach	54.7	D	--	49.4	D	--	--	
		EBT	0.3	A	25	0.3	A	25	--	
		EBR	Yield <sup>2</sup>						--	--
		EB Approach	0.1	A	--	0.1	A	--	--	
		WBL	5.9	A	100	7.7	A	75	190	
		WBT	0.2	A	25	2.6	A	50	200	
		WB Approach	2.0	A	--	3.6	A	--	--	
		<b>Intersection</b>	<b>6.3</b>	<b>A</b>	<b>--</b>	<b>6.5</b>	<b>A</b>	<b>--</b>	<b>--</b>	<b>--</b>
I-95 NB Ramps at SR-46	Sig. <sup>1</sup>	NBL	48.5	D	500	44.8	D	525	105	
		NBR	Yield <sup>2</sup>						110	
		NB Approach	31.3	C	--	27.7	C	--	--	
		EBL	12.5	B	100	26.0	C	125	200	
		EBT	1.1	A	25	9.6	A	100	225	
		EB Approach	4.3	A	--	15.2	B	--	--	
		WBT	7.7	A	75	39.1	D	250	--	
		WBR	Yield <sup>2</sup>						--	
		WB Approach	6.6	A	--	35.3	D	--	--	
<b>Intersection</b>	<b>15.8</b>	<b>B</b>	<b>--</b>	<b>27.3</b>	<b>C</b>	<b>--</b>	<b>--</b>	<b>--</b>		
SR-46 at Holder Road/Pine Avenue	Sig. <sup>1</sup>	NBL/NBT/NBR	46.4	D	250	44.5	D	225	--	
		NB Approach	46.4	D	--	44.5	D	--	--	
		SBL/SBT/SBR	30.4	C	100	39.2	D	100	--	
		SB Approach	30.4	C	--	39.2	D	--	--	
		EBL	17.0	B	25	5.8	A	25	215	
		EBT/EBR	38.8	D	350	0.6	A	25	--	
		EB Approach	37.9	D	--	0.9	A	--	--	
		WBL	23.7	C	75	6.0	A	25	330	
		WBT/WBR	10.4	B	125	1.6	A	25	--	
		WB Approach	13.0	B	--	2.1	A	--	--	
<b>Intersection</b>	<b>30.3</b>	<b>C</b>	<b>--</b>	<b>8.8</b>	<b>A</b>	<b>--</b>	<b>--</b>	<b>--</b>		

Notes:

- 1) Signalized intersection results from Synchro HCM 6<sup>th</sup> Edition Signalized Report.
- 2) HCM 6<sup>th</sup> Edition Signalized methodology does not support delay/LOS analysis for yield conditions.
- 3) All storage lengths are existing except for lengths at SR-46 and North Carpenter Road. The lengths presented will be existing upon signalization of the intersection.
- 4) Dual left-turn lanes.



### 5.3.4 Build Design Year 2031 Ramps Capacity and Queue Analysis

A Design Year 2031 queue analysis was performed for the intersection movements at the I-95 / SR-46 Southbound and Northbound Off-Ramps. The analysis identifies the highest of the maximum 95<sup>th</sup> percentile queues and determines the excess available length on the ramp. The queues were derived from Synchro's HCM 6<sup>th</sup> Edition Signalized Intersection Summary reports. The ramp lengths of the I-95 Southbound and Northbound Off Ramps are approximately 1,625 feet and 1,825 feet, respectively. The total ramp lengths are measured as the distance from the stop bar to the painted nose of the gore. Storage for the turn lanes was measured from the stop bar to the point where the ramp narrows to less than 24-ft wide. Excess available ramp length is defined as the length of ramp available to provide for vehicle deceleration and to store additional queues before extending to the I-95 mainline. As indicated in Table 27 and Table 28, all anticipated queues are not anticipated to extend to the I-95 mainline during the AM and PM peak hours.

**Table 27**  
**Build Design Year 2031 Southbound Off-Ramp 95<sup>th</sup> Percentile Queue Analysis**  
**I-95 at SR-46 IOAR**

	AM Peak-Hour		PM Peak-Hour	
	SB Left	SB Right	SB Left	SB Right
95 <sup>th</sup> Percentile Turn Lane Queues (ft.)	75	225	75	200
Existing Turn Lane Storage (ft.)	100	130	100	130
Additional Required Storage (ft.)	0	95	0	70
Maximum Potential 95 <sup>th</sup> Percentile Queue for Off-Ramp (ft.)	225		200	
Ramp Length (ft.)	1,625			
Excess Available Ramp Length (ft.)	1,400		1,425	

**Table 28**  
**Build Design Year 2031 Northbound Off-Ramp 95<sup>th</sup> Percentile Queue Analysis**  
**I-95 at SR-46 IOAR**

	AM Peak-Hour		PM Peak-Hour	
	NB Left	NB Right	NB Left	NB Right
95 <sup>th</sup> Percentile Turn Lane Queues (ft.)	500	0	525	0
Existing Turn Lane Storage (ft.)	105	110	105	110
Additional Required Storage (ft.)	395	0	420	0
Maximum Potential 95 <sup>th</sup> Percentile Queue for Off-Ramp (ft.)	500		525	
Ramp Length (ft.)	1,825			
Excess Available Ramp Length (ft.)	1,325		1,300	

### 5.4 Operational Comparison

A comparison of anticipated delays and LOS of the No-Build and Build Alternatives for the southbound left-turn movement on the Southbound Off-Ramp was conducted. The HCM 6<sup>th</sup> methodology anticipates an improvement in delay and LOS for the southbound left-turn movement for the Build Alternative versus the No-Build Alternative. Table 29 summarizes the results for the No-Build and Build Alternatives under AM and PM peak hours for Opening Year 2021 and Design Year 2031. As indicated in the table, the delays and LOS for the southbound left-turn movement on the Southbound Off-Ramp are anticipated to improve under the Build Alternative.

**Table 29**  
**Southbound Left-Turn on Southbound Off-Ramp Future MOEs**  
**I-95 at SR-46 IOAR**

Alternative	Year	Target LOS	AM Peak-Hour		PM Peak-Hour	
			Delay (sec.)	LOS	Delay (sec.)	LOS
No-Build	2021	D	41.0	E	57.4	F
	2031		122.6	F	103.5	F
Build	2021		39.2	D	40.8	D
	2031		39.0	D	40.5	D

## 5.5 Future Ramp Capacity

A future existing ramp capacity analysis was conducted based on HCM 6<sup>th</sup> Edition methodology. All ramps are anticipated to have sufficient capacity in the 2021 Opening Year and 2031 Design Year as indicated in Table 30 and Table 31, respectively.

**Table 30  
2021 Ramp Capacity Analysis  
I-95 at SR-46 IOAR**

Ramp	Number of Lanes	Speed Limit (mph)	Ramp Capacity (pc/h) <sup>1</sup>	Peak Hour Demand Volume (vph) <sup>2</sup>		Peak Hour Demand Flow Rate (pc/h) <sup>3</sup>		V/C <sup>4</sup>		Ramp Capacity Sufficient
				AM	PM	AM	PM	AM	PM	
I-95 Southbound Off-Ramp	1	35	2,000	189	177	213	193	0.11	0.10	Yes
I-95 Southbound On-Ramp	1	35	2,000	751	564	824	607	0.41	0.30	Yes
I-95 Northbound Off-Ramp	1	35	2,000	450	778	504	842	0.25	0.42	Yes
I-95 Northbound On-Ramp	1	35	2,000	179	167	193	178	0.10	0.09	Yes

Notes:

- 1) Ramp Capacity based on HCM 6<sup>th</sup> Edition, Exhibit 14-12.
- 2) Truck Percentages used in the calculation are obtained from the existing TMCs. They are as follows:
  - a. I-95 Southbound Off-Ramp: AM: 14%, PM: 6%
  - b. I-95 Southbound On-Ramp: AM: 5%, PM: 3%
  - c. I-95 Northbound Off-Ramp: AM: 8%, PM: 3%
  - d. I-95 Northbound On-Ramp: AM: 5%, PM: 2%
- 3) Flow rate in pc/h is estimated based on HCM 6<sup>th</sup> Edition Equations 12-10, 12-25, and 14-1; and with a PHF of 0.95.
- 4) V/C determined by dividing Peak Hour Demand Flow Rate/Ramp Capacity.

**Table 31  
2031 Ramp Capacity Analysis  
I-95 at SR-46 IOAR**

Ramp	Number of Lanes	Speed Limit (mph)	Ramp Capacity (pc/h) <sup>1</sup>	Peak Hour Demand Volume (vph) <sup>2</sup>		Peak Hour Demand Flow Rate (pc/h) <sup>3</sup>		V/C <sup>4</sup>		Ramp Capacity Sufficient
				AM	PM	AM	PM	AM	PM	
I-95 Southbound Off-Ramp	1	35	2,000	212	202	237	219	0.12	0.11	Yes
I-95 Southbound On-Ramp	1	35	2,000	858	709	937	760	0.47	0.38	Yes
I-95 Northbound Off-Ramp	1	35	2,000	709	852	777	920	0.39	0.46	Yes
I-95 Northbound On-Ramp	1	35	2,000	227	208	243	221	0.12	0.11	Yes

Notes:

- 1) Ramp Capacity based on HCM 6<sup>th</sup> Edition, Exhibit 14-12.
- 2) Truck Percentages used in the calculation are obtained from the existing TMCs. They are as follows:
  - a. I-95 Southbound Off-Ramp: AM: 14%, PM: 6%
  - b. I-95 Southbound On-Ramp: AM: 5%, PM: 3%
  - c. I-95 Northbound Off-Ramp: AM: 8%, PM: 3%
  - d. I-95 Northbound On-Ramp: AM: 5%, PM: 2%
- 3) Flow rate in pc/h is estimated based on HCM 6<sup>th</sup> Edition Equations 12-10, 12-25, and 14-1; and with a PHF of 0.95.
- 4) V/C determined by dividing Peak Hour Demand Flow Rate/Ramp Capacity.

## 5.6 Future Safety Performance

The proposed Southbound Off-Ramp modification is recommended to provide better progression along SR-46 and to better accommodate the southbound right traffic entering the westbound SR-46 traffic stream.

Crash data from the past five (5) years previously discussed suggests that the I-95 Southbound Ramps have a lower crash rate than the districtwide average. A crash modification factor (CMF) corresponding to the installation of a new traffic signal on a two-lane urban road countermeasure applicable to all crash types and severities was identified and applied to the existing crash rates and crash frequencies. CMF's #322, #1459, and #7848 were obtained from the *Crash Modification Factors Clearinghouse* online database maintained by the U.S. department of Transportation Federal highway Administration (FHWA). The factors were compared based on were compared based on crash type, crash severity, area type, prior conditions, and star quality rating. CMF #1459 has a low quality rating; thus, it was disregarded. CMF #7848 was chosen due to having a higher quality rating than #322. The output sheet is included in Appendix E. As indicated in Table 32, installation of a new traffic signal is anticipated to reduce the number of crashes by 1.638 crashes/year.

**Table 32**  
**Anticipated Crash Reductions**  
**I-95 at SR-46 IOAR**

Intersection			Average AADT	CMF <sup>1</sup>
SR-46 at I-95 Southbound Ramps	Number of Crashes	21	16,000	0.61
	Crash Frequency (crashes/year) <sup>2</sup>	4.200		
	Proposed Crash Frequency (crashes/year) <sup>3</sup>	2.562		
	Reduction in Crashes (crashes/year) <sup>4</sup>	1.638		

Notes:

- 1) CMF ID: 7848.
- 2) Crash frequency = Total Number of Crashes/Years.
- 3) Proposed Crash Frequency = Crash Frequency\*CMF.
- 4) Reduction in Crashes = Crash Frequency – Proposed Crash Frequency.

## **6. CONCEPTUAL SIGNING**

No signing changes are proposed to the I-95 mainline. Appendix N includes the Conceptual Signing and Pavement Marking Plans for the proposed improvements.

## 7. FUNDING AND SCHEDULE

Traffic signal design for the Southbound Ramps intersection improvements is currently underway. The final design phase is expected to be completed by the third quarter of 2021. Construction and implementation of the signal is expected by the second quarter of 2022. The engineer's estimate for roadway improvements, the temporary and permanent signals at SR-46 and North Carpenter Road, and the signal at the I-95 Southbound Ramps is of \$1,800,000. The improvements are funded by the Love's Travel Plaza Development. Table 33 details the estimated costs, schedule, and the funding source for the roadway improvements.

**Table 33**  
**Project Costs, Schedule, and Funding Source**  
**I-95 at SR-46 IOAR**

<b>Location</b>	<b>Cost</b>	<b>Schedule</b>	<b>Funding Source</b>
Signalization of SR-46 North Carpenter Road	\$700,000	June 1, 2022	Developer
Signalization of SR-46 at I-95 Southbound Ramps	\$600,000	June 1, 2022	
SR-46 Widening	\$500,000	August 1, 2021	

## **8. ENVIRONMENTAL IMPACTS**

No right-of-way 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 would influence the outcome of the selection process in comparing the No-Build and Build Alternatives.

The No-Build Alternative will pose no environmental impacts at the interchange influence area as it is the existing configuration. The Build Alternative is not anticipated to pose environmental impacts because the improvement is within the existing intersection footprint. In addition, the Build Alternative is not expected to impact air quality, contamination sites, navigation, wetlands, floodplains, protected species, community centers/institutions (churches, schools, etc.), historical/archaeological sites, and noise sites.

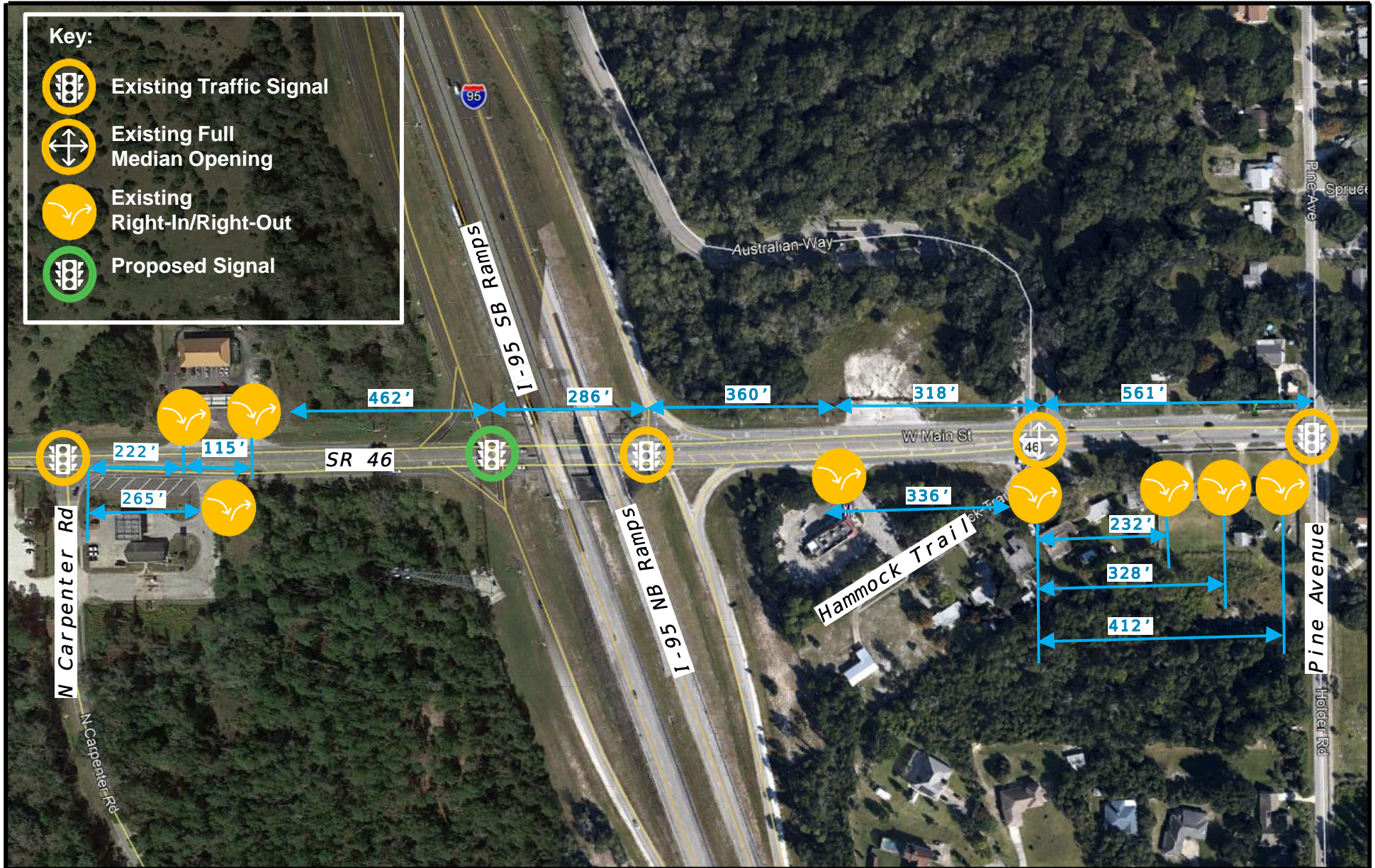
## **9. OTHER CONSIDERATIONS**

### **9.1 Design Exceptions**

Per the 90% plans, the project does not require design exceptions or variations.

### **9.2 Access Management**

Within the AOI, SR-46 is an Access Management Class 03 Roadway. This roadway classification is restrictive requiring spacing between full median opening to be 2,640 feet; directional openings to be 1,320 and connections to be 440 feet. Although the signal at N. Carpenter Road did not meet the spacing requirements, signalization was reviewed and approved by the Access Management Review Committee in January of 2020. The access management is identified in Figure 18.



<p><b>I-95 at SR-46 IOAR</b></p>		<p><b>Access Management</b></p>		
		<p>Project No.: 4607.10</p>	<p>Figure: 18</p>	



## 10. FEDERAL HIGHWAY ADMINISTRATION POLICY POINTS

The Federal Highway Administration (FHWA) regulates the addition or modification of access points to the Interstate System. Approval of an operational and safety analysis that has concluded that the proposed modifications will not have a significant adverse impact on the safety and operation of the Interstate facility or on the local street network is required. The new and revised access points shall meet FHWA's two policy point requirements discussed in this section.

### 10.1 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 crossroad) 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)).*

The operation needs being addressed by this IOAR can only be addressed by adding a signal to the I-95 Southbound Ramps intersection with SR-46. The ramp is operating below the target LOS and the southbound left-turn is experiencing high delays due to the existing stop control condition. Expected growth of traffic and proposed developments in the northwest quadrant of the interstate will increase the anticipated delay for the southbound left movement. The signalization will also remove the merge condition at the Southbound Off-Ramp. Improvements will alleviate the anticipated delays, provide better progression along SR-46, and better accommodate the southbound right traffic entering the westbound SR-46 traffic stream.

A detailed operational analysis for 2020 Existing Year, 2021 Opening Year, and 2031 Design Year was conducted in this IOAR to address this policy point. As indicated in Table 34, the future No-Build analyses show that delays and LOS at the Southbound Off-Ramp will continue to worsen without improvements; and the future Build analyses show anticipated improvements in delays and LOS at the Southbound Off-Ramp. Table 35 shows an increase in 95<sup>th</sup> percentile queue lengths, however, this is anticipated due to the replacement of yield/free-flow conditions with signalized conditions.

A crash modification factor (CMF) corresponding to the installation of a new traffic signal on a two-lane road (rural and suburban) countermeasure applicable to all crash types and severities was identified and applied to the existing crash rates and crash frequencies. Per results of the anticipated crash reductions analysis, installation of a new traffic signal is anticipated to reduce the number of crashes by 1.638 crashes/year.

**Table 34**  
**Operational Analysis Results**  
**I-95 at SR-46 IOAR**

Intersection	Movement/ Intersection	2020 Existing Year		2021 Opening Year				2031 Design Year			
		Delay (sec.) <sup>1</sup>	LOS <sup>1</sup>	No-Build		Build		No-Build		Build	
				Delay (sec.) <sup>1</sup>	LOS <sup>1</sup>	Delay (sec.) <sup>1</sup>	LOS <sup>1</sup>	Delay (sec.) <sup>1</sup>	LOS <sup>1</sup>	Delay (sec.) <sup>1</sup>	LOS <sup>1</sup>
<b>AM Peak-Hour</b>											
I-95 Southbound Ramps at SR-46	SBL	30.0	D	41.0	E	39.2	D	122.6	F	39.0	D
	Intersection <sup>2</sup>	2.9	--	3.3	--	6.1	A	5.6	--	6.3	A
<b>PM Peak-Hour</b>											
I-95 Southbound Ramps at SR-46	SBL	39.3	E	57.4	F	40.8	D	103.5	F	40.5	D
	Intersection <sup>2</sup>	2.6	--	3.7	--	6.4	A	5.2	--	6.5	A

Notes:

- 1) Signalized intersection results from Synchro HCM 6<sup>th</sup> Edition Signalized Report. Unsignalized intersection results from Synchro HCM 6<sup>th</sup> Edition TWSC Report.
- 2) HCM 6<sup>th</sup> Edition TWSC methodology does not support LOS analysis for the intersection.

**Table 35**  
**95<sup>th</sup> Percentile Queue Length**  
**I-95 at SR-46 IOAR**

Intersection	Existing Turn Lane Storage (ft.) <sup>1</sup>		Ramp Length (ft.) <sup>2</sup>	95 <sup>th</sup> Percentile Queue Length (ft.)				
	Southbound Left	Southbound Right		2020 Existing	2021 Opening Year		2031 Design Year	
					No-Build	Build	No-Build	Build
<b>AM Peak-Hour</b>								
I-95 Southbound Off-Ramps	100	130	1,625	25	50	200	100	225
<b>PM Peak-Hour</b>								
I-95 Southbound Off-Ramps	100	130	1,625	50	75	175	100	200

Notes:

- 3) Turn lane storage is measured from the stop bar to the point where the ramp narrows to less than 24-ft wide.
- 4) The total ramp lengths are measured as the distance from the stop bar to the painted nose of the gore.

## 10.2 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.*

Existing access points to/from I-95 will remain, no change is proposed and it connects to a public road. The proposed improvements do not have a negative impact on the mainline or ramp operations and meet FHWA policy points, purpose, and need.

## 11. CONCLUSIONS

This IOAR was conducted to analyze the proposed I-95 Southbound Off-Ramp modification at SR-46 located in Mims, Brevard County, Florida. The modification includes signalization of the existing southbound yield control right-turn onto westbound SR-46 and signalization of the I-95 Southbound Ramps / SR-46 intersection.

Based on the Build Opening Year 2021 and Design Year 2031 analyses conducted, the intersections included within the AOI are all anticipated to operate at the target LOS. Therefore, signalization of the I-95 Southbound Ramps intersection is recommended.

An analysis of crashes within the influence area indicates that the calculated crash rate of 3.321 MVMT on SR-46 west of I-95 is higher than the districtwide average for urban minor arterials with raised medians. An analysis of intersection crash rates at the study intersections indicates that the rates are lower than the statewide average for comparable facilities. Signalization of the I-95 Southbound Ramps is anticipated to reduce the number of crashes by 1.638 crashes/year. Although data doesn't indicate an existing safety concern at the Southbound Off-Ramp, the elimination of this merge condition is projected to better accommodate southbound right traffic entering the westbound traffic stream.

No right-of-way 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 would influence the outcome of the selection process in comparing the No-Build and Build Alternatives. Additionally, the Build Alternative is not expected to have any significant environmental impacts due to not increasing the interchange foot-print.

The funding for the Opening Year 2021 intersection signal design and construction will be through Love's Travel Plaza. The final design phase is expected to be completed by the first quarter of 2021 with construction completed by October 2021.

### 11.1 Recommendations

This IOAR recommends signalization of the I-95 Southbound Ramps intersection to mitigate existing LOS deficiencies due to delays, to provide better progression along SR-46, and to better accommodate the southbound right traffic entering the westbound SR-46 traffic stream. The proposed improvements do not have a negative impact on the mainline or ramp operations and meet FHWA policy points.

# Appendices