INTERCHANGE MODIFICATION REPORT

I-4 at SR 535

Orange County, Florida

Financial Project ID: 448914-1
Roadway ID: 75280000 (I-4), 75035000 (SR 535 interchange area),
75035001 (south of I-4 interchange area)

Prepared For:
FLORIDA DEPARTMENT OF TRANSPORTATION
DISTRICT FIVE

September 2022

Interchange Modification Report (IMR)

I-4 at SR 535 IMR

448914-1

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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SYSTEMS IMPLEMENTATION OFFICE

QUALITY CONTROL CERTIFICATION FOR INTERCHANGE ACCESS REQUEST SUBMITTAL

Submittal Date: 9/28/2022

FM Number: 448914-1

Project Title: I-4 at SR 535 Interchange Modification Report

District: Five

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Document Type: ☐ MLOU ☐ IJR ☒ IMR ☐ IOAR ☐ OTHER_____

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)

Final IMR Document

Quality Control (QC) Statement

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

Requestor DocuSigned by: Hatem Aguib EAD1C8A14E9A408... Date: 10/3/2022 | 2:30 PM EDT

Hatem Aguib, P.E.

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Melissa McKinney

CERTIFICATION

BY

KITTELSON & ASSOCIATES, INC.

Financial Project ID: 448914-1

Roadway ID: 75280000, 75035000, 75035001

I, Michael P. Eagle, Florida P.E. Number 86645, have prepared and reviewed the Project Traffic for the above referenced FLORIDA DEPARTMENT OF TRANSPORTATION project. I have specifically followed the "Project Traffic Forecasting Procedure" as adopted by the Florida Department of Transportation. Based on traffic count information, general data sources, and other pertinent information, the Project Traffic has been prepared using current traffic engineering, transportation planning, and Florida Department of Transportation practices and procedures.

Kittelson & Associates, Inc.
225 E. Robinson Street, Suite 355
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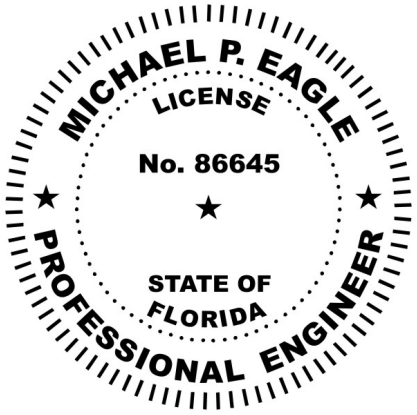
This item has been digitally signed and sealed by Michael P. Eagle, P.E., on October 3, 2022. Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.



Michael P. Eagle, P.E. #86645

Michael P Eagle

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1. EXECUTIVE SUMMARY

The Florida Department of Transportation (FDOT) District Five has prepared an Interchange Modification Report (IMR) for the proposed Phase I interchange improvements at the I-4 and SR 535 interchange, other arterial improvements, and a portion of the westbound express lane "Tube" (approximately 3 miles). The Phase I interchange improvements and westbound express Lane "Tube" are funded for construction in fiscal year 2023 (FM #448914-1 and G/W FM #449771-1). An ultimate interchange configuration for I-4 at SR 535 was identified as part of an evaluation; however, due to funding limitations and an increase in construction costs/materials, FDOT will be phasing the construction of the interchange improvements into two phases: Phase I and Phase II. At this time, it is not known when additional funding will become available to construct the Phase II interchange improvements; however, this is a top priority in the District. FDOT will coordinate with the appropriate agencies and will conduct the appropriate documentation for the Phase II improvements and plans to program Phase II within the next 10 years pending available funds. These improvements will be compatible with the overall improvements to I-4 as part of the I-4 Beyond the Ultimate (BtU) South project which was granted Safety, Operational & Engineering (SO&E) acceptability in May 2017 by the Federal Highway Administration (FHWA).

At this time, it is not known when additional funding will become available to expand the southern limits of the I-4 BtU project. The FDOT District 5 has initiated the evaluation of additional opportunities that maintain the purpose and need from the previously approved I-4 BtU PD&E Study as well as consider operational needs, construction costs, and constructability. Future projects in the I-4 BtU South Section will be evaluated as construction funding is identified.

The purpose of this IMR is to document the potential safety and operational impacts of the proposed interchange, typical section, and arterial modifications being proposed as part of the I-4 and SR 535 Phase I improvements. The findings of the operational and safety analysis and the FHWA Policy Point discussion are summarized as follows:

Purpose and Need

- The purpose of this project is to improve safety and improve traffic operations at the I-4 and SR 535 interchange. Improvements to the operation and safety of the SR 535 interchange area will better accommodate future population increases, improve mobility, and support economic growth.
- The westbound express lane "Tube" provides users of the westbound I-4 Ultimate express lanes desiring to make longer distance trips on I-4 the opportunity to avoid conflicts with local traffic on the general use lanes. The purpose of the "Tube" is to improve the safety and operations on the westbound general use lanes through the interchange areas (Sand Lake Road, SR 528, Central Florida Parkway, Daryl Carter Parkway, SR 535, SR 536, and Osceola Parkway) that are located adjacent to the "Tube" and to improve the safety and operations at the I-4 Ultimate express lane termination point. The "Tube" will allow the longer distance trips

on I-4 utilizing the westbound express lanes to bypass existing congestion on the I-4 general use lanes. The improvements to the operation and safety of I-4 will improve mobility and support economic growth.

Future Traffic Operations

- The microsimulation (VISSIM) analysis shows that the Build scenario provides improved operations to the No-Build scenario along I-4 during each of the future year AM and PM peak hours. The analysis confirmed that capacity improvements, such as those identified in the I-4 BtU South Section SAMR and PD&E Study, are needed along I-4 and will be evaluated as funding becomes available.
- The travel time along westbound I-4 is expected to be reduced with the westbound express lane "Tube" as part of the Build scenario. The I-4 westbound express lane "Tube" is expected to provide travel time benefits ranging between approximately 1 and 31 percent within the AOI during the future year peak hours.
- The Build scenario is not expected to create spillback from the SR 535 at I-4 westbound ramp terminal intersection onto the mainline I-4 westbound lanes or encroach into the section of the off-ramp designated for deceleration during either Design Year (2045) peak hour.
- The Build scenario VISSIM results show improvements over the No-Build scenario at each of the study intersections along SR 535 including the interchange area and the adjacent intersections during the Design Year (2045) peak hours. These improvements mitigate queue spillback between the signalized intersections along SR 535, improve travel time along SR 535 by 6 to 20 percent, and reduce the maximum queue length along the I-4 westbound off-ramp.
- Performance metrics such as average delay, average speed, total delay, latent demand, latent delay, and vehicles arrived are better in the Build when compared to the No-Build for each analysis year analyzed.

Future Safety Performance

- The Build condition is anticipated to improve safety along the I-4 westbound mainline when compared to the No-Build condition from a qualitative perspective. The "Tube" express lane will reduce traffic volume along the I-4 westbound mainline in the study area, which should improve safety and reduce potential sideswipe crashes. The reduced traffic should lead to a reduction in congestion, and thus a reduction in congestion related rear end crashes.
- Because the northbound left-turn movement from SR 535 to I-4 westbound is being removed at the westbound ramp terminal, there are 3 less crossing conflicts which should lead to less severe crashes for the proposed Phase I configuration.
- The removal of the northbound left-turn movement from SR 535 to I-4 westbound also mitigates the potential of rear end/sideswipe crashes caused by queue spillback out of the turn lane for this movement (congestion observed in the microsimulation analysis).
- The lengthening of the I-4 westbound off-ramp to SR 535 will provide more queue storage thus reducing the potential for congestion/queueing on the I-4 westbound mainline. Reducing the

congestion/queueing should reduce the potential for high speed/severity rear end crashes on the I-4 mainline.

FHWA Policy Points

The proposed improvements satisfy FHWA's Two Policy Point Requirements included in the May 22, 2017 update to "Policy on Access to the Interstate System".

- 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)).
    - Policy Point 1: The safety and operational analyses conducted as part of this IMR have concluded that the proposed interchange improvements and express lane "Tube" improvements do not have a significant adverse impact on the safety and operations of I-4 through the study area.
        - The proposed improvements improve the operations along SR 535 and the Phase I improvements are not expected to create spillback onto the mainline I-4 westbound lanes or encroach into the section of the off-ramp designated for deceleration during either peak hour in the future analysis years based on the microsimulation analysis conducted.
        - The proposed improvements improve the operations along I-4 with the travel time along westbound I-4 expected to be reduced with the westbound express lane "Tube" as part of the Build scenario.
        - The proposed improvements are predicted to result in fewer crashes along the I-4 mainline and reduce the potential for high speed/severity rear end crashes on the I-4 mainline due to the lengthening of the I-4 westbound off-ramp.
    - As described in the Future Traffic Operations and Future Safety Performance sections, the proposed improvements improve the ability of I-4, the I-4 westbound off-ramp to

SR 535, the I-4 westbound ramp terminal intersection with SR 535, and key local facilities to safely and efficiently collect, distribute, and accommodate traffic.

  - As noted in the Future Traffic Operations section, "The analysis confirmed that capacity improvements, such as those identified in the I-4 BtU South Section SAMR and PD&E Study, are needed along I-4 and will be evaluated as funding becomes available." At this time, the FDOT is using a phased approach to implement improvement projects as construction funding is identified.

- 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.
  - Policy Point 2: The proposed improvements will maintain full access between I-4 and SR 535. All traffic movements are being provided.

The interchange improvements evaluated as part of the Build scenario fulfill the project's purpose and need and satisfy the FHWA Policy Points.

2. GENERAL PROJECT INFORMATION

2.1. **Introduction**

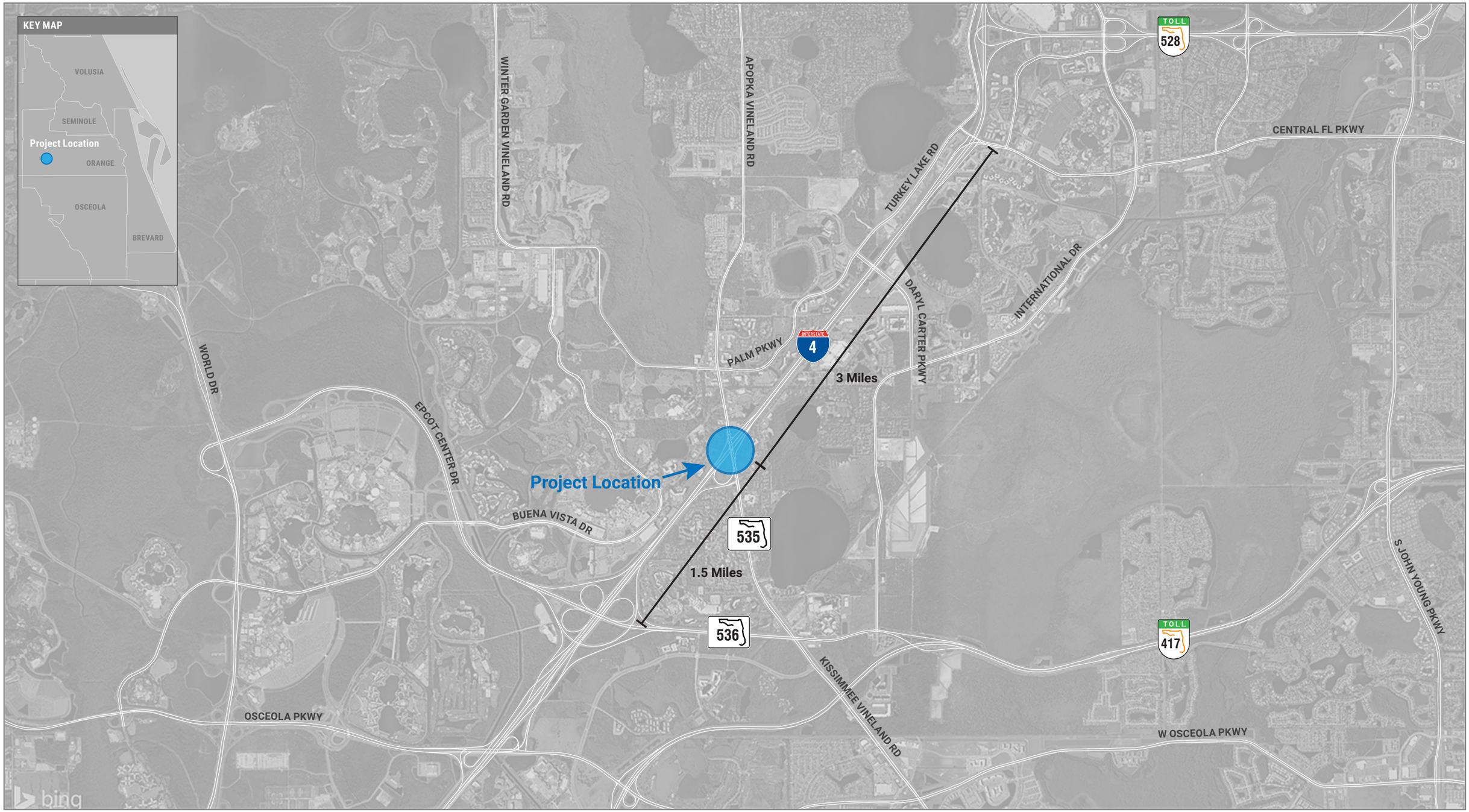
The Interstate 4 (I-4) at SR 535 interchange is an existing partial cloverleaf (par-clo) interchange that includes five ramps connecting to/from the interstate. The movement from SR 535 to eastbound I-4 is served via two separate ramps. The southbound SR 535 to eastbound I-4 movement is served via a two-lane loop ramp and the northbound SR 535 to eastbound I-4 movement is served via a separate free-flow ramp.

The Florida Department of Transportation (FDOT) District 5 has evaluated ultimate interchange configurations at the I-4 at SR 535 interchange to consider operational needs, construction costs, and constructability with the overall I-4 Beyond the Ultimate (BtU) project. An ultimate interchange configuration was identified; however, due to funding limitations and an increase in construction costs/materials, FDOT will be phasing the construction of the interchange improvements into two phases: Phase I and Phase II. At this time, it is not known when additional funding will become available to construct the Phase II interchange improvements; however, this is a top priority in the District. FDOT will coordinate with the appropriate agencies and will conduct the appropriate documentation for the Phase II improvements and plans to program Phase II within the next 10 years pending available funds.

The I-4 BtU South Section Systems Access Modification Report (SAMR) received a determination of Engineering and Operational Acceptability on May 9, 2017 from the Federal Highway Administration (FHWA). The first projects to be constructed in the I-4 BtU South Section are the interim I-4/Daryl Carter Parkway interchange (FM# 441113-1) and the I-4/Sand Lake Road interchange modification (FM# 444315-1).

At this time, it is not known when additional funding will become available to expand the southern limits of the I-4 BtU project. FDOT District 5 has initiated the evaluation of additional opportunities that maintain the purpose and need from the previously approved I-4 BtU Project Development and Environment (PD&E) Study as well as consider operational needs, construction costs, and constructability. These opportunities include reviewing the elements in the previously approved concept such as typical section, managed lane separation type, and use of the rail corridor.

Consistent with the intent of the commitment made in the 2017 SAMR, traffic will be evaluated for projects where funding for construction is identified. The approach of evaluating the project that is funded for construction is in response to previous direction given by FHWA. A Methodology Letter of Understanding (MLOU) was prepared and approved in November 2021, prior to the initiation of this study and is included in **Appendix A**. The project is located in Orange County, Florida. **Figure 1** shows the project location. The FDOT Roadway Identification number for I-4 in the study area is 75280000. SR 535 has two FDOT Roadway Identification numbers within the study area: 75035000 (within the interchange area) and 75035001 (south of the I-4 interchange).



Scale in Feet
0 4,000 North

I-4 at SR 535 Interchange Modification Report

FIGURE 1 | **Project Location**

The purpose of the interchange access request (IAR) is to document the potential safety and operational impacts of the proposed interchange and arterial modifications being proposed as part of Phase I of the I-4 and SR 535 interchange modification project. It is expected that a separate IAR will be prepared to document the potential safety and operational impacts of the Phase II interchange improvements when funding is identified.

2.2. Purpose and Need Statement

The purpose of this project is to improve safety and improve traffic operations at the I-4 and SR 535 interchange. Improvements to the operation and safety of the SR 535 interchange area will better accommodate future population increases, improve mobility, and support economic growth.

The need for the project is shown by the projections of future population and employment in the region indicating that travel demand will continue to increase well into the future. The ability to accommodate the new travel patterns resulting from growth must be provided to sustain the region's economy. Without the improvements, extremely congested conditions are expected to occur for extended periods of time in both the morning and evening peak periods. This congestion is expected to occur along SR 535 and impact the operations at the ramp terminal intersections with I-4. Queue spillback onto the mainline I-4 is expected to occur in the future without improvements at the interchange and the arterial.

Due to these congested conditions, user travel times will continue to increase, the movement of goods through the urban area will be slower, and the deliveries of goods within the urban area will be forced to other times throughout the day. The need for improvements is illustrated by the important transportation role I-4 serves to the Central Florida region and the State of Florida.

2.3. Analysis Years

Traffic operations were analyzed for the existing year (2019) and the following future years:

- Opening Year – 2025
- Interim Year – 2035 (analyzed to understand when Phase II improvements may be needed)
- Design Year – 2045

2.4. Area of Influence

The area of influence of the study interchange is illustrated in **Figure 2**. The following key facilities were evaluated:

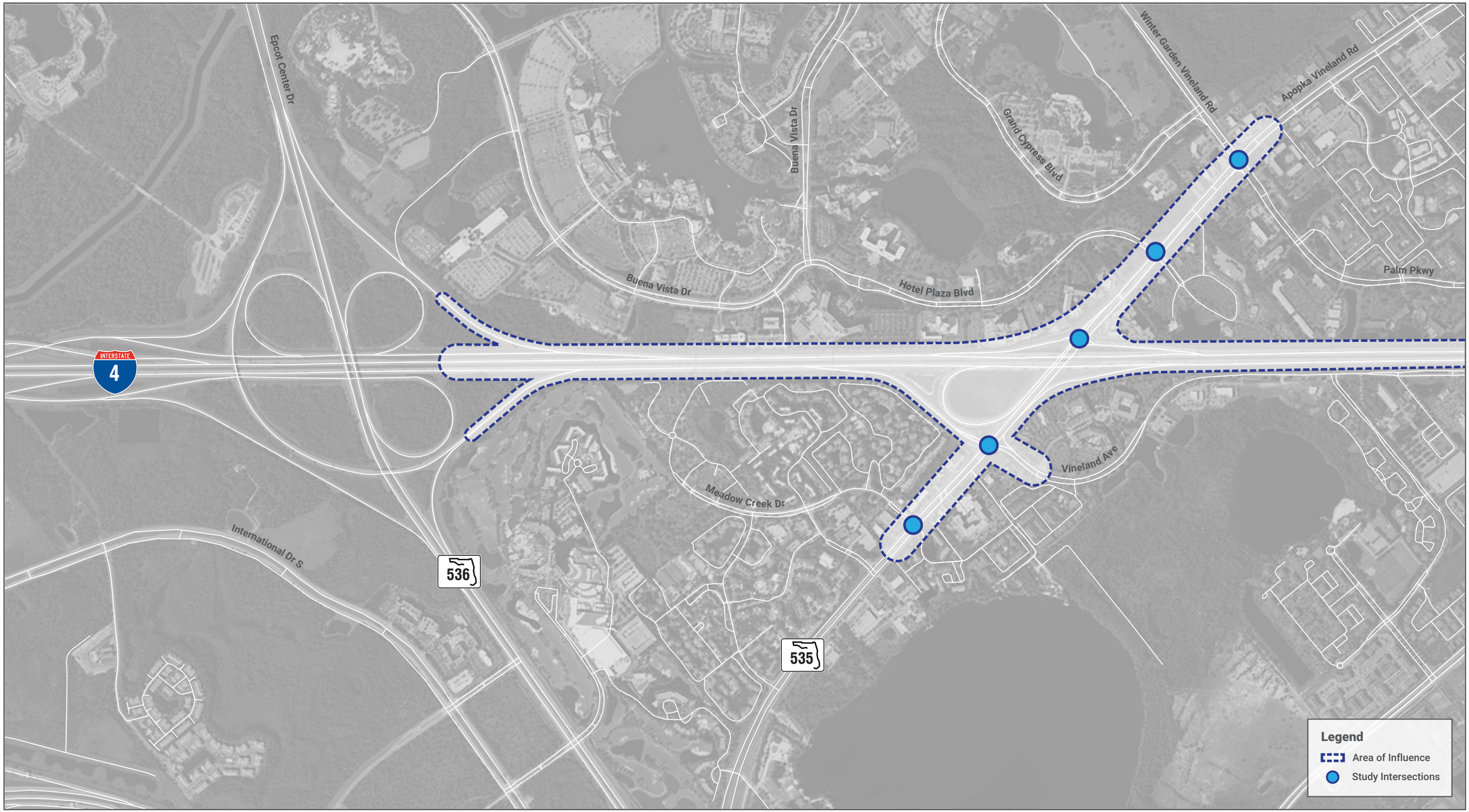
Along I-4 – The study ramps and freeway segments within the AOI are as follows:

- I-4 EB on-ramp from SR 536
- I-4 WB off-ramp to SR 536
- I-4 between SR 536 and SR 535
- I-4 EB off-ramp to SR 535
- I-4 WB on-ramp from SR 535
- I-4 EB on-ramp from SB SR 535
- I-4 EB on-ramp from NB SR 535
- I-4 WB off-ramp to SR 535
- I-4 between SR 535 and Daryl Carter Parkway (future only)
- I-4 EB off-ramp to Daryl Carter Parkway (future only)
- I-4 WB off-ramp to Daryl Carter Parkway (future only)
- I-4 EB on-ramp from Daryl Carter Parkway (future only)
- I-4 EB between Daryl Carter Parkway and Central Florida Parkway (future only)
- I-4 EB off-ramp to Central Florida Parkway
- I-4 WB on-ramp from Central Florida Parkway

Along cross streets – The study signalized intersections within the AOI are as follows:

- SR 535 at Meadow Creek Drive
- SR 535 at I-4 EB off-ramp/Vineland Avenue
- SR 535 at I-4 WB ramps
- SR 535 at Hotel Plaza Boulevard
- SR 535 at Palm Parkway
- Daryl Carter Parkway at Palm Parkway
- Daryl Carter Parkway at I-4 WB off-ramp (future only)
- Daryl Carter Parkway at I-4 EB ramps (future only)
- Daryl Carter Parkway at Regency Village Drive (unsignalized in the existing year, but has since been signalized)

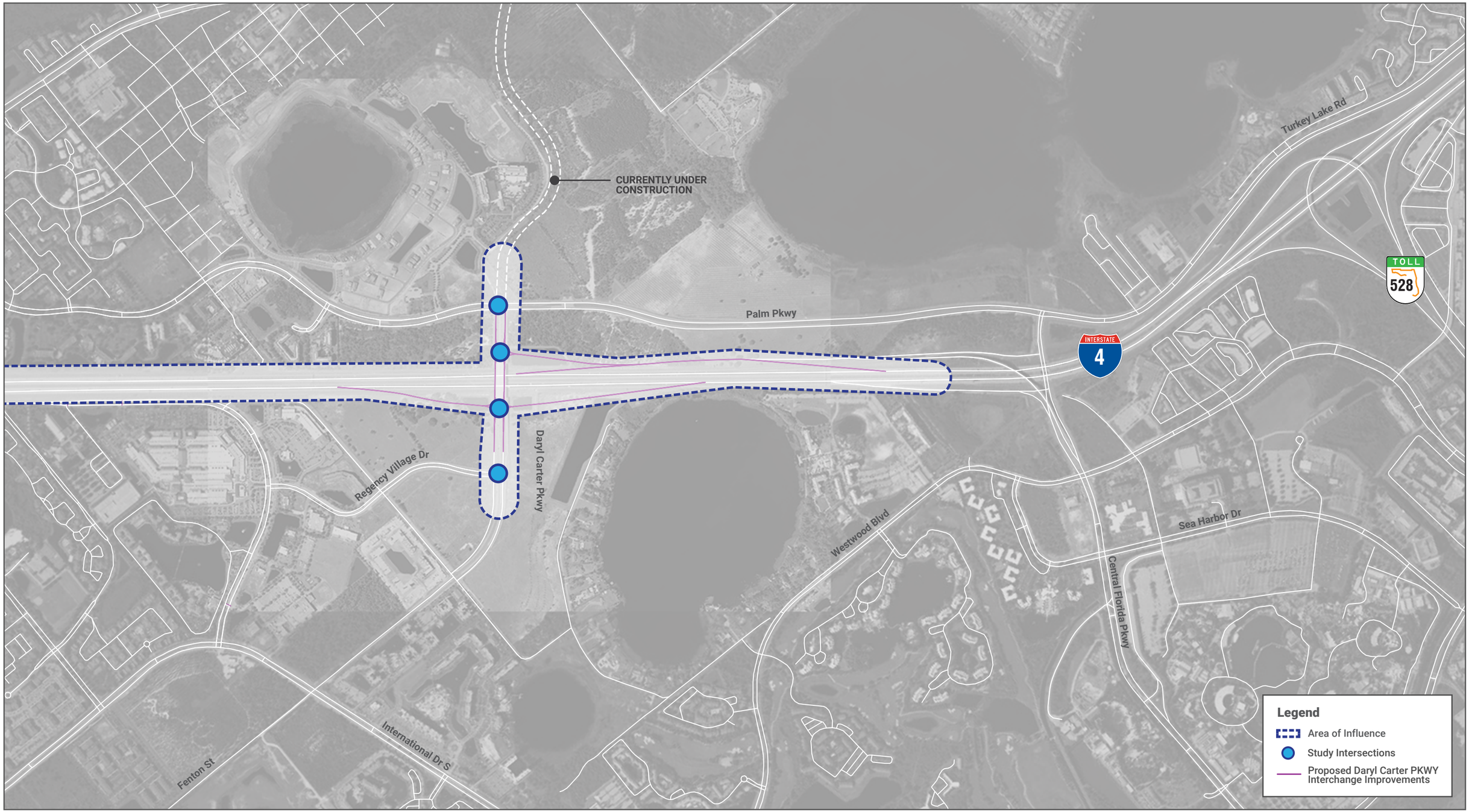
The interim Daryl Carter Parkway interchange is a ¾ DDI without an on-ramp to westbound I-4. Therefore, the adjacent ramp to the SR 535 interchange is the Central Florida Parkway on-ramp which utilizes a C-D road with Daryl Carter Parkway. The entire SR 536 interchange is not assumed in the AOI because its inclusion would also result in the inclusion of the Osceola Parkway ramps to/from the east since these ramps braid with the SR 536 ramps to/from the west.



Scale in Feet
0 1,200 North

FDOT **I-4 at SR 535 Interchange Modification Report**

FIGURE 2 | **Area of Influence**



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I-4 at SR 535 Interchange Modification Report

FIGURE 2 | **Area of Influence**

(2 of 2)

2.5. Level of Service (LOS) Targets

The Level of Service performance targets for each roadway classification, including the ramp terminal intersections and the crossroad beyond the interchange ramp terminal intersections are identified below, consistent with the approved MLOU.

- I-4 Mainline and Ramps: LOS D
- State Arterial Facilities: LOS D
- County Arterial Facilities: LOS E

2.6. Funding Plan and Schedule

Funding for this project is included in the FDOT Five Year Work Program (FM# 448914-1 and G/W FM# 449771-1). The following is the anticipated funding plan and schedule for this project.

- Design – Concept Design underway for Design-Build procurement – initiated Nov. 2021
- ROW – ROW certification for Design-Build due June 2022
- RFP Package – October 2022
- Construction Letting – June 2023

3. DATA COLLECTION

3.1. **Traffic Data**

Multiple data sources were used to obtain the existing traffic volumes for the study area. Traffic counts were obtained for the I-4 mainline, I-4 ramps, and the cross streets from the FDOT Florida Traffic Online database. The use of 2019 data for the existing year was included and approved in the MLOU. Traffic counts were collected in the field during September 2019, prior to the COVID-19 pandemic. This data set represents a consistent set of data without the impacts of COVID-19 or holidays and during the school year. It is worth noting that the traffic volume for one of the study intersections (Meadow Creek) was obtained in April 2016. The data at this intersection was reviewed in comparison to the 2019 data for reasonableness. The data collection locations are illustrated in **Figure 3**. The raw data from the data collection efforts are included in **Appendix B**. The following summarizes the counts collected and used as part of this IMR:

- 8-hour Intersection Turning Movement Counts (6:00 – 10:00 AM and 3:00 – 7:00 PM) – September 2019
    - SR 535 at I-4 EB off-ramp/Vineland Avenue
    - SR 535 at I-4 WB ramps
    - SR 535 at Hotel Plaza Boulevard
    - SR 535 at Palm Parkway
    - Daryl Carter Parkway at Palm Parkway
    - Daryl Carter Parkway Regency Village Drive
- 4-hour Intersection Turning Movement Counts (7:00 – 9:00 AM and 4:00 – 6:00 PM) – April 2016
    - SR 535 at Meadow Creek Drive
- 48-hour Volume Counts – September 2019
    - SR 535 south of Vineland Avenue
    - Vineland Avenue east of SR 535
    - I-4 EB off-ramp to SR 535 (FDOT Site 752006)
    - I-4 EB on-ramp from SB SR 535 (FDOT Site 752009)
    - I-4 EB on-ramp from NB SR 535 (FDOT Site 752007)
    - I-4 WB on-ramp from SR 535 (FDOT Site 752010)
    - I-4 WB off-ramp to SR 535 (FDOT Site 752008)
    - SR 535 between I-4 and Hotel Plaza Boulevard (FDOT Site 750581)
    - SR 535 between Hotel Plaza Boulevard and Palm Parkway
    - Winter Garden Vineland Road west of SR 535
    - Palm Parkway east of SR 535
    - Apopka Vineland Road north of Palm Parkway
    - Palm Parkway south of Daryl Carter Parkway
    - Daryl Carter Parkway east of Palm Parkway
    - Palm Parkway north of Daryl Carter Parkway

Scale in Feet
0 1,200 North

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I-4 at SR 535 Interchange Modification Report

FIGURE 3 | **Data Collection Locations**

Scale in Feet
0 1,200 North

FDOT

I-4 at SR 535 Interchange Modification Report

FIGURE 3 | **Data Collection Locations**

(2 of 2)

3.2. Signal Timing Data

Signal timing data including time of day schedules, coordination splits, controller settings, and phasing sequences was requested from Orange County for each of the signalized intersections in the study area. The signals within the AOI along SR 535 run under adaptive signal control. The actual adaptive timings including splits and pedestrian actuations were provided by FDOT for the day of turning movement count data collection (September 24, 2019). The adaptive timings were reviewed and summarized with the average splits/cycle lengths of the peak hours for use in the microsimulation analysis. The summarized splits and pedestrian actuations are included in **Appendix C** along with the timing sheets provided by Orange County. The timings sheets were referenced for the controller settings such as yellow clearance, red clearance, pedestrian walk times, pedestrian clearance intervals, etc.

3.3. Planned and Programmed Projects

The FDOT Five Year Work Program, Metroplan Orlando Transportation Improvement Program (TIP), and Metroplan Orlando Metropolitan Transportation Plan (MTP) 2045 were reviewed to identify planned and programmed projects along I-4 and the study facilities in the vicinity of the study location.

3.3.1. Planned Projects

- Hotel Plaza Boulevard from Buena Vista Dr to SR 535, (MTP ID B35 – Unfunded Need) – Operational/Safety
- Daryl Carter Parkway from International Drive to Palm Parkway (MTP ID B36 – Unfunded Need) – ITS/Technology
- Daryl Carter Parkway from Regency Village Drive to International Drive (MTP ID 7008 – Unfunded Need) – Operational/Safety
- Daryl Carter Parkway from Palm Parkway to Regency Village Drive (MTP ID 7012 – Unfunded Need) – Operational/Safety

3.3.2. Programmed Projects

- Apopka-Vineland Road/SR 535-North of Lake Bryan Beach Boulevard to Vineland Avenue, (FM #439237-1) – Resurfacing
    - Preliminary Engineering – FY 2021
    - Highways/Construction – FY 2021
- Vineland Avenue at SR 535, (FM #435554-1) – Intersection improvements, addition of westbound right-turn lane.
    - Preliminary Engineering – FY 2021
    - Highways/Construction – FY 2021
- Vineland Avenue from East of SR 535 to East of Little Lake Bryan Road, (TIP #75103) – Widen to 4 lanes (Metroplan Orlando Transportation Improvement Plan)
    - Private Funding – FY 21-25
- I-4 (SR 400) at Daryl Carter Parkway Interchange, (FM #441131-1)

  - Design-Bid-Build Advertisement: May 2022
  - Construction Letting: June 2022
  - Construction: FY 2022
- I-4 (SR 400) at Sand Lake Road Interchange, (FM #44315-1)
  - Design-Build Advertisement: October 2021
  - Final Selection: FY 23
- I-4 Westbound Express Lane “Tube”, (G/W FM #44315-3 and FM #441113-3)

4. EXISTING CONDITIONS

The following section summarizes the existing roadway characteristics, existing traffic characteristics, existing operational analysis results, and the historical safety analysis.

4.1. **Existing Roadway Characteristics**

Roadway segment characteristics, including road names, area type, roadway type, FDOT access classification, number of lanes, and posted speed limit were reviewed using Straight Line Diagrams (SLDs), aerial photography, and the FDOT Open Data Hub. **Table 1** summarizes existing characteristics for the roadways in the study area. The Straight-Line Diagrams are provided in **Appendix D**.

SR 535 is a six-lane urban minor arterial with a grass median that ranges from 10-14 feet. The I-4 interchange is a partial clover leaf. The movement from SR 535 to eastbound I-4 is served via two separate ramps. The southbound SR 535 to eastbound I-4 movement is served via a two-lane loop ramp and the northbound SR 535 to eastbound I-4 movement is served via a separate free-flow ramp. Each of the ramp terminal intersections are signalized. The segment has a posted speed of 45 mph from the southern portion of the segment and transitions to 40 mph at the SR 535 at Vineland intersection.

Daryl Carter Parkway is a four-lane divided urban major collector. The roadway is divided by a grass median that transitions into a concrete median strip. The posted speed is 40 mph along the corridor. The corridor has bicycle lanes.

The existing lane configurations along the I-4 mainline, at the gore points for each on-ramp and off-ramp, and at each of the study intersections are illustrated in **Figure 4**.

Table 1: Existing Roadway Characteristics

Roadway Segment			
Characteristics	**I-4**	**SR 535**	**Daryl Carter Parkway**
FDOT Roadway ID	75280000	75035000/75035001	N/A
Location (Milepost)	1.382 – 5.438	0.000 – 0.159/1.903 – 2.298	N/A
Functional Classification	Urban Principal Arterial - Interstate	Urban Minor Arterial	Urban Major Collector
SIS Designation	SIS	Non-SIS	Non-SIS
Speed Limit	60 mph	40/45 mph	40 mph
Lane Width	12 ft	12 ft	12 ft
Shoulder width	12 ft	None	4 ft paved outside shoulder
Median	64 ft vegetation median	10-14 ft vegetation median	50 ft vegetation median/4ft concrete strip median
FDOT Access Classification	1	1*/3	N/A
Curb and Gutter	None	Yes	Yes
Sidewalks	None	Yes (on east side of roadway)	Yes
Bike Lanes	None	None	Yes
Street Lighting	Present	Present	Present
Surrounding Land Uses	Commercial	Commercial/Residential	Commercial

* Only a small portion of 7503500 (within the interchange ramps) is Access Class 1 (Limited Access)

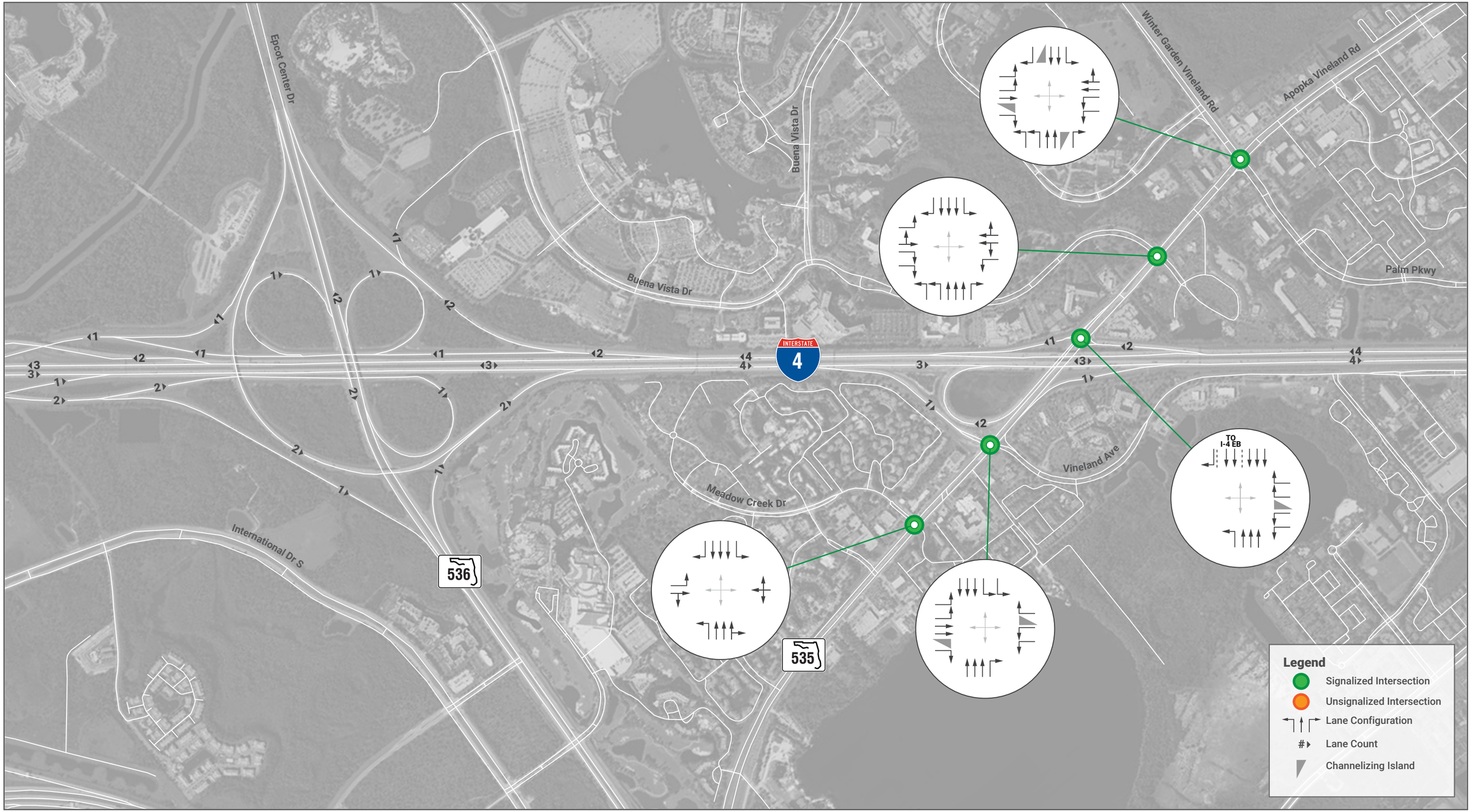
4.2. Existing Traffic Characteristics

The following section summarizes the existing traffic characteristics including the estimation of system peak hours and existing traffic volumes/adjustments.

4.2.1. Existing System Peak Hours

The field collected data was reviewed to determine a system peak hour for the purposes of balancing counts and evaluating a consistent peak hour for the operational analyses (intersection, freeway, and microsimulation). The total entering intersection volume for each intersection was summed for the entire study area for each 15-minute bin collected. The 15-minute bins were summed together to determine the max total network hourly volume for each period collected. The resulting system peak hours are as follows and are summarized in **Table 2**.

- AM Peak Hour: 7:45 AM – 8:45 AM
- PM Peak Hour: 4:45 PM – 5:45 PM



FDOT

I-4 at SR 535 Interchange Modification Report

FIGURE 4 | **Existing Lane Configurations**

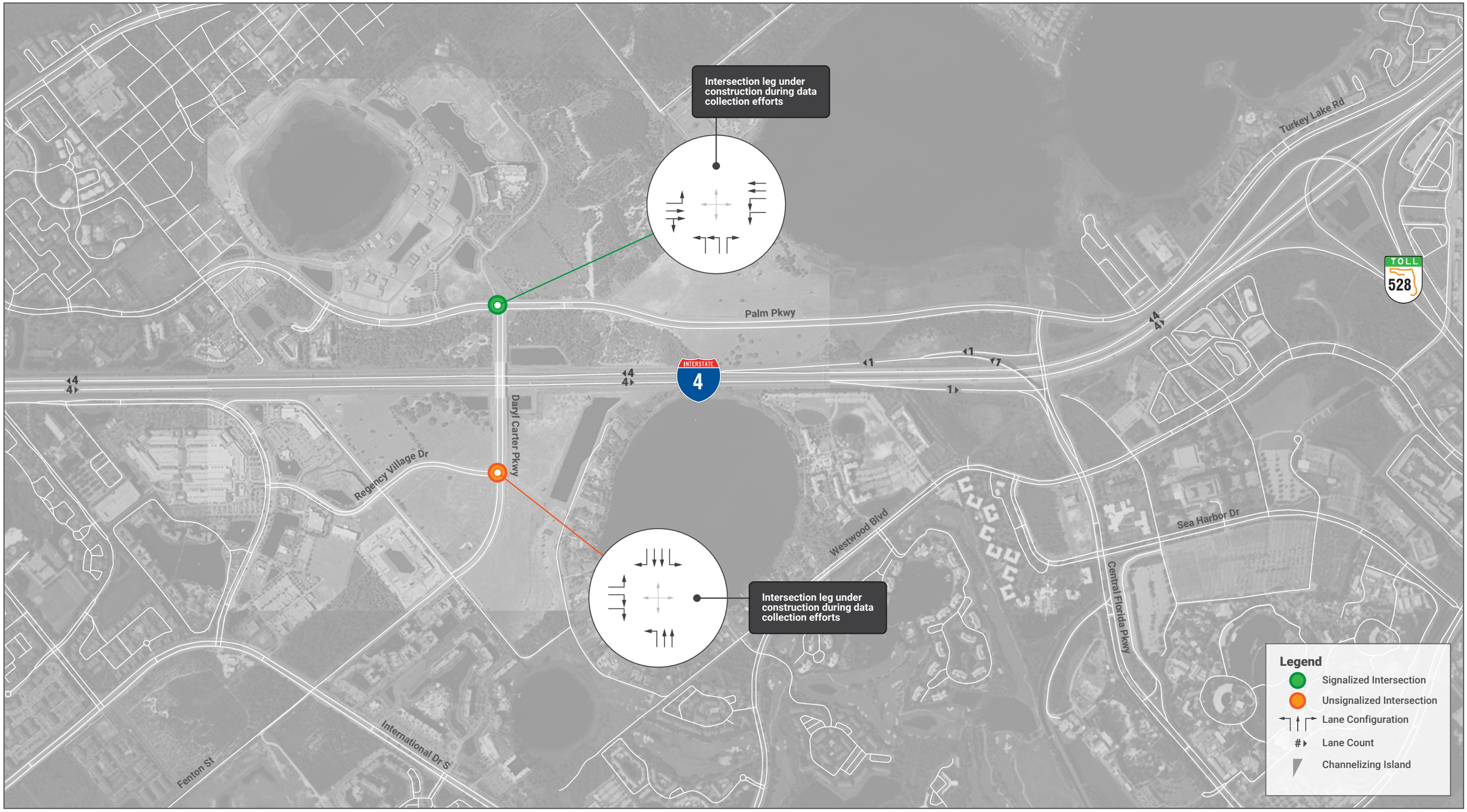

Intersection leg under construction during data collection efforts
Palm Pkwy
Turkey Lake Rd
INTERSTATE
4
TOLL
528
Daryl Carter Pkwy
Regency Village Dr
Westwood Blvd
Sea Harbor Dr
Central Florida Pkwy
International Dr S
Fenton St
Intersection leg under construction during data collection efforts
Legend
Signalized Intersection
Unsignalized Intersection
Lane Configuration
Lane Count
Channelizing Island
Scale in Feet
0
1,200
North

Table 2: Existing (2019) System Peak Hour Summary

AM Peak				PM Peak			
Start Time	Total Network Entering Intersection Volume	Total Hourly Network Entering Intersection Volume	Peak Hour	Start Time	Total Network Entering Intersection Volume	Total Hourly Network Entering Intersection Volume	Peak Hour
6:00:00 AM	2,626			3:00:00 PM	6,544		
6:15:00 AM	3,335			3:15:00 PM	6,838		
6:30:00 AM	4,279			3:30:00 PM	7,160		
6:45:00 AM	5,055	15,295		3:45:00 PM	7,087	27,629	
7:00:00 AM	5,752	18,421		4:00:00 PM	8,110	29,195	
7:15:00 AM	6,706	21,792		4:15:00 PM	8,446	30,803	
7:30:00 AM	6,991	24,504		4:30:00 PM	9,058	32,701	
7:45:00 AM	7,322	26,771		4:45:00 PM	8,919	34,533	
8:00:00 AM	6,966	27,985		5:00:00 PM	9,300	35,723	
8:15:00 AM	6,969	28,248		5:15:00 PM	9,347	36,624	
8:30:00 AM	7,447	28,704	**7:45am - 8:45 am**	5:30:00 PM	9,190	36,756	**4:45pm - 5:45 pm**
8:45:00 AM	7,300	28,682		5:45:00 PM	8,662	36,499	
9:00:00 AM	6,112	27,828		6:00:00 PM	7,345	34,544	
9:15:00 AM	5,759	26,618		6:15:00 PM	6,917	32,114	
9:30:00 AM	5,744	24,915		6:30:00 PM	6,928	29,852	
9:45:00 AM	5,490	23,105		6:45:00 PM	6,579	27,769	

4.2.2. Existing Traffic Volumes

The collected intersection turning movement counts and volume counts were adjusted using a seasonal adjustment factor obtained from the 2019 Florida Traffic Online (FTO) to estimate 2019 average daily traffic (ADTs) volumes and Annual Average Daily Traffic (AADTs). The volume counts were adjusted using both seasonal factors and axle adjustment factors obtained from the 2019 Florida Traffic Online (current at the time of count post processing). The raw ADTs, seasonal factors, and resulting 2019 AADTs collected for the SR 535, Daryl Carter Parkway and I-4 mainline summarized in **Table 3**. The peak season factor category and axle correction factor reports are provided in **Appendix E**. The 2019 AADTs within the study area are shown in **Figure 5**. I-4 mainline counts were not field collected as part of the data collection efforts for this study. The 2019 FTO was used to summarize the existing AADT for the I-4 mainline at a selected anchor point location (Site 750535). The mainline I-4 AADTs were balanced directionally and summed for the bi-directional AADTs. The 2019 FTO Historical AADT and synopsis reports were also used to summarize ramp volumes (AADT and peak hour) at the adjacent interchanges (SR 536 and Central Florida Parkway).

The seasonally adjusted intersection volumes were reviewed for reasonableness of balancing between intersections. The volumes were adjusted accordingly to balance between intersections that do not have driveways, roadways, or access points that would account for a volume imbalance (e.g., ramp terminal intersections). The 2016 intersection turning movement volumes at the SR 535 and Meadow Creek Drive intersection were reviewed and compared against the 2019 field collected volumes. The volumes along SR 535 were similar to the volumes collected at the adjacent signalized intersection so minimal adjustments were needed (outside of seasonal adjustments). In addition, land uses along Meadow Creek Drive and Lake Vining Drive are built out, so growth was not applied to the side street movements.

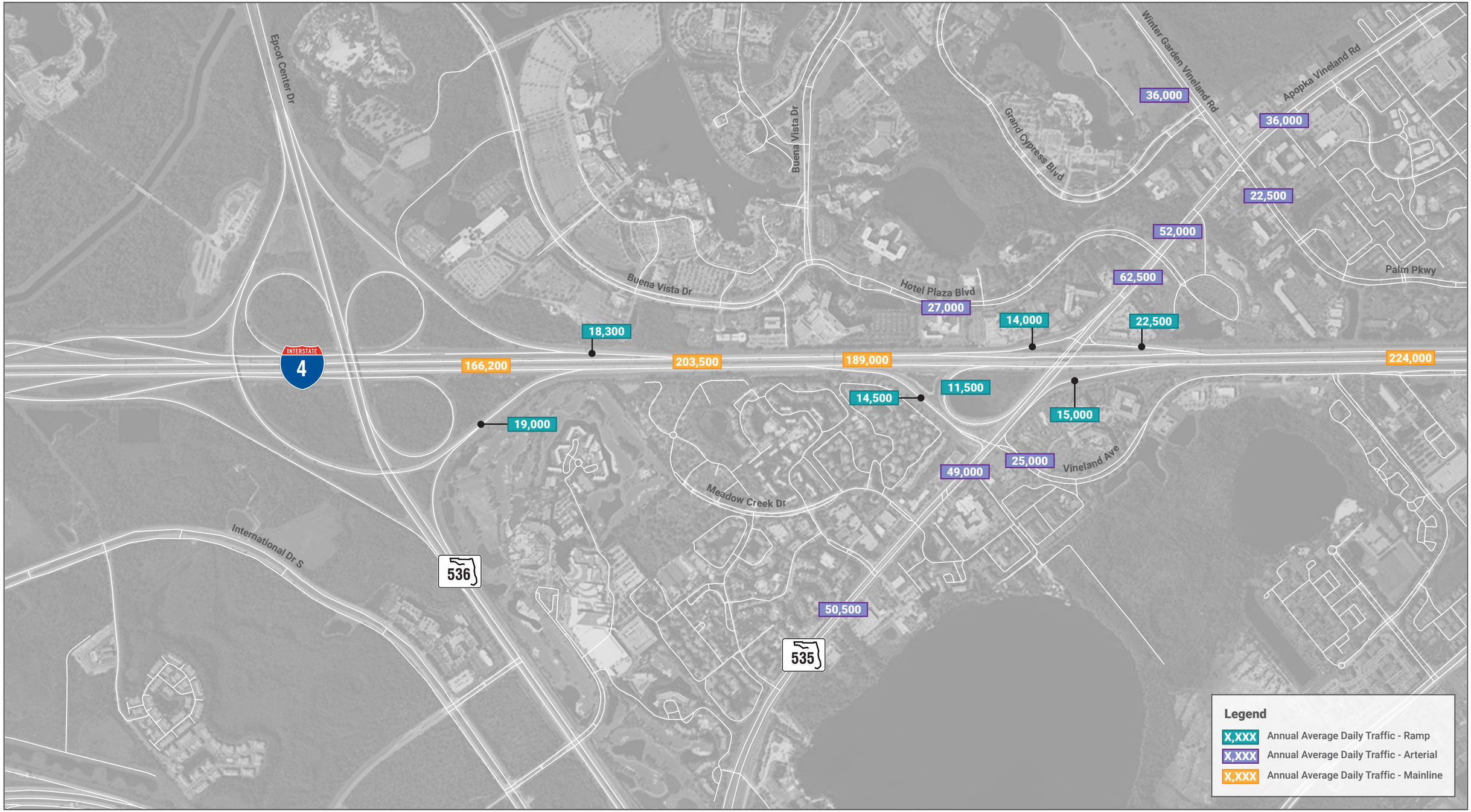
Volumes (peak hour and AADT) along the I-4 mainline were balanced using an anchor point at FDOT Site 750535 (I-4 west of Central Florida Parkway). The existing raw AM and PM peak hour volumes collected in the field, including peak-to-daily ratios and directional (D) percentages, are summarized in **Table 4**. The seasonally adjusted intersection turning movement volumes and balanced mainline volumes used in the existing conditions analysis for the AM and PM peak hours are illustrated in **Figure 6**.

Table 3: Existing (2019) Daily Volumes

Roadway	Count Type	Day 1	Day 2	ADT	Axle Adj. Factor	Seasonal Adj. Factor	AADT
SR 535, South of Meadow Creek Drive	FTO (Site 750630)	-	-	-	-	-	50,500
SR 535, South of Vineland Ave	48-Hour Volume	48,955	50,055	49,505	0.95	1.04	49,000
Vineland Avenue, East of SR 535	48-Hour Volume	24,619	24,199	24,409	0.99	1.04	25,000
I-4 WB Off-Ramp to SR 535	48-Hour Volume	22,127	23,241	22,684	0.95#	1.04	22,500
I-4 EB On-Ramp from NB SR 535	48-Hour Volume	14,637	15,373	15,005	0.95#	1.04	15,000
I-4 EB On-Ramp from SB SR 535	48-Hour Volume	11,253	11,616	11,435	0.95#	1.04	11,500
I-4 EB Off-Ramp to SR 535	48-Hour Volume	14,519	14,455	14,487	0.95#	1.04	14,500
I-4 WB On-Ramp from SR 535	48-Hour Volume	14,229	14,300	14,265	0.95#	1.04	14,000
SR 535, South of Hotel Plaza Boulevard	48-Hour Volume	62,920	63,825	63,373	0.95	1.04	62,500
SR 535, North of Hotel Plaza Boulevard	48-Hour Volume	52,041	53,286	52,664	0.95	1.04	52,000
Winter Garden Vineland Road, West of Grand Cypress Boulevard	48-Hour Volume	34,593	35,334	34,964	0.99	1.04	36,000
Palm Parkway, East of SR 535	48-Hour Volume	21,417	22,043	21,730	0.99	1.04	22,500
Apopka Vineland Road, North of Palm Parkway	48-Hour Volume	34,709	35,364	35,037	0.99	1.04	36,000
Daryl Carter Pkwy, East of Palm Parkway	48-Hour Volume	13,620	13,527	13,574	0.99	1.04	14,000
Palm Parkway, South of Daryl Carter Parkway	48-Hour Volume	23,493	23,365	23,429	0.99	1.04	24,000
Turkey Lake Road, North of Daryl Carter Parkway	48-Hour Volume	23,130	23,663	23,397	0.99	1.04	24,000
Daryl Carter Parkway, East of Regency Village Drive	48-Hour Volume*	8,677	8,454	8,566	0.99	1.00	8,500
I-4, from Daryl Carter Parkway to SR 535	FTO (Site 750535)	-	-	-	-	-	224,000

*Orange County Count

Axle factor specific to SR 535 (0.95) was used for the I-4 at SR 535 ramps



Scale in Feet
0 1,200 North

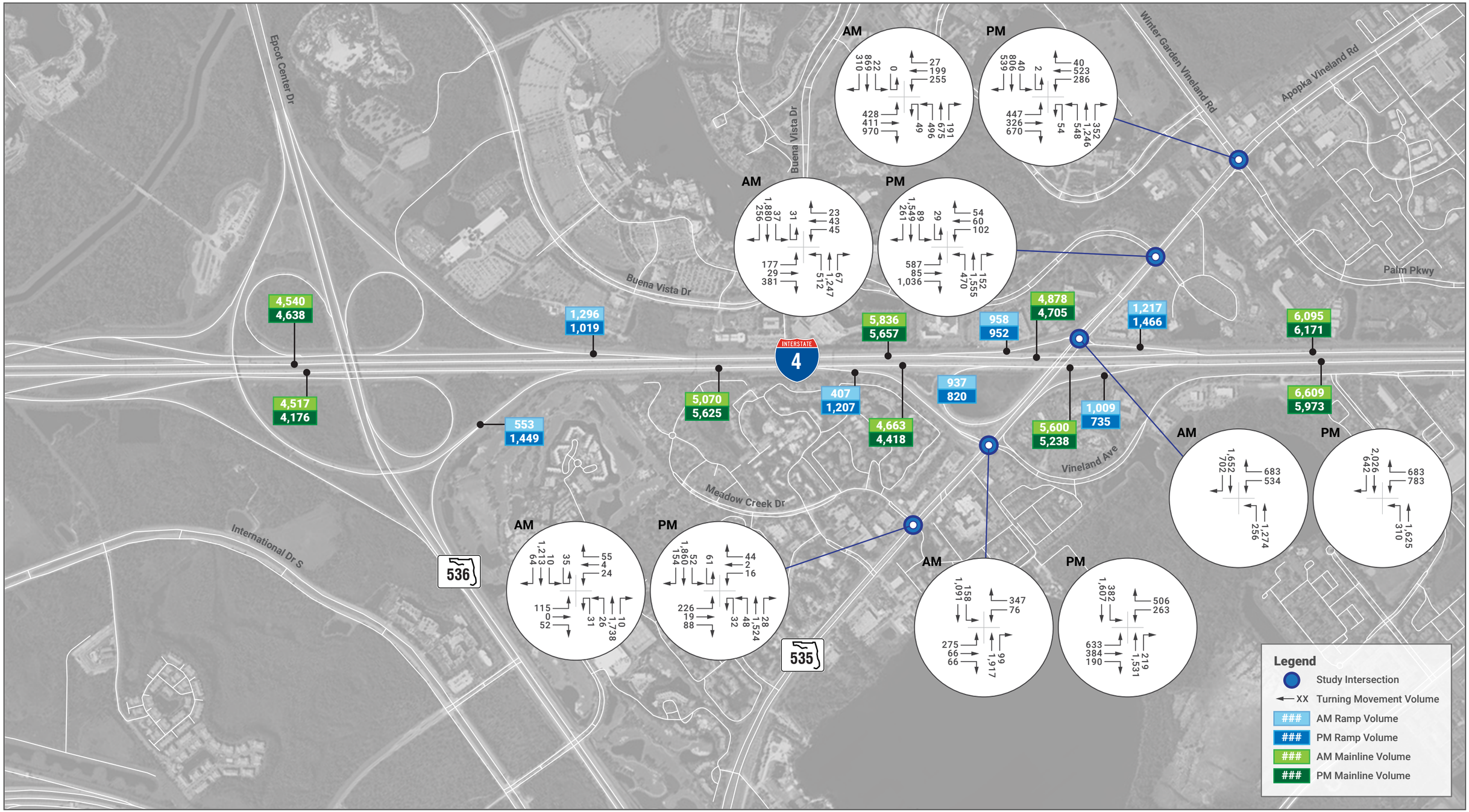
FDOT **I-4 at SR 535 Interchange Modification Report**

FIGURE 5 | **2019 Annual Average Daily Traffic**

Scale in Feet
0 1,200 North

Table 4: Existing (2019) Peak Hour Traffic Characteristics

Roadway	AM Peak Hour: 7:45 – 8:45 AM					PM Peak Hour: 4:45 – 5:45 PM				
	Peak Hour Volume	NB/EB	SB/WB	Peak-to-Daily Ratio	D Factor	Peak Hour Volume	NB/EB	SB/WB	Peak-to-Daily Ratio	D Factor
SR 535, South of Vineland Avenue	3,109	1,938	1,171	6.3%	0.64	3,661	1,683	1,978	7.4%	0.54
Vineland Avenue, East of SR 535	715	308	407	2.9%	0.58	1,667	927	740	6.8%	0.55
I-4 Ramps (East of SR 535)	3,150	1,980	1,170	-	0.64	2,989	1,579	1,410	-	0.64
I-4 WB Off-Ramp to SR 535	1,170	-	1,170	5.2%	-	1,410	-	1,410	6.2%	-
I-4 EB On-Ramp from NB SR 535	1,040	1,040	-	6.9%	-	758	758	-	5.1%	-
I-4 EB On-Ramp from SB SR 535	940	940	-	8.2%	-	821	821	-	7.2%	-
I-4 Ramps (West of SR 535)	1,306	390	916	-	0.70	2,072	1,161	911	-	0.56
I-4 EB Off-Ramp to SR 535	390	390	-	2.7%	-	1,161	1,161	-	8.0%	-
I-4 WB On-Ramp from SR 535	916	-	916	6.4%	-	911	-	911	6.4%	-
SR 535, South of Hotel Plaza Boulevard	3,923	1,707	2,216	6.2%	0.57	4,675	2,093	2,582	7.4%	0.56
SR 535, North of Hotel Plaza Boulevard	3,492	1,373	2,119	6.6%	0.61	3,990	2,137	1,853	7.6%	0.53
Winter Garden Vineland Road, West of Grand Cypress Boulevard	2,725	1,749	976	7.8%	0.65	2,987	1,413	1,574	8.5%	0.52
Palm Parkway, E. of SR 535	1,064	601	463	4.9%	0.57	1,507	690	817	6.9%	0.54
Apopka Vineland Road, North of Palm Parkway	2,241	1,086	1,155	6.4%	0.53	3,001	1,668	1,333	8.6%	0.55
Daryl Carter Parkway, East of Palm Parkway	711	296	415	5.2%	0.60	1,387	644	743	10.2%	0.50
Palm Parkway, South of Daryl Carter Parkway	1,555	919	636	6.6%	0.59	2,224	978	1,246	9.5%	0.56
Turkey Lake Rd, North of Daryl Carter Parkway	1,492	947	545	6.4%	0.63	2,111	872	1,239	9.0%	0.58




AM
438
129
775
179
210
222
PM
903
393
629
394
278
392
Palm Pkwy
Turkey Lake Rd
INTERSTATE
4
TOLL
528
6,095
6,171
6,609
5,973
618
994
437
541
5,477
5,177
6,172
5,432
Daryl Carter Pkwy
Regency Village Dr
AM
217
91
87
11
345
3
PM
564
223
270
29
400
0
14
Westwood Blvd
Sea Harbor Dr
Central Florida Pkwy
International Dr S
Fenton St
Legend
Study Intersection
XX Turning Movement Volume
AM Ramp Volume
PM Ramp Volume
AM Mainline Volume
PM Mainline Volume
Scale in Feet
0
1,200
North

4.3. Existing Traffic Operational Analysis

Based on the Methodology Letter of Understanding (MLOU), microsimulation will be the primary method used in the analysis of the study facilities within the AOI. Microsimulation models were developed using VISSIM (PTV Software) to evaluate the existing conditions of the interstate system and interchange cross streets within the AOI. VISSIM version 2020 SP 13 was utilized for the microsimulation analysis consistent with the approved MLOU document.

4.3.1. Data Sources

The following summarizes the data sources utilized for the existing microsimulation models including traffic, speed, travel time, and traffic control data.

4.3.1.1. Traffic Data

The 2019 peak hour traffic volumes illustrated previously in **Figure 6** were utilized as part of the existing year microsimulation models. Section 4.2 summarizes the existing (2019) traffic detail in further detail.

4.3.1.2. Speed and Travel Time Data

Speed and travel time data was obtained in September 2019 (consistent with the field data collection efforts). The data was obtained via the Federal Highway Administration (FHWA) National Performance Management Research Data Set (NPMRDS). In general, the dataset consists of speeds and travel times for 5-minute intervals at traffic message channel (TMC) segments along the freeway. The 5-minute speed data is created by measuring speeds for all vehicles traveling along a TMC segment and averaging them into 5-minute bins. The TMCs were manually matched with the VISSIM model, and the data points potentially impacted by incidents and severe weather were removed from the dataset. A set of "typical" conditions was then developed using averaged recurring weekday speeds.

4.3.1.3. Traffic Control

The model includes mainline freeway segments, on/off-ramps, ramp terminal intersections, and adjacent intersections. The appropriate traffic control – traffic signals, pedestrian signals, detection (as applicable), and stop/yield signs – were included in the model. Traffic signal timing plans were obtained from Orange County. These timing plans were used to reference controller settings (e.g., yellow clearance, all-red clearance, pedestrian walk, pedestrian clearance, etc.). The signals along SR 535 within the AOI run under adaptive signal control. The actual adaptive timings including splits and pedestrian actuations were provided by FDOT for the day of turning movement count data collection (September 24, 2019). The adaptive timings were reviewed and summarized with the average splits/cycle lengths of the peak hours for use in the microsimulation analysis. The average peak hour adaptive signal timing splits and cycle lengths were coded into Synchro models and then exported to develop Ring Barrier Controller (RBC) files required for modeling signal operations in VISSIM.

4.3.2. Model Development

The following section summarizes the VISSIM model development for this project including model geometry, driver behaviors, routing, speed control, vehicle inputs, vehicle compositions, conflict management and traffic control.

4.3.2.1. Model Geometry

The network within the area of influence was developed as part of the VISSIM model. Model links and connectors were made to fit available FDOT aerial imagery within VISSIM. Lane configurations, turn bay lengths, and stop bar locations were coded based on the aerial imagery and verified in the field.

Connector lengths were generally minimized to allow most calculations during validation to occur on the links. Also, overlaps between links and connectors were avoided where appropriate. Links along curves were adjusted by creating a spline from the beginning to the end of the curve. The shapes of the links and connectors were coded so that if the model is run with aerial imagery in the background and the network made invisible, the simulation will show vehicles running smoothly on the aerial image's roadway network.

4.3.2.2. Driver Behavior

The following list includes the behavior assumptions included in the models:

- Wiedemann 74 driving behaviors[1] were used for all arterials within the model.
- Wiedemann 74 driving behaviors were used for all freeway off-ramps within the model.
- Wiedemann 99 driving behaviors were used for the freeway segments within the model.
- Wiedemann 99 driving behaviors were used for all freeway on-ramps within the model.

4.3.2.3. Routing Decisions

Static routing decisions were used for the primary routing throughout the network. Static routing decisions were created for all Origin-Destination (OD) pairs in VISUM using Origin-Destination Matrix Estimation (ODME). These routes were imported from VISUM using route coordinate files (rcf). Having full OD routes coded in the model enables vehicles to anticipate their routes appropriately and be prepared to change lanes as needed. This minimizes unrealistic lane changing behaviors that can occur with using static routing decisions at each intersection (non-OD routes).

[1]The traffic flow model in VISSIM is a discrete, stochastic, time step based, microscopic model with driver-vehicle-units as single entities. The model contains a psycho-physical car following model for longitudinal vehicle movement and a rule-based algorithm for lateral movements. This driver behavior model, the Wiedemann 74 model, is contained within VISSIM and contains default parameters that are typically used with urban roadways.

4.3.2.4. Speed Control

The following summarizes the various speed control elements coded into the models including desired speed distributions, desired speed decisions, and reduced speed areas.

Desired Speed Distributions

Speed distributions were based on existing speed data where data is available. For I-4, speed data from NPMRDS was reviewed to estimate free-flow speeds along I-4. Where link speed data is not available, speed distributions were based on a linear distribution as follows:

- +/- 5 mph from the posted speed limit along arterials; and
- +/- 5 mph from the posted advisory speed limit for ramps.
- 7.5-15.5 mph for Right Turns[2]
- 12.4-18.6 mph for Left Turns
- 5-8 mph for U-turns

Desired Speed Decisions

Vehicle inputs were coded with vehicle compositions with defined speed distributions where possible; otherwise, speed decisions were placed at each entrance to the model (freeway segment or intersection approach). These were placed so the vehicle changes speeds as soon as they are on the link with the new anticipated speed. Speed decisions were placed downstream of a left- or right-turn connector at intersections when desired speeds from the minor street vary from the major arterial. Desired speed decisions were placed along off-ramps just downstream of the freeway diverge and along the on-ramps, downstream of the connector from the arterial to the ramp.

Reduced Speed Areas

Reduced speed areas were placed on the apex of a curve on links or connectors whose corresponding roadway geometry would cause vehicles to temporarily slow down to negotiate the area. The lengths of the reduced speed areas were modeled appropriately (between 5 and 15 feet) as there is potential for a reduction in turning movement capacity with the use of an excessively long reduced speed area.

4.3.2.5. Vehicle Inputs

Vehicle inputs for each link going into the network were developed through the VISUM ODME process. The ODME process provided the peak hour volumes for both AM and PM. The traffic demand profile of peak periods (AM and PM) was developed based on the field data and was used to convert the peak hour volume into peak period (3-hour period for both AM and PM) demand with 15-min analysis intervals. Finally, the vehicle inputs were included for each 15-minute analysis period within the 3-hour

[2] Other than turns for which speed data is available or non-standard geometry (i.e. wide right-turns or sharp left-turns)

analysis, as well as a 15-minute warm-up period so that the peaking characteristics during the simulation period was simulated. The volume profiles used for each of the vehicle inputs are included in **Appendix F**. The volume profiles are based on percentages of the peak hour volumes based on the field collected intersection turning movement counts.

The pedestrian calls were provided in the adaptive timing data. These pedestrian calls were coded into the model in 15-min periods based on the actual pedestrian calls logged in the field.

4.3.2.6. Vehicle Compositions

The North America Default vehicle fleet available on the PTV website was used in the VISSIM models. Heavy vehicle percentages for the existing conditions were based on available classification data along the arterials and the freeway. The truck percentages listed in **Table 5** are based on 2019 Florida Traffic Online data. Further detail on the truck percentages is summarized in Section 6.1.

Table 5: Truck Percentages

Roadway Segment	Recommended T Factor	DHT
I-4 Mainline	7.9	4.0
SR 535 North of I-4	6.2	3.1
SR 535 South of I-4	11.6	5.8
SR 535 Ramps	6.9	3.5
SR 536 Ramps	4.4	2.2
Central Florida Parkway Ramps	3.8	1.9
Hotel Plaza Boulevard	5.6	2.8
Palm Parkway	3.8	1.9
Daryl Carter Parkway	3.8	1.9
Vineland Avenue	3.8	1.9
Minor Side Streets	N/A	1.0

4.3.2.7. Conflict Management

Conflict areas were modeled for conflicting movements that might occur (permissive left-turns, right-turn-on-red (RTOR), yield-controlled bypass lanes, etc.). Conflict areas were also used in combination with stop signs for stop-controlled intersection approaches. Priority rules were used as needed to prevent intersection blockage at particular intersections due to observed queue spillback.

4.3.2.8. Traffic Control

The following section includes a description of the traffic control elements including traffic signals, detectors, and stop signs.

Traffic Signals

Traffic signals were modeled using the Ring Barrier Controller (RBC) within VISSIM. As noted previously, the signals at the SR 535 intersections within the AOI operate under adaptive signal control. Controller parameters, lead/lag left-turn sequences (based on adaptive timings), and the average adaptive timing splits were coded into the RBC files for the SR 535 signalized intersections. Right Turn on Red (RTOR) conditions were coded at applicable intersections where vehicles are permitted to turn if the signal is red.

Pedestrian signals were coded at the signalized intersections to account for the pedestrian activity along the corridor based on the logged pedestrian calls in the adaptive timing data from September 24, 2019.

Detectors

Traffic signal detectors were placed on approaches to signalized intersections that use detection to make a call to the signal controller. The detector length was coded to best match the length in the field when available. The detector number was generally defined as the number of the phase and the signal control number to which the detector is placing a call. Pedestrian detectors were also coded at signalized pedestrian crossings where appropriate in the model.

Stop-Controlled Intersections

Stop signs were placed at the stop bar of unsignalized intersections. Conflict areas were used to model conflicts for the stopped movements.

4.3.3. Simulation Parameters

This section summarizes the simulation parameters used in the simulation models including simulation resolution, network warm/up periods, and the simulation run time.

4.3.3.1. Simulation Resolution

The simulation resolution is the number of times the position of a vehicle will be calculated within one simulated second (ranging from 1 to 20). The input parameter of one will result in the vehicles moving once per simulation second while an input parameter of 10 will result in the position of the vehicle being calculated 10 times per simulation second, thus making vehicles move more smoothly throughout the network. The higher the simulation resolution, the more realistic the behavior and interactions of vehicles is. The change of simulation speed is inversely proportional to the number of

time steps. A value of 10 was used on all models and this value will not change between the existing and future analyses.

4.3.3.2. Network Warm-Up Period/Cooldown Period

A warm-up period of 15 minutes (900 seconds) was used prior to the analysis period to allow for the model to populate with a sufficient number of vehicles to better represent field conditions (consistent with the approved MLOU). The measures of effectiveness (MOEs) were not reported for the warm-up period. A 15-minute cooldown period was also included after the analysis period (consistent with the approved MLOU). Similar to the warm-up period, MOEs were not reported for the cooldown period.

4.3.3.3. Simulation Run Time

The simulation run time was conducted for a three-hour peak period during the AM and PM in addition to a 15-min warm-up period. The peak period and corresponding peak hours are:

- AM Peak Period: 6:45 – 9:45 AM
- AM Peak Hour: 7:45 – 8:45 AM
- PM Peak Period: 3:45 – 6:45 PM
- PM Peak Hour: 4:45 – 5:45 PM

Analysis of each time period was 900 seconds (15 minutes). The simulation run time used in the existing conditions models will be the same used in the future condition models.

4.3.4. Model Calibration

VISSIM models were developed and calibrated to 2019 existing average peak hour conditions. The 2021 FDOT Traffic Analysis Handbook was used as guideline for the development of the project VISSIM models. Calibration parameters developed as part of the validation efforts for each of the existing condition models will be carried forward to respective future conditions models.

4.3.4.1. Calibration Parameters

The calibration parameters used in the study are described in this section.

Driver Behaviors

Five driver behaviors, Urban (SR 535), Urban (motorized), Freeway (free lane selection), Freeway Low Capacity, and Freeway Weaving were used throughout the model. Urban (SR 535) using the Wiedemann 74 model as the car following model, was applied for all SR 535 roadway links. Urban (motorized) using the Wiedemann 74 model as the car following model, was used for all other arterials and off-ramps. SR 535 roadway links in the network use reduced average standstill distance (i.e., 3.29 ft) of Wiedemann 74, while the other arterials and off-ramps use the default car following parameters of Wiedemann 74. Car following model, Wiedemann 99, was used for all freeways and on-

ramps. The adjusted parameters of car flowing models of the freeway driver behaviors are summarized in **Table 6** and the adjusted parameters of lane change of the driver behaviors are summarized in **Table 7**. For the Urban (SR 535), Urban (motorized) and Freeway Weaving driver behaviors, the parameter "number of interaction objects" was increased to "4". For the Urban (motorized) behavior, the maximum look ahead distance was increased to 1,000 ft. All the parameters are within the acceptable range shown in Table 7-12 of the FDOT Traffic Analysis Handbook.

Table 6: Parameters of Car Following Model

Category	CC0 (Standstill Distance)	CC1 (Gap Time)	CC2 (Following Distance Oscillation
(default)	4.92	0.9	13.12
Freeway (Free Lane Selection)	4.92	1.05	13.12
Freeway Low Capacity	10.00	1.3	15.72
Freeway Weaving	10.00	1.45	20.31

Table 7: Parameters of Lane Change

Category	Safety Distance Reduction Factor	Cooperative Lane Change	Max Deceleration for Cooperative Braking
(default)	0.6	Unchecked	-9.84
Freeway (Free Lane Selection)	0.6	Unchecked	-9.84
Freeway Low Capacity	0.5	Checked	-18.00
Freeway Weaving	0.5	Checked	-18.00
Urban (SR 535)	0.1	Unchecked	-9.84
Urban (motorized)	0.2	Unchecked	-9.84

(Unlisted parameters are left as defaults)

Lane Change Distance

In general, the default value of 656.32 feet (200 meters) was used for lane change distance throughout the model. This distance was increased to half a mile (2,640 feet) or quarter a mile (1,320 feet) for freeway merge or diverge connectors. Other connectors on arterial may have adjusted lane change distance based on observed model behavior. These lane change distances can impact the lane utilization of upstream links and were refined as needed based on field data, local knowledge of travel patterns, and engineering judgement.

4.3.4.2. Calibration Targets

The calibration of the existing AM and PM models will target the thresholds indicated in the FDOT Traffic Analysis Handbook for the volumes, and travel times on mainline. **Table 8** summarizes the

project's calibration criteria and acceptable targets as documented in FDOT Traffic Analysis Handbook. These criteria and thresholds are consistent with those described and approved in the MLOU document.

Table 8: Calibration Criteria and Acceptance Targets

Measure	Criteria	Calibration Acceptance Targets
Volume	**Hourly Flows, Model Versus Observed**	
	Individual Link Flows, vehicles per hour (vph)	
	Within 100 vph, for Flow < 700 vph Within 15%, for 700 vph < Flow < 2700 vph Within 400 vph, for Flow > 2700 vph	> 85% of cases
	Sum of All Link Flows	Within 5% of sum of all link counts GEH < 5
	Intersection Movements	
	All Intersection Movements	> 85% of movements GEH < 5 100% of movements GEH <10
Travel Time	Model Versus Observed Travel Time	within ±1 minute for routes with observed travel times less than seven (7) minutes and within ±15% for routes with observed travel times greater than seven (7) minutes

***Note:** GEH is an empirical formula expressed as $\sqrt{2*(M-C)2/(M+C)}$ where M is the simulation model volume and C is the field counted volume.

Link Flow Calibration

Field count locations were modeled as data collection points in VISSIM. The model volumes at these data collection points were compared with the turning movement count approach or departure volumes. Each data collection point was separated into the appropriate volume category based on the field volume. The number in each category, and the calibration results are shown in **Table 9** and **Table 10**. Detailed results are included in **Appendix G** for reference.

Table 9: AM Link Volume Calibration Results

Volume Category	Number of segments	Number of segments in calibration	Percent Passing	Meets Target?
Within 100 vph, for Flow < 700 vph	4	4	100%	**Yes (>85%)**
Within 15%, for 700 vph < Flow < 2700 vph	5	5	100%	**Yes (>85%)**
Within 400 vph, for Flow > 2700 vph	11	11	100%	**Yes (>85%)**

Table 10: PM Link Volume Calibration Results

Volume Category	Number of segments	Number of segments in calibration	Percent Passing	Meets Target?
Within 100 vph, for Flow < 700 vph	1	1	100%	**Yes (>85%)**
Within 15%, for 700 vph < Flow < 2700 vph	8	8	100%	**Yes (>85%)**
Within 400 vph, for Flow > 2700 vph	11	11	100%	**Yes (>85%)**

The calibration of "Sum of all link flows" was based on the sum of the data collection points above. The results for this calibration parameter are shown in **Table 11**.

Table 11: Sum of all Link Flow Calibration Results

Scenario	Field Volume	Simulation Volume	Percent Difference	GEH*	Meets Target?
AM	66,889	66,904	0.0%	0.06	**Yes (<5%, <5)**
PM	66,393	66,831	0.7%	1.70	**Yes (<5%, <5)**

Intersection Movement Calibration

Processed volume for each intersection movement (measured by nodes) was compared with field volumes and the GEH parameter was calculated for each. The calibration results are shown in **Table 12**.

Table 12: Intersection Turning Movement Calibration

Scenario	# Obs.	# Obs. (GEH <5)	% >5 GEH	% >10 GEH	Meets Target?
AM	68	68	0%	0%	**Yes (<15%/0%)**
PM	68	68	0%	0%	**Yes (<15%/0%)**

Travel Time Calibration

Travel time along the I-4 corridor and SR 535 corridor was measured in VISSIM and was then compared with field measurements. NPMRDS measurements was used for both I-4 and SR 535 corridors. NPMRDS data is collected for individual TMCs. As previously discussed, the NPMRDS data was processed to get the average peak hour speed for each TMC segment. The average speed was used to calculate the travel time of each segment based on the TMC segment length. The corridor travel time measurements were calculated by aggregating all corresponding TMCs. The corridor travel time measurements were compared to the VISSIM results and analyzed according to the criteria in **Table 8**. For both the 2019 AM and PM peak hours, the overall corridor travel time measurements meet the calibration criteria as shown in **Table 13** and **Table 14**.

A speed comparison between field observations and simulation was also conducted and summarized in **Appendix G**. It should be noted that the field speed measurements were calculated based on

NPMRDS travel time data and therefore they represent the average speed over the corresponding TMCs, not specific locations. The simulation speed outputs were obtained in the same way, (i.e., calculated based on the travel time measurements over certain distances which are defined in vehicle travel time measurements in VISSIM) and are consistent with the TMC segments in the NPMRDS data.

Table 13: Corridor Travel Time Calibration Results (AM Peak Hour)

Corridor	Direction	Time	Travel Time* (HERE)	Travel Time* (VISSIM)	Difference*	Target	Meets Target?
I-4	EB	7:45	235	229	-6	+/-60	**Yes**
		8:00	238	236	-2	+/-60	**Yes**
		8:15	244	237	-6	+/-60	**Yes**
		8:30	239	229	-11	+/-60	**Yes**
	WB	7:45	186	191	6	+/-60	**Yes**
		8:00	182	189	8	+/-60	**Yes**
		8:15	178	190	11	+/-60	**Yes**
		8:30	175	191	16	+/-60	**Yes**
SR 535	NB	7:45	429	391	-38	+/-65	**Yes**
		8:00	431	396	-36	+/-65	**Yes**
		8:15	410	385	-25	+/-60	**Yes**
		8:30	403	388	-15	+/-60	**Yes**
	SB	7:45	381	421	40	+/-60	**Yes**
		8:00	378	427	49	+/-60	**Yes**
		8:15	389	431	42	+/-60	**Yes**
		8:30	361	417	56	+/-60	**Yes**
Total Observations					16		
Observations within Target					16		
Observations within Target / Total					100%	> 85%	**Yes**

***Note:** Travel time is reported in seconds

Table 14: Corridor Travel Time Calibration Results (PM Peak Hour)

Corridor	Direction	Time	Travel Time* (HERE)	Travel Time* (VISSIM)	Difference*	Target	Meets Target?
I-4	EB	16:45	256	233	-23	+/-60	**Yes**
		17:00	241	227	-13	+/-60	**Yes**
		17:15	246	223	-23	+/-60	**Yes**
		17:30	244	227	-17	+/-60	**Yes**
	WB	16:45	220	225	5	+/-60	**Yes**
		17:00	211	219	7	+/-60	**Yes**
		17:15	217	201	-16	+/-60	**Yes**
		17:30	220	197	-23	+/-60	**Yes**
SR 535	NB	16:45	435	488	53	+/-65	**Yes**
		17:00	422	467	45	+/-63	**Yes**
		17:15	412	462	50	+/-60	**Yes**
		17:30	451	447	-5	+/-68	**Yes**
	SB	16:45	472	518	46	+/-71	**Yes**
		17:00	473	516	43	+/-71	**Yes**
		17:15	445	493	48	+/-67	**Yes**
		17:30	449	510	61	+/-67	**Yes**
Total Observations					16		
Observations within Target					16		
Observations within Target / Total					100%	> 85%	**Yes**

***Note:** Travel time is reported in seconds

4.3.4.3. Number of Runs

The simulation was run multiple times with different random seeds to capture the impact of the stochastic nature of the model on the results. Ten (10) simulation runs were performed first with different random seed numbers. After the ten simulation runs, the adequacy of the number of runs was assessed using the following equation:

$$n = \left(\frac{s * t_{\alpha/2}}{\mu * \varepsilon}\right)^2$$

Where:

n is the required number of simulation runs

s is the standard deviation of the system performance measure (such as total traffic volume) based on previously conduced simulation runs.

$t_{\alpha/2}$ is the critical value of a two-sided Student's t-statistic at the confidence level of α and $n-1$ degrees of freedom. An α of 5% is typical.

μ is the mean of the system performance measure

ε is the tolerable error, specified as a fraction of μ. A 10% error is desired.

In the previous equation, the system performance measure used is the "average delay time per vehicles (sec), all vehicle types" for the peak hour period through vehicle network performance. With 10 runs and an alpha of 5%, the critical t value is approximately 2.262. A 10% tolerable error was used. **Table 15** shows the minimum required number of runs for each scenario. Detailed calculations are shown in **Appendix G**. This calculation shows a minimum number of runs of one and a maximum number of runs of nine; however, it is standard practice is to use no fewer than ten runs. Ten runs were used for each scenario.

Table 15: Required Number of Runs

Scenario	Average Delay (s) Mean	Average Delay (s) Standard Deviation	Number of Runs Required
AM	52.74	1.55	1
PM	74.43	9.56	9

4.3.4.4. Visual Error Checking

Upon development of each model, a visual inspection of the model was completed to check the coding of each network element (signals, detectors, conflict areas, reduced speeds, lane changing, etc.). Adjustments due to this review were completed prior to the calibration summarized previously.

4.3.5. Existing Conditions Results

A variety of measures were collected to summarize traffic operations throughout the simulation model consistent with the performance measures listed in the approved MLOU.

- Network-wide performance, such as total travel time, total delay time, vehicle-miles of travel, latent volume, and latent delay were summarized.
- Speed and density measures were collected on all freeway links in 1,500 ft and five-minute increments. These results are presented in contour diagrams for the I-4 corridor (eastbound and westbound) in **Section 4.3.5.2**.
- Volume, delay, estimated LOS, average, and maximum queue length were measured for all the study area intersections.

4.3.5.1. Networkwide Statistics

Network wide statistics for the AM and PM peak hour are shown in **Table 16**. The average network delay per vehicle ranges between 44.8 and 74.8 seconds within an average speed range between 41.2 and 47.6 miles-per-hour.

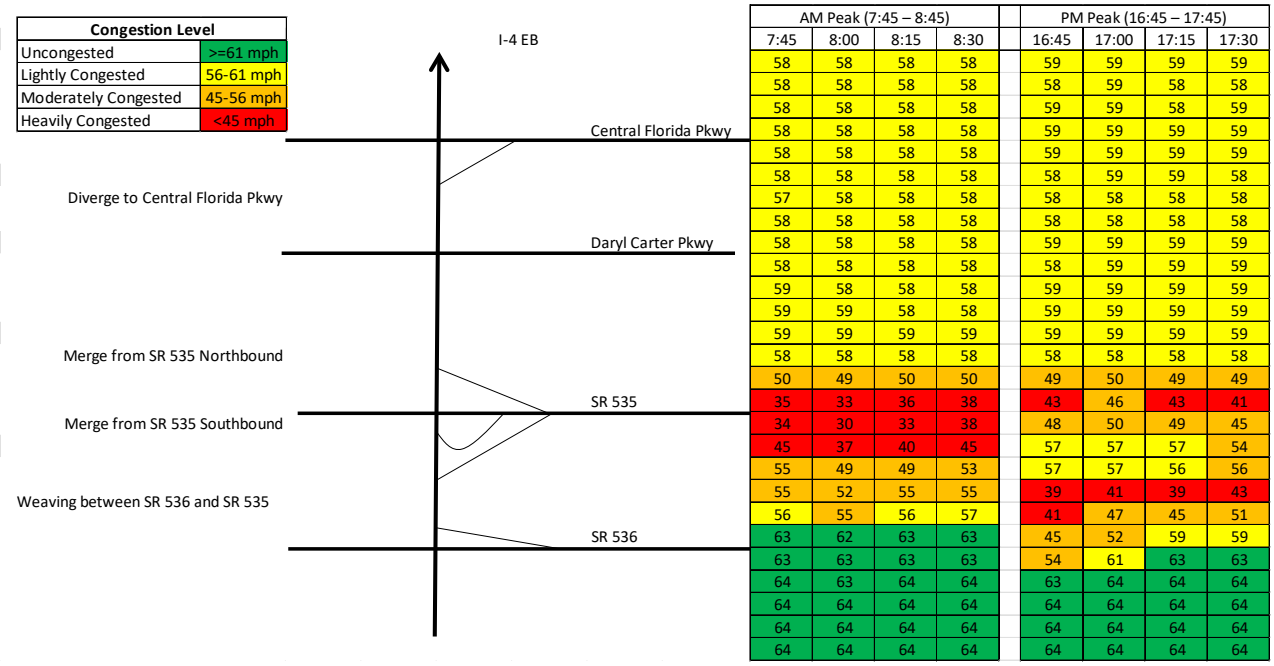
Table 16: Network Wide Statistics – 2019 AM and PM Peak Hour

Network Wide Statistics	AM Peak Hour	PM Peak Hour
Average Delay (sec)	52.7	74.4
Average Speed (mph)	46.2	41.0
Total Delay (hr)	326.3	540.2
Active Vehicles (at end of peak hour)	2,018	2,198
Vehicles Arrived (during peak hour)	20,256	23,924
Total peak hour vehicles (Active + Arrived)	22,274	26,122
Latent Demand (at end of peak hour)/Percentage of total peak hour vehicles	1/ 0.0%	1 / 0.0%
Latent Delay (hr)/ Percentage of total delay	0.4 / 0.1%	8.8 / 1.6%

4.3.5.2. Link Evaluation on I-4 Corridor

Speed and density/estimated LOS results for the I-4 study corridor from SR 536 to Central Florida Pkwy are shown in **Figure 7** to **Figure 10**. The speed contours utilize the congestion level thresholds in Table 9-12 of the latest FDOT Traffic Analysis Handbook. During the AM peak hour, congestion occurs on I-4 eastbound just upstream of the merge segment from southbound SR 535 to I-4 eastbound. There are also some minor slowdowns observed along westbound I-4 at the merge segment from Central Florida Pkwy and the diverge segment from I-4 westbound to SR 535 due to the merging and diverging behavior.

During the PM peak hour, there is some congestion on I-4 eastbound within the weaving segment between SR 536 and SR 535 and the merge segment from southbound SR 535 to I-4 eastbound. Congestion is also observed on I-4 westbound at the on-ramp segment from Central Florida Pkwy and the off-ramp segment to SR 535 and those locations are more congested during the PM peak hour than the AM peak hour.



AM Peak (7:45 – 8:45)				PM Peak (16:45 – 17:45)			
7:45	8:00	8:15	8:30	16:45	17:00	17:15	17:30
58	58	58	58	59	59	59	59
58	58	58	58	58	59	58	58
58	58	58	58	59	59	58	59
58	58	58	58	59	59	59	59
58	58	58	58	59	59	59	59
58	58	58	58	58	59	59	58
57	58	58	58	58	58	58	58
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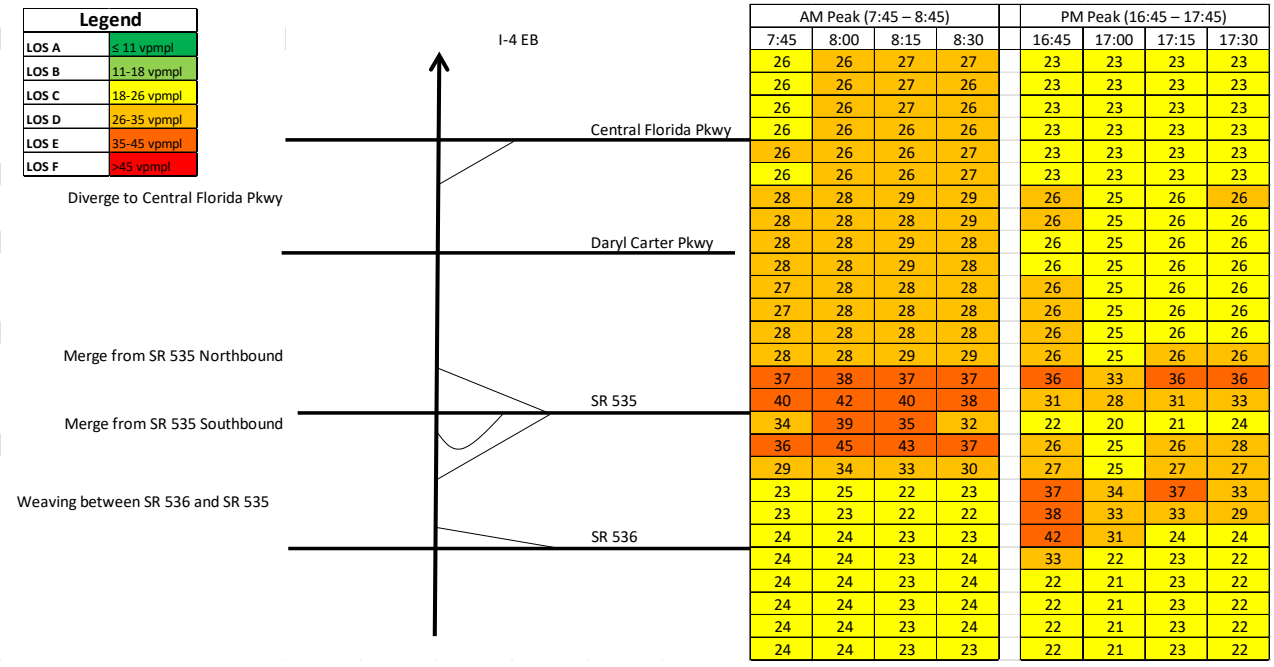
58	58	58	58	59	59	59	59
58	58	58	58	58	59	59	59
59	58	58	58	59	59	59	59
59	59	58	58	59	59	59	59
59	59	59	59	59	59	59	59
58	58	58	58	58	58	58	58
50	49	50	50	49	50	49	49
35	33	36	38	43	46	43	41
34	30	33	38	48	50	49	45
45	37	40	45	57	57	57	54
55	49	49	53	57	57	56	56
55	52	55	55	39	41	39	43
56	55	56	57	41	47	45	51
63	62	63	63	45	52	59	59
63	63	63	63	54	61	63	63
64	63	64	64	63	64	64	64
64	64	64	64	64	64	64	64
64	64	64	64	64	64	64	64
64	64	64	64	64	64	64	64

Figure 7: 2019 AM and PM I-4 Eastbound Speed Contours



AM Peak (7:45 – 8:45)				PM Peak (16:45 – 17:45)			
7:45	8:00	8:15	8:30	16:45	17:00	17:15	17:30
26	26	27	27	23	23	23	23
26	26	27	26	23	23	23	23
26	26	27	26	23	23	23	23
26	26	26	26	23	23	23	23
26	26	26	27	23	23	23	23
26	26	26	27	23	23	23	23
28	28	29	29	26	25	26	26
28	28	28	29	26	25	26	26
28	28	29	28	26	25	26	26
28	28	29	28	26	25	26	26
27	28	28	28	26	25	26	26
27	28	28	28	26	25	26	26
28	28	28	28	26	25	26	26
28	28	29	29	26	25	26	26
37	38	37	37	36	33	36	36
40	42	40	38	31	28	31	33
34	39	35	32	22	20	21	24
36	45	43	37	26	25	26	28
29	34	33	30	27	25	27	27
23	25	22	23	37	34	37	33
23	23	22	22	38	33	33	29
24	24	23	23	42	31	24	24
24	24	23	24	33	22	23	22
24	24	23	24	22	21	23	22
24	24	23	24	22	21	23	22
24	24	23	24	22	21	23	22
24	24	23	23	22	21	23	22

Figure 8: 2019 AM and PM I-4 Eastbound Density Contours

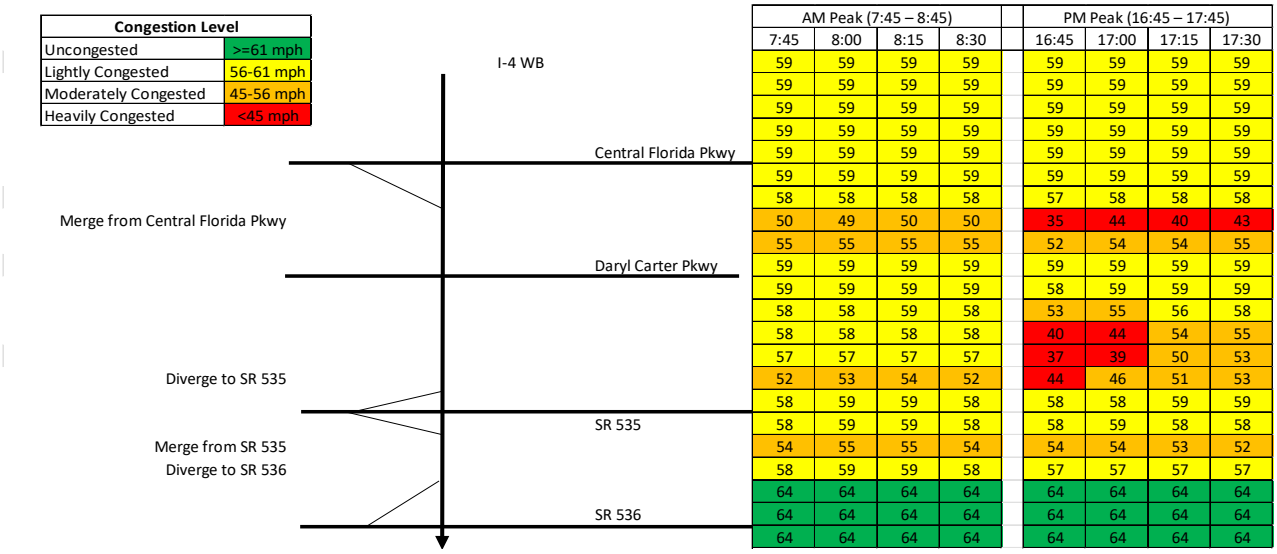


Figure 9: 2019 AM and PM I-4 Westbound Speed Contours

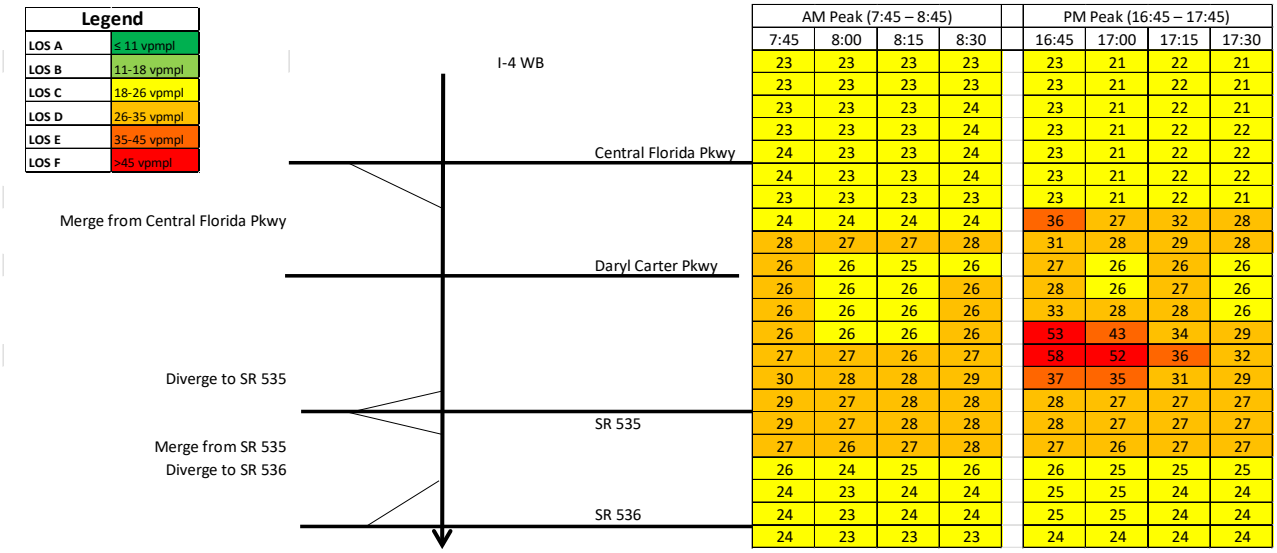


Figure 10: 2019 AM and PM I-4 Westbound Density Contours

4.3.5.3. Intersection Node Evaluation Results

The performance measures of study intersections are summarized in **Table 17**, **Table 18**, and **Table 19** including the average queue, maximum queue, delay, and estimated overall intersection LOS. The tables also include the turn lane lengths for the exclusive turn lanes which were estimated by measuring from the stop bar to the end of the taper. Queue lengths were rounded to the nearest foot. It is important to note that the LOS from simulation is an estimate and is not the same as the LOS derived in the Highway Capacity Manual.

Table 17: 2019 AM and PM Peak Hour Node Evaluation Results – SR 535 at Meadow Creek Drive and Vineland Avenue

Intersection	Movement	AM Peak Hour				PM Peak Hour				Turn Lane Length (feet)
		Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	
SR 535 @ Meadow Creek Drive	NBU	29	58.6	31	178	29	85.1	52	273	300
	NBL	59	63.5	31	178	84	84.5	52	273	300
	NBR	9	15.8	59	504	28	30.2	135	616	-
	NBT	1,725	15.2	59	501	1,558	36.1	134	614	-
	EBR	51	5.5	49	257	91	21.3	111	413	-
	EBT	0	0	0	0	19	68.8	111	412	-
	EBL	111	69.1	49	257	221	72.0	111	412	-
	WBL	22	65.5	19	187	17	61.0	11	162	-
	WBT	5	80.1	19	187	2	67.2	11	162	-
	WBR	57	27.4	20	190	44	22.3	13	165	-
	SBT	1,193	14.2	36	339	1,872	13.5	61	606	-
	SBR	68	4.7	1	80	167	6.0	1	78	225
	SBL	43	82.9	37	177	124	69.6	70	461	275
	SBU	32	101.5	37	177	64	80.4	70	461	275
	Intersection	**3,404**	**19.7**	**LOS B***		**4,318**	**29.6**	**LOS C***		**-**
SR 535 @ I-4 EB Off-Ramp/ Vineland Avenue	EBR	65	2.6	0	41	197	9.7	10	185	900
	EBL	275	71.0	73	276	642	77.8	533	1,640	375
	EBT	64	82.5	25	110	379	93.1	148	1,163	-
	SBT	1,089	5.6	12	223	1,624	25.7	92	482	-
	SBL	153	64.9	37	144	377	82.6	103	334	750
	WBL	72	79.4	27	103	269	83.6	81	288	-
	WBR	343	27.3	51	421	508	22.7	63	568	-
	NBT	1,904	19.3	103	690	1,533	13.4	51	590	-
	NBR	100	11.8	2	122	214	8.0	3	132	350
	Intersection	**4,064**	**23.1**	**LOS C***		**5,741**	**37.7**	**LOS D***		**-**

***Note:** Estimated LOS from VISSIM. Distance to the I-4 EB gore point from the stop bar is approximately 2,100 feet.

Table 18: 2019 AM and PM Peak Hour Node Evaluation Results – SR 535 at I-4 WB Ramps and Hotel Plaza Boulevard

Intersection	Movement	AM Peak Hour				PM Peak Hour				Turn Lane Length (feet)
		Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	
SR 535@ I-4 WB Ramps	WBL	525	61.1	117	406	790	64.9	195	639	-
	WBR	670	63.6	162	532	678	62.9	164	601	-
	NBL	259	96.6	155	479	318	80.2	153	627	325
	NBT	1,279	6.5	17	237	1,644	10.0	27	336	-
	SBT (TO RAMP)	954	15.2	18	278	790	15.9	19	305	-
	SBR	707	16.2	28	581	643	15.6	29	544	700
	SBT (TO SB 535)	699	23.1	40	291	1,230	41.1	103	507	-
	Intersection	**5,093**	**29.5**	**LOS C***		**6,093**	**34.3**	**LOS C***		**-**
SR 535 @ Hotel Plaza Boulevard	NBT	1,244	30.7	89	520	1,626	72.7	328	1,247	-
	NBL	522	84.5	142	455	474	92.3	135	523	550
	NBR	68	5.3	1	62	157	28.2	3	98	300
	EBR	402	45.9	65	289	1,002	38.8	156	969	-
	EBL	172	94.0	69	236	583	168.6	489	1,121	-
	EBT	27	90.0	69	236	83	169.8	489	1,121	-
	WBL	45	105.3	42	205	98	108.3	66	265	-
	WBR	24	22.2	54	222	55	42.1	79	282	100
	WBT	44	103.3	42	205	59	113.0	66	265	-
	SBT	1,877	53.3	417	1,230	1,584	62.9	296	1,117	-
	SBU	33	109.9	58	253	29	112.2	80	377	350
	SBR	250	31.8	7	141	259	27.2	13	188	350
	SBL	68	106.9	58	253	114	106.5	80	377	350
	Intersection	**4,775**	**52.0**	**LOS D***		**6,123**	**75.0**	**LOS E***		**-**

***Note:** Estimated LOS from VISSIM. Distance to the I-4 WB gore point from the stop bar is approximately 1,265 feet.

Table 19: 2019 AM and PM Peak Hour Node Evaluation Results – SR 535 at Palm Pkwy and Daryl Carter Pkwy at Palm Pkwy

Intersection	Movement	AM Peak Hour				PM Peak Hour				Turn Lane Length (feet)
		Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	
SR 535 @ Palm Pkwy	NBU	47	116.0	190	554	52	102.1	164	537	950
	NBR	186	5.3	0	38	352	8.7	0	49	950
	NBL	571	98.3	190	554	606	80.7	164	537	950
	NBT	697	29.2	63	490	1,336	45.7	228	1,178	-
	EBR	966	26.4	97	1,025	682	5.5	4	218	-
	EBT	398	100.2	332	1,003	315	68.9	151	639	-
	EBL	422	98.0	166	671	435	88.1	149	596	-
	SBT	870	47.4	143	600	826	59.4	180	859	-
	SBL	21	72.0	7	64	41	148.4	33	296	170
	SBR	327	2.7	0	63	544	5.9	0	91	460
	SBU	0	0	0	0	2	144.2	33	296	170
	WBT	197	54.6	45	200	505	77.7	165	628	-
	WBR	26	36.0	61	225	40	73.9	186	653	-
	WBL	255	77.0	83	258	284	89.2	102	350	330
	Intersection	**4,982**	**53.2**	**LOS D***		**6,021**	**51.2**	**LOS D***		**-**
Daryl Carter Pkwy @ Palm Pkwy	NBR	206	6.5	6	101	278	6.8	9	123	-
	NBL	222	28.7	26	132	385	39.5	56	211	-
	WBL	134	27.4	17	101	390	35.5	50	212	480
	WBT	431	9.8	12	122	905	17.1	49	345	-
	EBR	182	14.2	50	321	393	25.7	101	504	-
	EBT	764	17.5	49	317	629	27.2	99	501	-
	Intersection	**1,939**	**16.3**	**LOS B***		**2,980**	**24.7**	**LOS C***		**-**

***Note:** Estimated LOS from VISSIM.

As summarized in **Table 17** - **Table 19**, during the existing (2019) AM and PM peak hours, all the intersections are operating at LOS D or better, except the SR 535 and Hotel Plaza Boulevard intersection, which is operating at LOS E during PM peak hour. The northbound left-turn movement, eastbound left-turn and through movements, westbound left-turn and through movements, and southbound left-turn movement at the intersection of SR 535 and Hotel Plaza Boulevard experience relatively high delay during the PM peak hour. The northbound through and southbound through movements at this intersection experience queues of approximately 1,200 feet during the PM peak hour. The maximum eastbound left and through movement queues extend approximately 1,100 feet during the PM peak hour.

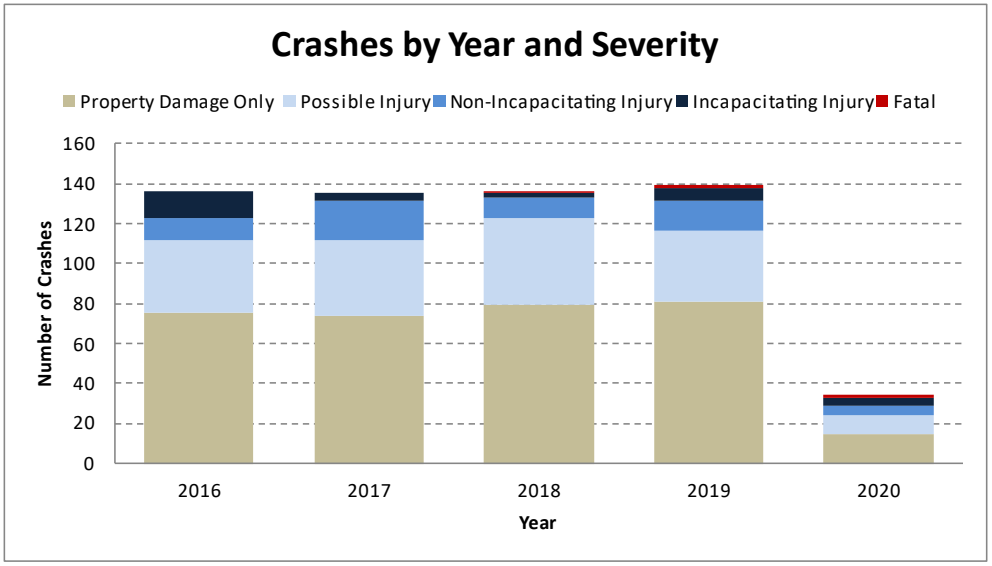
4.4. Historical Crash Analysis

A safety analysis was conducted to support the I-4 at SR 535 IMR. Crash records were obtained for I-4 from the SR 536 interchange to the Central Florida Parkway interchange for the five-year period of 2016 through 2020 from FDOT's Crash Analysis Reporting (CAR) online database.

Crash data for the arterials within the project's area of influence was also obtained and analyzed. CAR data was utilized for State Road arterials. The FDOT State Safety Office Geographic information system (SSOGis) and the University of Florida's Signal Four (S4) crash database was utilized for the Non-State Road arterials. This section summarizes the I-4 eastbound, I-4 westbound, I-4 interchange ramps, and arterial roadway/intersection crash rate/frequency statistics based on the safety analysis performed. A more detailed summary of the 2016 to 2020 crash data set in tabular and graphical format is also provided in **Appendix H**.

4.4.1 I-4 Eastbound Crash Statistics

Figure 11 displays a summary of crash frequency by year along with their respective severity from 2016 to 2020. There were a total of 580 reported crashes during this period, 253 of which (44 percent) resulted in 552 injuries and three of which resulted in three fatalities. As displayed in **Figure 11**, the crashes per year along the corridor generally remained the same from 2016 through 2019, with a drop in reported crashes in 2020 due to the lag in processing CAR data; however, it should be noted that fatal and incapacitating injury crash data is complete for 2020. The drop in 2020 could also be attributed to the impacts of the COVID-19 pandemic. Caution should be used in comparing the year 2020 data set with historical data from previous years.



Note: 2020 data likely impacted by the COVID-19 Pandemic. Caution should be used in comparing the year 2020 data set with historical data from previous years.

Figure 11: Crashes per Year – I-4 Eastbound

Figure 12 displays the crashes along I-4 eastbound by type and severity for the five-year study period. The highest crash type observed was rear end, comprising 66 percent of the total crashes. Sideswipe (17 percent) and fixed object/run-off road (five percent) were the second and third highest defined crash types. Rear end and sideswipe accounted for 83 percent of the injury crashes. As noted above, three fatal crashes occurred during the five-year period along I-4 eastbound. These fatal crashes were angle, fixed object/run-off road, and pedestrian.

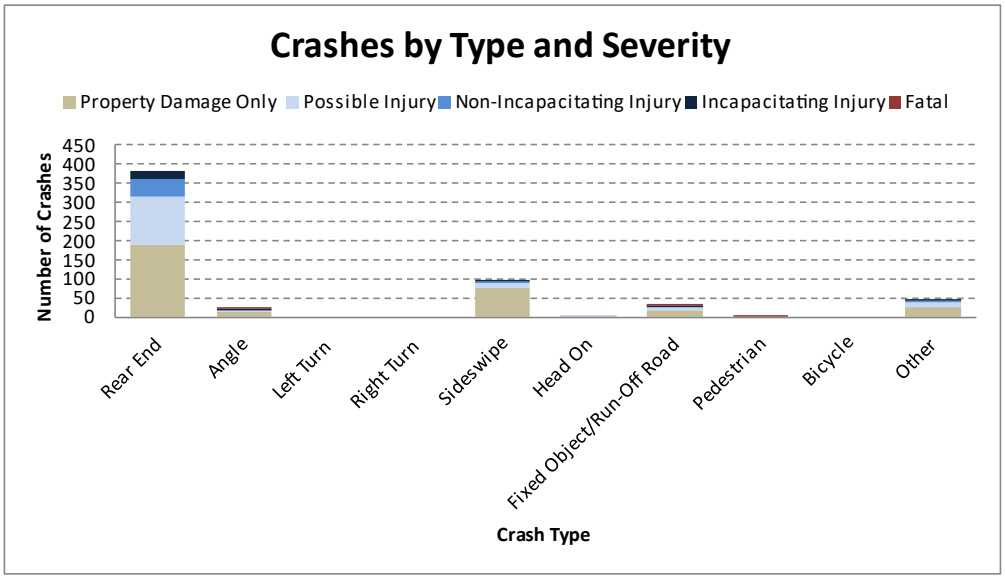
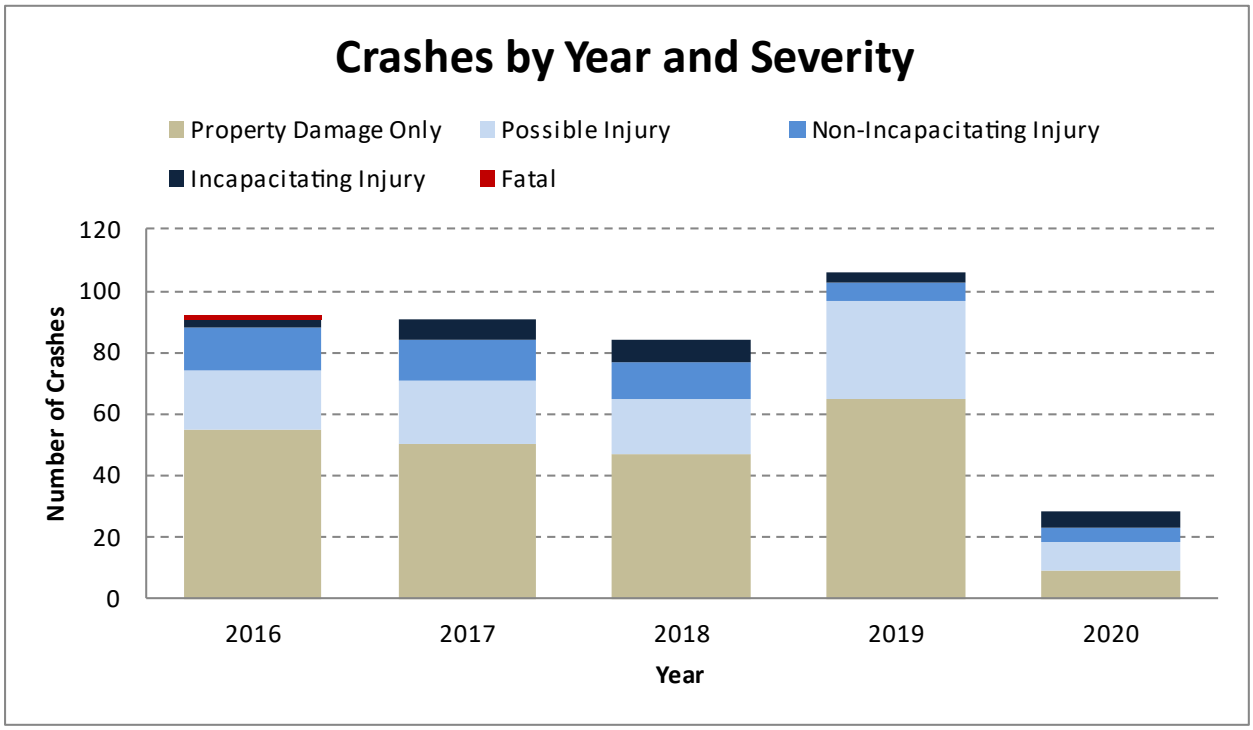


Figure 12: Crashes by Type and Severity – I-4 Eastbound

4.4.2 I-4 Westbound Crash Statistics

Figure 13 displays a summary of crash frequency by year along with their respective severity from 2016 to 2020. There was a total of 401 reported crashes during this period, 174 of which (43 percent) resulted in 330 injuries and one of which resulted in one fatality. As displayed in **Figure 13**, the crashes per year along the corridor generally decreased from 2016 through 2018, then increased in 2019 to 106 crashes. Crashes reduced in 2020 due to the lag in processing CAR data; however, it should be noted that fatal and incapacitating injury crash data is complete for 2020. The drop in 2020 could also be attributed to the impacts of the COVID-19 pandemic. Caution should be used in comparing the year 2020 data set with historical data from previous years.

Figure 14 displays the crashes along I-4 westbound by type and severity for the five-year study period. The highest crash type observed was rear end, comprising 55 percent of the total crashes. Sideswipe (21 percent) and fixed object/run-off road (eight percent) and were the second and third highest defined crash types. Rear end and sideswipe accounted for 76 percent of the injury crashes. As noted above, one fatal crash occurred during the five-year period along I-4 westbound. The crash was a sideswipe crash.



Note: 2020 data likely impacted by the COVID-19 Pandemic. Caution should be used in comparing the year 2020 data set with historical data from previous years.

Figure 13: Crashes per Year – I-4 Westbound

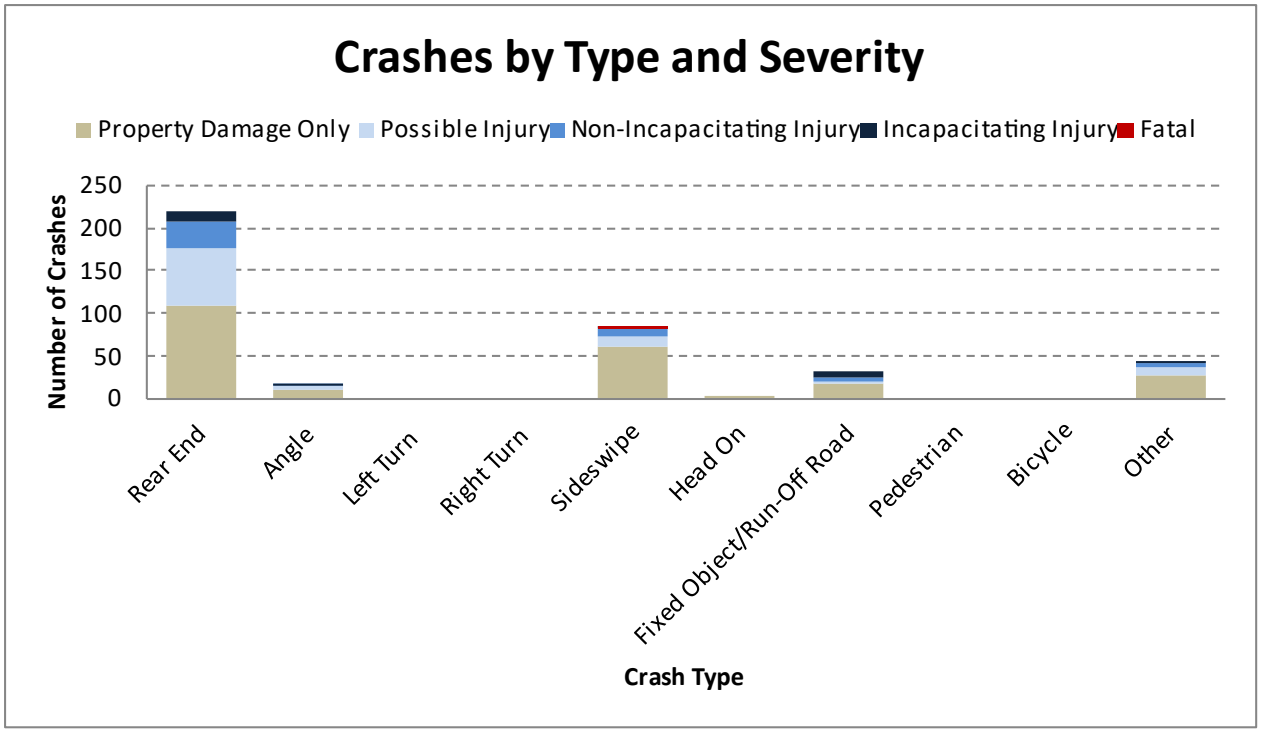


Figure 14: Crashes by Type and Severity – I-4 Westbound

4.4.3 Contributing Factors

As discussed in the previous sections, rear-end was the highest crash type for both the I-4 eastbound and I-4 westbound directions (66 percent of eastbound and 55 percent of westbound total crashes). Sideswipe was the second highest crash type for both the eastbound and westbound directions, with 17 percent of the eastbound and 21 percent of westbound total crashes. Fixed object/run-off road was the third highest crash type for both the eastbound and westbound directions, with five percent of the eastbound and eight percent of westbound total crashes.

Contributing factors relating to the three highest crash types in an urban freeway setting may be the following:

- Rear-end –
  - Reoccurring congestion related to AM and PM peak hour traffic volumes;
  - Non-reoccurring congestion related to crashes, disabled vehicles, etc.; and
  - Near interchange weave/merge/diverge areas where vehicles traveling at different speeds are interacting.
- Sideswipe –
  - Near interchange weave/merge/diverge areas where vehicles needing to make lane change movements are occurring;
  - When a vehicle needs to change lanes to avoid a disabled vehicle, crash, etc.;
  - When a vehicle needs to change lanes for an emergency vehicle on the shoulder; and

  - When a vehicle makes a sudden lane change in reoccurring or non-reoccurring congestion.
- Fixed object/run-off road –
  - Vehicles traveling at high speeds; and
  - Roadside barrier present on the shoulder immediately adjacent to the paved shoulders through the interchange area.

4.4.4 Arterial Crash Statistics

Table 20 displays the arterial crash frequency and highest crash types for the two arterial roadways within the I-4/SR 535 area of influence. The highest crash type for each arterial was rear-end, with the second highest crash type varying by corridor. A more detailed summary of the 2016 to 2020 arterial crash data set in tabular and graphical format is provided in **Appendix H**.

Table 20: Arterial Crash Frequency – 2016 to 2020

Arterial	From	To	5 Year Total Crashes	Highest Crash Type 1	Highest Crash Type 2
SR 535	Meadow Creek Drive	Winter Garden Vineland Road	1,197	Rear End - 58%	Sideswipe - 19%
Daryl Carter Parkway	Palm Parkway	Regency Village Drive	51	Rear End - 47%	Left Turn - 18%

4.4.5 Intersection Crash Statistics

Table 21 displays the intersection crash frequency and highest crash types for the following seven intersections identified within the I-4/SR 535 area of influence. As displayed in the table, SR 535 at I-4 Eastbound Off-Ramp/Vineland Avenue (333 crashes), SR 535 at Winter Garden Vineland Road (267 crashes), and SR 535 at Hotel Plaza Boulevard (260 crashes) were the three highest crash intersections in the influence area. Rear-end was the highest crash type for six of the seven study intersections with sideswipe being the second highest crash type for six of the seven study intersections. A more detailed summary of the 2016 to 2020 intersection crash data set in tabular and graphical format is provided in **Appendix H**.

Table 21: Intersection Crash Frequency – 2016 to 2020

Roadway 1	Roadway 2	5 Year Total Crashes	Highest Crash Type	Second Highest Crash Type
SR 535	Meadow Creek Drive	170	Rear End - 61%	Sideswipe - 11%
SR 535	I-4 Eastbound Off-Ramp/Vineland Avenue	333	Rear End - 61%	Sideswipe - 19%
SR 535	I-4 Westbound Ramps	237	Rear End - 60%	Sideswipe - 13%
SR 535	Hotel Plaza Boulevard	260	Rear End - 59%	Sideswipe - 23%
SR 535	Winter Garden Vineland Road	267	Rear End - 49%	Sideswipe - 19%
Daryl Carter Parkway	Regency Village Drive	24	Left Turn - 33%	Angle - 29%
Daryl Carter Parkway	Palm Parkway	26	Rear End - 73%	Sideswipe - 15%

4.4.6 Crash Rate and Frequency Analysis

A crash rate and crash frequency analysis were performed for I-4 eastbound, I-4 westbound, and the arterials noted in the previous section. Note that as 2020 average crash rates are not yet available, crash rate analyses were limited to 2016 through 2019 data. I-4 was segmented for the interchange areas and the freeway segments between the interchanges. Interchange areas extended from the beginning of the off-ramp west of the interchange to the end of the on-ramp east of the interchange. Due to the short distance between the SR 536 on ramp and the SR 535 off ramp in the eastbound direction, a freeway segment between the two interchanges was not analyzed for the eastbound direction.

Actual crash rates, expressed as number of crashes per million vehicle miles traveled (MVMT), were calculated from the total number of crashes in a year, AADT, and the length of the segment/corridor based on the equation below:

Actual Crash Rate = (Number of crashes per year x 1,000,000) / (ADT x 365 x segment length)

Traffic data, such as functional classification and AADTs, were obtained from the Florida Traffic Online website. For Non-State roads where AADT was not available on the FDOT database, Orange County traffic count data was used to obtain historical AADTs. The calculated actual crash rates were compared to the critical crash rate to find the safety ratio for I-4 segments, arterials, and intersections within the area of influence. The critical crash rate is calculated using the Statewide average crash rates for similar facilities based on the equation below:

Critical Crash Rate = Statewide Average Crash Rate + (K Factor x SQRT {Statewide Average Crash Rate / Vehicle Exposure}) – (1 / {2 x Vehicle Exposure})

Where Vehicle Exposure = (ADT x 365 x Segment Length) / 1,000,000

Safety Ratio = Actual Crash Rate / Critical Crash Rate

The facility types and statewide average crash rates for study corridor segments and analyzed intersections are summarized in **Table 22**. **Table 23** through **Table 26** provides a crash rate and safety ratio summary for I-4 eastbound, I-4 westbound, arterials, ramp terminals, and intersections within the area of influence. Intersection crash rate analysis could not be completed for the intersection of SR 535 and Meadow Creek Drive, SR 535 and Hotel Plaza Boulevard, and Daryl Carter Parkway and Regency Village Drive due to the absence of historical volume data on the minor roads. The detailed crash rate analysis for each of the I-4 segments, arterials, and intersections can be found in **Appendix I**. A map set showing the crash rate analysis limits can also be found in **Appendix I**.

Table 22: Facility Types and Statewide Average Crash Rates

Facility Type	Year				4 Year Average
	2016	2017	2018	2019	
I-4 – Urban Interstate	1.039	1.038	0.980	0.956	1.005
SR 535 – Urban 6+ Lane 2 Way Divided Raised	5.020	5.000	5.061	4.890	4.995
Daryl Carter Parkway – Urban 4-5 Lane 2 Way Divided Raised	3.800	3.911	3.922	3.892	3.884
SR 535 at I-4 Eastbound Off-Ramp/Vineland Avenue – Urban Ramp 4 Leg	1.267	1.808	1.963	2.406	1.861
SR 535 at I-4 Westbound Ramps – Urban Ramp 3 Leg	1.536	1.478	1.455	1.293	1.422
SR 535 at Winter Garden Vineland Road – Urban 6+ Lane Divided Raised 4 Leg	0.939	0.938	0.948	0.915	0.942
Daryl Carter Parkway at Palm Parkway – Urban 4-5 Lane Divided Raised 3 Leg	0.436	0.448	0.442	0.439	0.446

Table 23: I-4 Eastbound Crash Rates and Safety Ratios

I-4 Eastbound Segment	4 Year Actual Crash Rate	4 Year Critical Crash Rate	Safety Ratio
SR 536 Interchange Area	1.307	1.719	0.760
SR 535 Interchange Area	**2.152**	**1.535**	**1.402**
SR 535 to Central Florida Parkway Interchange	0.260	1.358	0.191
Central Florida Parkway Interchange Area	0.568	1.792	0.317

Bold Rows display roadway segments with crash rates higher than rates of similar facilities.

Table 24: I-4 Westbound Crash Rates and Safety Ratios

I-4 Westbound Segment	4 Year Actual Crash Rate	4 Year Critical Crash Rate	Safety Ratio
Central Florida Parkway Interchange Area	0.598	1.639	0.365
Central Florida Parkway to SR 535 Interchange	0.486	1.392	0.349
SR 535 Interchange Area	1.186	1.639	0.724
SR 535 to SR 536 Interchange	0.212	1.847	0.115
SR 536 Interchange Area	0.499	1.692	0.295

Bold Rows display roadway segments with crash rates higher than rates of similar facilities.

Table 25: Arterial Crash Rates and Safety Ratios

Arterial	From	To	4 Year Actual Crash Rate	4 Year Critical Crash Rate	Safety Ratio
SR 535	**Meadow Creek Drive**	**Winter Garden Vineland Road**	**11.365**	**6.488**	**1.752**
Daryl Carter Parkway	Palm Parkway	Regency Village Drive	5.155	8.448	0.610

Bold Rows display roadway segments with crash rates higher than rates of similar facilities.

Table 26: Ramp Terminal and Intersection Crash Rates and Safety Ratios

Intersection	4 Year Actual Crash Rate	4 Year Critical Crash Rate	Safety Ratio
SR 535 at I-4 Eastbound Off-Ramp/ Vineland Avenue	2.647	2.691	0.984
SR 535 at I-4 Westbound Ramps	1.453	2.055	0.707
SR 535 at Winter Garden Vineland Road	**2.308**	**1.542**	**1.497**
Daryl Carter Parkway at Palm Parkway	0.430	0.446	0.422

Bold Rows display roadway segments with crash rates higher than rates of similar facilities.

The crash rate analysis demonstrated that the crash rates on the following roadway segments and intersections in the study area are higher than the average crash rates for similar facilities:

- I-4 Eastbound in the SR 535 interchange area;
- SR 535 from Meadow Creek Drive to Winter Garden Vineland Road; and
- SR 535 at Winter Garden Vineland Road.

The eastbound I-4 segment through the interchange area has one egress point (SR 535 off ramp) and multiple ingress points (SR 535 southbound to I-4 eastbound loop ramp and the SR 535 northbound to I-4 eastbound on ramp). The ingress points cause weaving maneuvers through this stretch of I-4 which is likely the primary reason for the higher safety ratio.

For SR 535 from Meadow Creek Drive to Winter Garden Vineland Road, the high traffic volumes and urban context with numerous access points is likely a primary reason for the higher safety ratio. It is reasonable to assume that the safety will improve on the north side of the interchange primarily due to the removal of the left turn movement at the SR 535/I-4 westbound ramp terminal intersection.

Similar contributing factors exist at the SR 535 and Winter Garden Vineland Road intersection, including high traffic volumes along both SR 535 and Winter Garden Vineland Road/Palm Parkway. There are also numerous access points within the intersection influence area, as well as a closely spaced intersection on Winter Garden Vineland Road approximately 725' west of SR 535, that is likely contributing to the higher than average crash rate.

4.4.7 Interchange Ramp Crash Analysis

In addition to the I-4 mainline segments and other study roadways, interchange ramp crashes were summarized to identify high crash ramps. A crash rate analysis was not performed for the ramps because no statewide average crash rates are available for ramps. **Table 27** displays each of the ramps and the total number of crashes. Raw ramp crash data can be found in **Appendix H**.

Table 27: Interchange Ramp Crash Statistics

Ramp	5 Year Total Crashes
I-4 WB Off-Ramp to SR 535	69
I-4 WB On-Ramp from SR 535	41
I-4 EB Off-Ramp to SR 535	22
I-4 EB On-Ramp from SR 535 SB	14
I-4 EB On-Ramp from SR 535 NB	32

5. SUBAREA MODEL DEVELOPMENT

The following summarizes the results of the base year subarea model validation and future year model development. Detailed information on validation metrics, changes to the future year model, etc. is included in the final subarea validation report included in **Appendix J**. A review of the subarea validated was completed by FDOT D5 prior to the completion of this IMR.

5.1. Travel Demand Model

The Central Florida Regional Planning Model, version 7.0 (CFRPM 7.0) was used to complete the modeling for this IMR. The model base year is 2015 and the model horizon year is 2045. The CFRPM 7.0 went through extensive reviews with the local planning agencies and with the Metropolitan Planning Organization (MPO)/Transportation Planning Organization (TPOs) in the area prior to release in March 2021. The subarea model calibration and validation followed the procedures outlined in FDOT's 2019 Project Traffic Forecasting Handbook and Florida Standard Urban Transportation Model Structure (FSUTMS) Model Calibration and Validation Standards.

5.2. Subarea Model Validation

Volume over count ratios, root mean square error (RMSE), vehicle miles traveled (VMT), and vehicle hours traveled within the base year (2015) CFRPM 7.0 were compared against the FDOT validation thresholds and each of these metrics were met resulting in a validated subarea model suitable for use in this IMR.

5.3. Future Year Subarea Model Development

To support the Design Year (2045) traffic analysis and forecasts, a future year (2045) subarea model was developed based on the CFRPM 7.0 Year 2045 Cost Feasible scenario. Detailed information on the future year subarea model development is included in the final subarea validation report provided in **Appendix J**.

The following updates discussed below were included during the future year subarea model development:

- Network modifications made during the base year (2015) model calibration process were applied in the future year (2045) subarea model, as they remain valid in the future years.
- The planned projects included in the MetroPlan Orlando's Transportation Improvement Program (TIP) Fiscal Year 2021-2025 and 2045 Cost Feasible MetroPlan Transportation Plan (MTP) were reviewed and included in the horizon year model.
- Turn prohibitors to match future geometric conditions in the network.

6. FUTURE TRAFFIC DEVELOPMENT

6.1. **Recommended Design Traffic Factors**

The procedures contained in FDOT's *2019 Project Traffic Forecasting Handbook* result in initial estimates of future daily traffic volumes that would occur during the average day of the year. Several factors are then used to convert from daily volumes to the "design hour" volumes used for analysis. This section of the IMR documents pertinent data used for selecting the traffic factors to be applied in preparing the design hour volumes. These factors are important as they play a role in determining the appropriate number of lanes along a facility or design features such as pavement thicknesses. Key traffic factors include K-factor, D-factor, and T-factor, which are further described as follows.

In general terms, the K-factor is the percentage of the daily traffic volume that occurs during the peak hour of the day. Specifically, the K-factor is used to convert an Annual Average Daily Traffic (AADT) volume into a two-way design hour volume (DHV) for a given roadway segment. The FDOT has implemented standardized K-factors for use in traffic forecasting statewide. The Standard K-factor is dependent upon the area type and facility type for a given project. A standard K-factor of 9.0% is typically used for most urban arterials. This means that 9 percent of the daily traffic occurs in the design hour. For this project, however, K- factor values specific to the study area were applied consistent with the approved MLOU.

The D-factor represents the percentage of traffic traveling in each direction along a roadway segment during the design hour. For example, a D-Factor of 60 percent would represent 60 percent of the traffic traveling in the peak direction and the remaining 40 percent of traffic traveling in the opposite direction. By applying a D-factor to the previously developed two-way design hour volume, the directional design hourly volumes (DDHVs) are calculated for a given roadway segment. These segment DDHVs for each leg of an intersection are then utilized in developing design hour intersection volumes.

The ratio of passenger vehicles and larger trucks is also important in the analysis and design of roadway improvements. T-factors identify the percentage of truck traffic utilizing the roadway during the design hour (DHT) as well as over the entire typical day (T_{24}).

6.1.1. K Factor

The K factor for the I-4 mainline was determined from reviewing historical K factor data along I-4 as documented in the approved MLOU. A K factor of 7.0 percent is recommended for design hour analysis on the I-4 mainline. For SR 535 and the SR 535 ramps, a K factor of 7.5 percent is recommended for the design hour analysis and is consistent with the approved MLOU. In addition to historical data, the recommended K factors along SR 535 are consistent with the K factors selected based on the ongoing analysis for the SR 535 Project Development & Environment (PD&E) Study.

Based on historical K factor data, a 10 percent K factor is recommended for the I-4 eastbound off-ramp to SR 535 for the PM peak hour and is consistent with the approved MLOU. It is important to note that the

AM K factor along this ramp is approximately 3 percent (refer to **Table 4**) so the use of a 10% K factor in the AM would result in unreasonably high volumes, so a lower value was used along this ramp for the AM peak hour. The effective K factors for the I-4 ramp pair (SR 535 west of SR 535) is an average of the individual existing K factors based on the unique peaking characteristics along the ramps. The K factors used in the traffic forecasting for this IMR are summarized in **Table 28**.

Table 28: Recommended K Factors

Roadway Segment	AM K Factor	PM K Factor
I-4	7.0%	7.0%
SR 535	7.5%	7.5%
Daryl Carter Parkway	9.0%	9.0%
Winter Garden Vineland Road	8.0%	9.0%
Palm Parkway	5.0%	6.0%
Turkey Lake Road	9.0%	9.0%
Meadow Creek, West of SR 535	9.0%	9.0%
Lake Vining Drive, East of SR 535	9.0%	9.0%
Regency Village Drive	9.0%	9.0%
I-4 Ramps (East of SR 535)	7.5%*	7.5%*
I-4 Ramps (West of SR 535)	5.5%*	7.5%*
I-4 Ramps (North of Daryl Carter Parkway)	9.0%*	9.0%*
I-4 Ramps (West of CFP)	9.0%*	9.0%*
I-4 Ramps (East of SR 536)	9.0%*	9.0%*

*Effective K factor applied to the ramp pairs.

6.1.2. Directional (D) Factors

A comprehensive review of the 2019 field collected volume and classification counts and the approach and departure volumes from the turning movement counts was completed to estimate the recommended D factors for AM and PM peak hours. The recommended D factors for the AM and PM peak hours are summarized in **Table 29**. The raw data and recommended D factors for each approach to each study intersection in the study area is also included in **Appendix K**.

It is acknowledged that there are select D factors along minor side streets that may be outside the range of D factors in Table 2-2 of the 2019 PTFH (higher than 67.1%); however, these instances are not along state roads and will have minimal growth applied to them based on their surrounding built out land uses. Artificially lowering them may result in lower volumes in the future than the existing condition. As such the field observed D factors were maintained for forecasting purposes.

Table 29: Recommended D Factors

Roadway Segment	AM D Factor	PM D Factor
SR 535, South of Meadow Creek Drive	57.8%	55.0%
Meadow Creek, West of SR 535	64.0%	62.0%
Lake Vining Drive, East of SR 535	80.6%	61.5%
SR 535, South of Vineland Ave	63.9%	54.1%
Vineland Ave, East of SR 535	57.5%	55.6%
I-4 Ramps (East of SR 535)	62.9%	53.4%
I-4 Ramps (West of SR 535)	70.3%	55.9%
SR 535, North of Hotel Plaza Blvd	60.7%	53.1%
SR 535, South of Hotel Plaza Blvd	56.4%	55.9%
Hotel Plaza Blvd, West of SR 535	58.0%	68.3%
Winter Garden Vineland Road, West of Grand Cypress Blvd	65.0%	52.2%
Palm Parkway, E. of SR 535	56.9%	54.2%
Apopka Vineland Road, North of Palm Parkway	52.9%	54.7%
Daryl Carter Parkway, East of Palm Parkway	59.9%	52.0%
Palm Parkway, South of Daryl Carter Parkway	59.4%	55.5%
Daryl Carter Parkway, West of Palm Parkway	56.9%*	57.4%*
Turkey Lake Road, North of Daryl Carter Parkway	62.6%	58.3%
Daryl Carter Parkway, West of Regency Village Drive	58.4%	54.0%
Daryl Carter Parkway, East of Regency Village Drive	60.4%	58.9%
Regency Village Drive, South of Daryl Carter Parkway	51.0%	55.8%
I-4 Ramps (North of Daryl Carter Parkway)	59.5%*	50.2%*
I-4 Ramps (West of CFP)	58.6%	64.8%
I-4 Ramps (East of SR 536)	70.1%	58.8%
I-4 from Daryl Carter Parkway to SR 535 (Anchor Point)	52.0%	50.8%

*Segment does not exist in the existing condition. CFRPM v7 model referenced to estimate D factor.

6.1.3. Truck Factors

Truck data from the 2019 Florida Traffic Online was reviewed as field collected classification counts were not included as part of the data collection efforts for this study. The recommended truck factors (T_{24} and DHT) for I-4, SR 535, and other arterials are summarized in **Table 30**. These truck percentage were based on the T Factors included on the Historical AADT Reports at the FDOT sites unless otherwise noted (e.g., synopsis report referenced for Site 750630).

Table 30: Recommended T24 and DHT Values

Roadway Segment	Recommended T Factor	Recommended DHT	Source
I-4 Mainline	7.9%	4.0%	Sites 753002, 750535, 750648
SR 535 north of I-4	6.2%	3.1%	Site 750581
SR 535 south of I-4	11.6%#	5.8%#	Site 750630
SR 535 Ramps	6.9%	3.5%	Sites 752006, 752007, 752008, 752009, 752010
SR 536 Ramps	4.4%	2.2%	Sites 752001, 752002
CFP Ramps	3.8%	1.9%	Sites 752011, 752012
Hotel Plaza Boulevard	5.6%	2.8%	Site 757083
Palm Parkway	3.8%	1.9%	Site 758116
Daryl Carter Parkway	3.8%	1.9%	Site 758364
Vineland Avenue	3.8%	1.9%	Site 758210
Minor Side Streets	N/A	1.0%*	*
Meadow Creek Drive	N/A	1.0%*	*
Lake Vining Drive	N/A	1.0%*	*
Regency Village Drive	N/A	1.0%*	*

*Truck percentages collected as part of turning movement counts used as class count data was unavailable.
Average of 2019 Synopsis Reports (1/28/19 – 1/30/19) – Site 750630

7. TRAFFIC FORECASTING

An annual growth rate was selected for each study roadway segment based upon comparison of historical volume trends, projected area-wide growth trends from the University of Florida's Bureau of Economic and Business Research (BEBR), and model growth rates. The following summarizes the review of the growth rates and the resulting forecast AADTs and DDHVs.

7.1. Historic Growth Rates

Historical AADTs were obtained from the 2019 FDOT Florida Traffic Online. Historic growth rates were evaluated using FDOT standard spreadsheets for linear trend analysis. Evaluations were conducted for 18 FDOT count locations within the study area. The FDOT Historical AADT reports and trends analyses for each count station are provided in **Appendix L**.

Table 31 and **Table 32** summarize the historical AADT data along with the linear historical growth rates and respective R^2 values at each FDOT station along SR 535 and nearby study roadways. The historical trends analysis indicates traffic along SR 535 to the south of I-4 show a positive annual growth averaging 1.40 percent with a 42.14 percent R^2 value. The SR 535 segment between I-4 and south of Hotel Plaza Boulevard, however, displays a negative annual growth rate of -0.20 percent with an R^2 value of 2.06 percent. Due to the low R^2 value, the negative growth rate can be deemed to be insignificant on SR 535. Further up north of the study corridor, the annual growth rate for SR 535 north of Winter Garden is 6.5 percent with an R^2 value of 72.24 percent.

The traffic along the I-4 ramps at SR 535 show annual growth ranging from 0.30 to 2.3 percent approximately with R^2 values ranging between 8.4 and 50.9 percent. The I-4 mainline annual growth rate ranged from -0.40 to 4.60 percent. The corresponding R^2 ranged from 2.34 to 94.03 percent. Generally, only growth rates with an R^2 value greater than or equal to 75 percent should be considered when determining growth factors with historical trends.

Table 31: Historical AADTs and Historical Growth Rates - SR 535 Arterial and SR 535 Ramps

Year	SR 535, North of Winter Garden Vineland	SR 535, North of I-4	SR 535, South of I-4	I-4 WB Off-Ramp to SR 535	I-4 EB On-Ramp from SR 535 NB	I-4 EB On-Ramp from SR 535 SB	I-4 EB Off-Ramp to SR 535	I-4 WB On-Ramp from SR 535
	FDOT site	FDOT site	FDOT site	FDOT site	FDOT site	FDOT site	FDOT site	FDOT site
	758311	750581	750630	752008	752007	752009	752006	752010
2004	-	-	41,500	22,500	10,500	11,500	9,900	12,000
2005	-	-	43,500	26,500	14,000	11,000	12,500	10,500
2006	-	-	51,000	19,500	11,000	11,500	9,900	9,100
2007	-	-	39,500	20,500	14,500	12,500	11,000	10,500
2008	-	-	43,000	26,000	13,000	13,000	13,500	10,000
2009	-	-	45,000	23,500	12,500	10,500	12,000	9,900
2010	-	-	39,000	22,500	12,000	12,000	11,500	8,600
2011	-	-	46,500	23,500	13,000	13,000	12,000	10,000
2012	20,000	64,500	50,500	26,500	13,500	11,500	13,000	10,500
2013	20,000	64,500	48,000	23,000	14,000	12,000	11,000	10,500
2014	20,000	57,000	49,000	26,000	14,500	11,500	12,500	11,000
2015	20,000	62,500	47,000	26,500	15,000	11,500	13,000	11,000
2016	22,500	63,500	51,500	25,500	15,000	12,000	13,000	12,500
2017	23,500	64,500	53,500	25,500	15,000	12,000	13,000	12,500
2018	23,500	61,500	48,000	26,500	15,500	12,500	13,500	13,000
2019	30,000	61,500	50,500	22,000	15,500	12,500	14,500	15,000
Annual Linear Growth Rate	6.5%	-0.2%	1.4%	0.8%	2.2%	0.3%	1.8%	2.3%
Annual Linear Volume Growth	1,196	-149	600	182	255	42	195	223
R^2	72.24%	2.06%	42.14%	14.18%	61.72%	8.40%	50.86%	43.27%

Table 32: Historical AADTs and Historical Growth Rates - I-4, Daryl Carter Parkway, and Adjacent I-4 Ramps

Year	I-4 Mainline (West of CFP)	I-4 Mainline (East of SR 535)	I-4 Mainline (West of SR 535)	I-4 Mainline (East of SR 536)	Daryl Carter, South of Regency Drive	I-4 EB Off-Ramp to CFP	I-4 WB On-Ramp from CFP	I-4 EB On-Ramp from SR 536	I-4 WB Off-Ramp to SR 536 NB	I-4 WB Off-Ramp to SR 536 SB
	FDOT site	FDOT site	FDOT site	FDOT site	FDOT site	FDOT site	FDOT site	FDOT site	FDOT site	FDOT site
	750648	750535	753003	753002	758364	752011	752012	752001	752002	752004
2004	119,000	147,500	-			8,200	5,900	12,000	12,000	1,500
2005	123,000	156,000	-			8,800	6,000	14,500	14,500	1,300
2006	126,000	165,000	-			6,600	6,600	14,000	12,000	1,500
2007	129,000	171,200	-			7,700	6,200	15,500	13,000	1,900
2008	132,000	177,300	-			7,400	7,900	9,300	13,000	2,200
2009	135,000	183,500				9,100	6,100	14,000	13,000	1,800
2010	138,000	189,500				7,600	7,400	12,000	12,000	2,400
2011	132,000	180,500				7,300	6,400	15,500	13,000	1,800
2012	135,500	184,000		142,000		9,500	6,900	13,500	14,500	2,500
2013	135,500	198,500		155,000		8,600	6,200	18,000	15,000	2,100
2014	136,500	203,000		157,000	3,700	9,500	6,900	19,500	17,000	2,100
2015	137,000	207,000		129,000	3,700	9,700	7,000	20,000	17,500	2,100
2016	184,500	208,000	168,000	132,000	3,700	9,100	6,600	20,000	17,500	2,100
2017	192,000	210,000	170,000	141,000	3,700	9,200	6,700	20,000	17,500	2,100
2018	193,000	235,000	177,500	143,000	8,800	9,500	6,900	20,500	18,000	2,200
2019	204,000	224,000	179,500	149,500	9,000	8,200	10,000	19,000	16,000	2,300
Annual Linear Growth Rate	4.6%	3.2%	2.5%	-0.4%	50.0%	1.4%	1.7%	5.2%	3.3%	3.3%
Annual Linear Volume Growth	5,072	4,907	4,200	(625)	1,194	108	107	600	395	48
R^2	72.46%	94.03%	93.58%	2.34%	69.19%	29.20%	26.22%	65.32%	70.69%	46.00%

7.2. BEBR Growth Rates

The University of Florida's BEBR projections were obtained for Orange County. The BEBR projections show an estimate for 2020 and projections up to 2045. The low, medium, and high projections for 2045 are summarized in **Table 33.** Growth rates range from approximately 0.53 percent to 2.59 percent. BEBR population study data is provided in **Appendix M**.

It is important to note that the BEBR data accounts for countywide data and does not necessarily reflect expected growth on specific roadways or sub-areas of the county. It is useful in reviewing reasonableness of growth rates obtained from other sources such as travel demand models or historical AADT data.

Table 33: BEBR Population Growth Rates

Estimation	2020 Estimate	2045 Projection	Annual Growth Rate, Growth/Year (%)
Orange County			
Low	1,415,260	1,602,500	7,490 (0.53%)
Medium		1,941,800	21,062 (1.49%)
High		2,331,800	36,662 (2.59%)

Source: BEBR Volume 54, Bulletin 189, April 2021

7.3. CFRPM 7.0 Growth Rates

The subarea validated CFRPM 7.0 with base year 2015 and forecast year 2045 was utilized to estimate model volume growth. A sub-area validation was completed as part of this project as previously described in Section 5.0. The peak season weekday average daily traffic (PSWADT) model volumes were converted to model AADTs using the appropriate model output conversion factors (MOCF) for Orange County. The model plots are included in **Appendix N**.

The model linear growth rates and annual model growth along the study segments within the area of influence are summarized in each table for the 2045 model as follows:

- SR 535 Arterial and Ramps - **Table 34**
- I-4 Mainline and other Arterials - **Table 35**

Model growth rates along SR 535 range between 0.58 and 0.99 percent per year. Model growth rates along Palm Parkway, Winter Garden Vineland Road, Hotel Plaza Boulevard, and Vineland Avenue (arterials connecting to SR 535) range between 1.54 and 1.87 percent.

Table 34: Model Growth Rates – SR 535 Arterial and Ramps

Roadway Segment	2015 Model AADT	2045 Model AADT	Annual Volume Growth	Annual Growth Rate
Lake Vining Drive East of SR 535	*	*	*	*
SR 535 South of Meadow Creek Drive	51,443	66,006	485	0.94%
SR 535 North of Vineland Avenue	69,051	82,128	436	0.63%
Vineland Avenue East of SR 535	23,671	36,146	416	1.76%
SR 535 North of I-4	59,241	69,474	341	0.58%
I-4 WB off-ramp to SR 535	25,499	30,943	181	0.71%
I-4 EB on-ramp from SR 535 (NB and SB)	23,438	23,234	-7	-0.03%
SR 535 South of I-4	53,685	69,563	529	0.99%
I-4 EB off-ramp to SR 535	13,304	14,377	36	0.27%
I-4 WB on-ramp from SR 535	15,398	23,550	272	1.77%
SR 535 North of Hotel Plaza Boulevard	52,273	62,356	336	0.64%
Hotel Plaza Boulevard West of SR 535	31,492	47,861	546	1.73%
Palm Parkway East of SR 535	23,196	36,199	433	1.87%
Winter Garden Vineland Road West of SR 535	36,515	53,355	561	1.54%
SR 535, North of Winter Garden Vineland Road	34,394	42,988	286	0.83%

*Link not included in the model

Table 35: Model Growth Rates – I-4 Mainline, Daryl Carter Parkway, and Adjacent I-4 Ramps

Roadway Segment	2015 Model AADT	2045 Model AADT	Annual Volume Growth	Annual Growth Rate
I-4 from Daryl Carter Parkway to SR 535	199,118	252,020	1,763	0.89%
I-4 WB off-ramp to Daryl Carter Parkway	*	21,990	733	-
I-4 EB on-ramp from Daryl Carter Parkway	*	23,633	788	-
Daryl Carter Parkway East of I-4	11,348	44,518	1,106	9.75%
I-4 EB off-ramp to Daryl Carter Parkway	*	6,096	203	-
Daryl Carter Parkway West of I-4	11,348	50,397	1,302	11.47%
Daryl Carter Parkway East of Regency Village Drive	5,244	29,400	805	15.35%
Regency Village Drive South of Daryl Carter Parkway	6,174	16,435	342	5.54%
Palm Parkway North of Daryl Carter Parkway	28,619	35,120	217	0.76%
Daryl Carter Parkway East of Palm Parkway	11,348	50,397	1,302	11.47%
Palm Parkway South of Daryl Carter Parkway	24,500	49,691	840	3.43%
Daryl Carter Parkway West of Palm Parkway	*	25,670	856	-
I-4 EB off-ramp to Central Florida Parkway	9,877	15,463	186	1.88%
I-4 WB on-ramp from Central Florida Parkway	17,673	19,955	76	0.43%
I-4 WB off ramp to SR 536	30,348	45,725	513	1.69%
I-4 EB on ramp from SR 536	19,505	38,267	625	3.20%

*Under the base year model, these links don't exist, but are being constructed as part of future construction projects

7.4. Recommended Growth Rates and Future AADTs

Recommended growth rates were determined based on a comprehensive evaluation of historic, BEBR, and model growth rates. The following summarizes the recommended growth rates and the resulting future year AADTs for the opening, interim, and design years.

7.4.1. Design Year (2045) AADTs

The applied linear growth rates, the AADT growth per year, and the forecast AADTs/DDHVs are summarized in **Table 36** and **Table 37** for the Design Year (2045) as follows. Generally, the model growth per year or model growth rate was applied to the existing year (2019) AADT volumes. However, there were two instances where the historical growth per year was selected to grow existing year (2019) AADT volumes. The determination between model slope, model growth rate and historical growth rate was made based on the impacts each has on the future AADT. There were instances where engineering judgement was applied based on the land use characteristics and available land in the area remaining for future development. For example, Meadow Creek Drive and Lake Vining Drive connect to SR 535 and have built out land uses with minimal potential to grow. For these locations, it was assumed that they would grow at a minimum of 0.50 percent per year. Notes on what source was used to select the recommended growth rate for each segment is included in the tables.

It is important to note that the closure of the development on the east leg of the Hotel Plaza Boulevard intersection was accounted for within the travel demand model and the growth rates used within the AOI reflect this condition. The resulting 2045 AADTs for the No-Build and Build conditions are illustrated in **Figure 15** and **Figure 16**, respectively. It is important to note that the Build geometry is reflective of the Phase I interchange improvements only.

7.4.1. Opening Year (2025) and Interim Year (2035) AADTs

Each of the study segments were interpolated between the existing (2019) and Design Year (2045) AADTs to estimate Opening Year (2025) AADTs. For ramps that didn't exist in the existing conditions (e.g., I-4 ramps to/from Daryl Carter Parkway), it was assumed that 70 percent of the design year volumes will be using the ramps/interchange in the opening year. The Interim Year (2035) AADTs were interpolated between the Opening Year (2025) and Design Year (2045) AADTs.

The Opening Year (2025) and Interim Year (2035) AADTs are summarized in the following figure sets:

- 2025 No-Build AADT – **Figure 17**
- 2025 Build AADT – **Figure 18**
- 2035 No-Build AADT – **Figure 19**
- 2035 Build AADT – **Figure 20**

Table 36: Recommended Growth Rates, Forecast AADTs, and Forecast DDHVs – SR 535

Roadway Segment	Recommended Linear Growth Rate	Recommended Annual Volume Growth	Notes on Growth Rate Selection	Existing Year	Future Year (2045)		
				AADT	AADT	AM DDHV	PM DDHV
SR 535 North of Meadow Creek Drive	1.08%	530	Model Slope	49,000	63,000	3,019	2,555
Lake Vining Drive East of SR 535	0.50%	N/A	Assume 0.5% Growth Rate	#	#	97	111
SR 535 South of Meadow Creek Drive	0.99%	485	Model Slope	50,500	63,000	2,729	2,600
Meadow Creek Drive West of SR 535	0.50%	N/A	Assume 0.5% Growth Rate	#	#	186	378
SR 535 North of Vineland Avenue	1.22%	440	Model Slope	36,000	47,500	2,388	2,042
Vineland Avenue East of SR 535	1.68%	420	Model Slope	25,000	36,000	1,555	1,495
SR 535 South of Vineland Avenue	1.08%	530	Model Slope	49,000	63,000	3,019	2,555
SR 535 North of I-4	0.54%	340	Model Slope	62,500	71,500	3,027	2,999
I-4 WB off-ramp to SR 535	0.71%	160	Model Growth Rate	22,500	26,500	1,657	2,078
I-4 EB on-ramp from SR 535 (NB and SB)	0.96%	255	Historical Slope	26,500	33,000	2,806	2,384
I-4 EB off-ramp to SR 535	1.34%	195	Historical Slope	14,500	19,500	653	1,677
I-4 WB on-ramp from SR 535	1.75%	245	Model Growth Rate	14,000	20,500	1,547	1,323
SR 535 South of I-4	1.08%	530	Model Slope	49,000	63,000	3,019	2,555
SR 535 North of Hotel Plaza Boulevard	0.65%	340	Model Slope	52,000	61,000	2,776	2,429
Hotel Plaza Boulevard West of SR 535	1.70%	N/A	Model Growth Rate	#	#	1,160	2,461
SR 535 South of Hotel Plaza Boulevard	0.54%	340	Model Slope	62,500	71,500	3,027	2,999
SR 535 North of Winter Garden Vineland Road	0.81%	290	Model Slope	36,000	43,500	1,726	1,783
Palm Parkway East of SR 535	1.90%	428	Model Growth Rate	22,500	33,500	953	1,089
SR 535 South of Winter Garden Vineland Road	0.65%	340	Model Slope	52,000	61,000	2,776	2,429
Winter Garden Vineland Road West of SR 535	1.50%	540	Model Growth Rate	36,000	50,000	2,601	2,350

No AADT data available at the intersection. The approach/departures from the peak hour turning movement volumes were grown to estimate future DDHVs.

Table 37: Recommended Growth Rates, Forecast AADTs, and Forecast DDHVs – I-4 mainline, Daryl Carter Parkway, and Adjacent I-4 Ramps

Roadway Segment	Recommended Linear Growth Rate	Recommended Annual Volume Growth	Notes on Growth Rate Selection	Existing Year	Future Year (2045)		
				AADT	AADT	AM DDHV	PM DDHV
Palm Parkway North of Daryl Carter Parkway	0.76%	182	Model Growth Rate	24,000	28,500	1,605	1,494
Daryl Carter Parkway East of Palm Parkway	7.14%	1,000	Average Model Slope Along Daryl Carter Pkwy	14,000	40,000	2,157	1,873
Palm Parkway South of Daryl Carter Parkway	3.43%	823	Model Growth Rate	24,000	45,500	2,432	2,271
Daryl Carter Parkway West of Palm Parkway	**	**	**	**	25,500	1,306	1,318
I-4 WB off-ramp to Daryl Carter Parkway	**	**	**	**	22,000	1,658	2,054
I-4 EB on-ramp from Daryl Carter Parkway	**	**	**	**	23,500	2,437	2,041
Daryl Carter Parkway East of I-4	7.14%	1,000	Average Model Slope Along Daryl Carter Pkwy	14,000	40,000	2,157	1,873
I-4 EB off-ramp to Daryl Carter Parkway	**	**	**	**	6,100	549	549
Daryl Carter Parkway West of I-4	7.14%	1,000	Average Model Slope Along Daryl Carter Pkwy	14,000	40,000	2,157	1,873
Daryl Carter Parkway East of Regency Village Drive	11.76%	1,000	Average Model Slope Along Daryl Carter Pkwy	8,500	34,500	1,876	1,828
Regency Village Drive South of Daryl Carter Parkway	5.20%	#	Model Growth Rate	#	#	235	725
Daryl Carter Parkway West of Regency Village Drive	7.14%	1,000	Average Model Slope Along Daryl Carter Pkwy	14,000	40,000	2,102	1,945
I-4 EB off-ramp to Central Florida Parkway	1.90%	156	Model Growth Rate	8,200	12,500	876	746
I-4 WB on-ramp from Central Florida Parkway	0.45%	45	Model Growth Rate	10,000	11,000	1,239	1,369
I-4 WB off ramp to SR 536	1.69%	315	Model Growth Rate	18,300	26,500	3,880	2,279
I-4 EB on ramp from SR 536	3.21%	610	Model Growth Rate	19,000	35,000	1,655	3,256
I-4 between SR 536 and SR 535	Future volumes determined based on balancing along the I-4 mainline from the anchor point location.						
I-4 from SR 535 to Daryl Carter Parkway*	0.89%	2,000	Model Growth Rate	224,000	276,000	10,051	9,817
I-4 from Daryl Carter Parkway to Central Florida Parkway	Future volumes determined based on balancing along the I-4 mainline from the anchor point location.						
I-4 north of Central Florida Parkway							

***Note:** Anchor Point Location

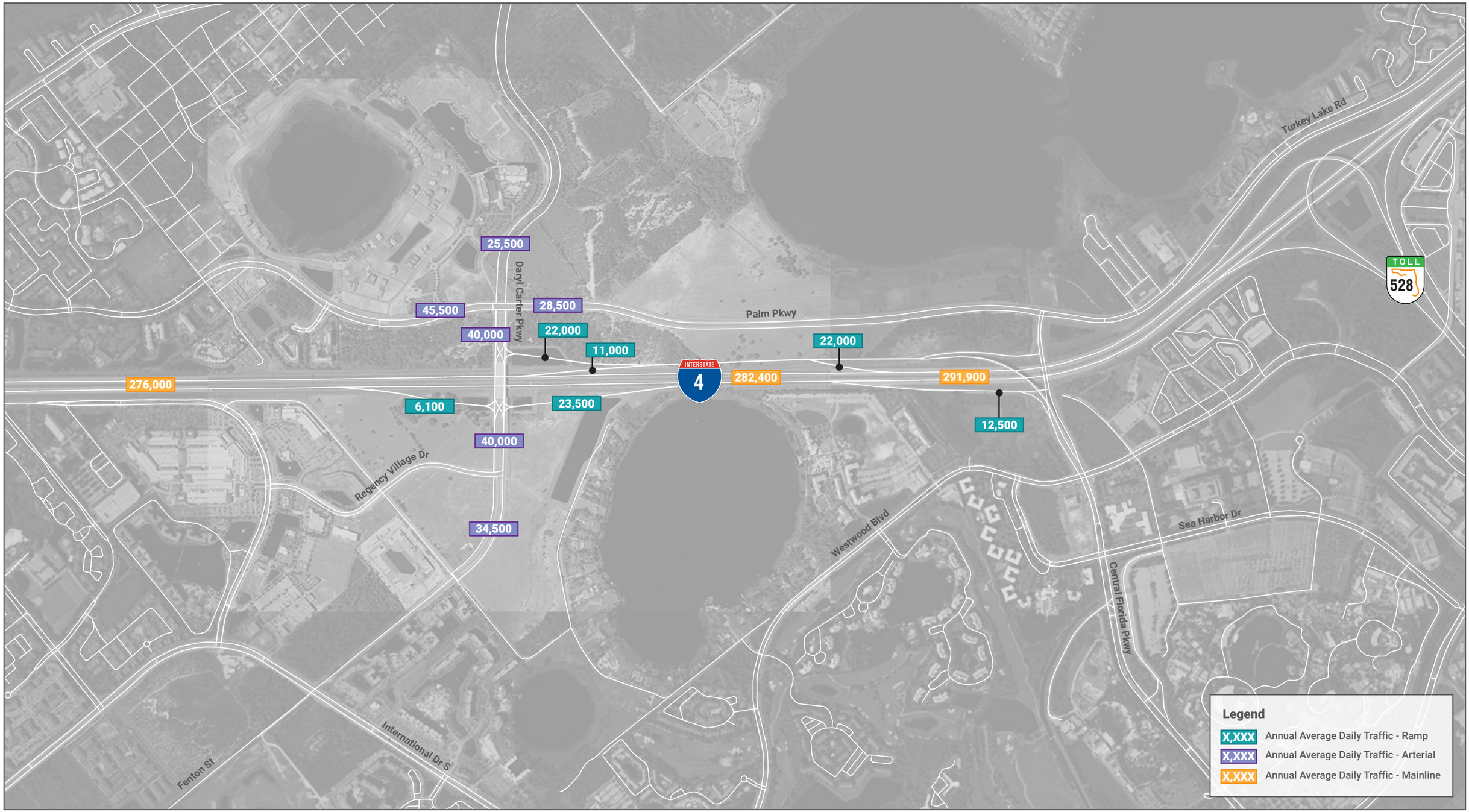
** Segment does not exist under the existing conditions. Model volume used as an estimate.

No AADT data available. The approach/departures from the peak hour turning movement volumes were grown to estimate future DDHVs.

Scale in Feet
0 1,200 North

FDOT **I-4 at SR 535 Interchange Modification Report**

FIGURE 15 | **2045 No-Build Annual Average Daily Traffic**



Scale in Feet
0 1,200 North

FIGURE 15 | **2045 No-Build Annual Average Daily Traffic**

(2 of 2)

Scale in Feet
0 1,200 North

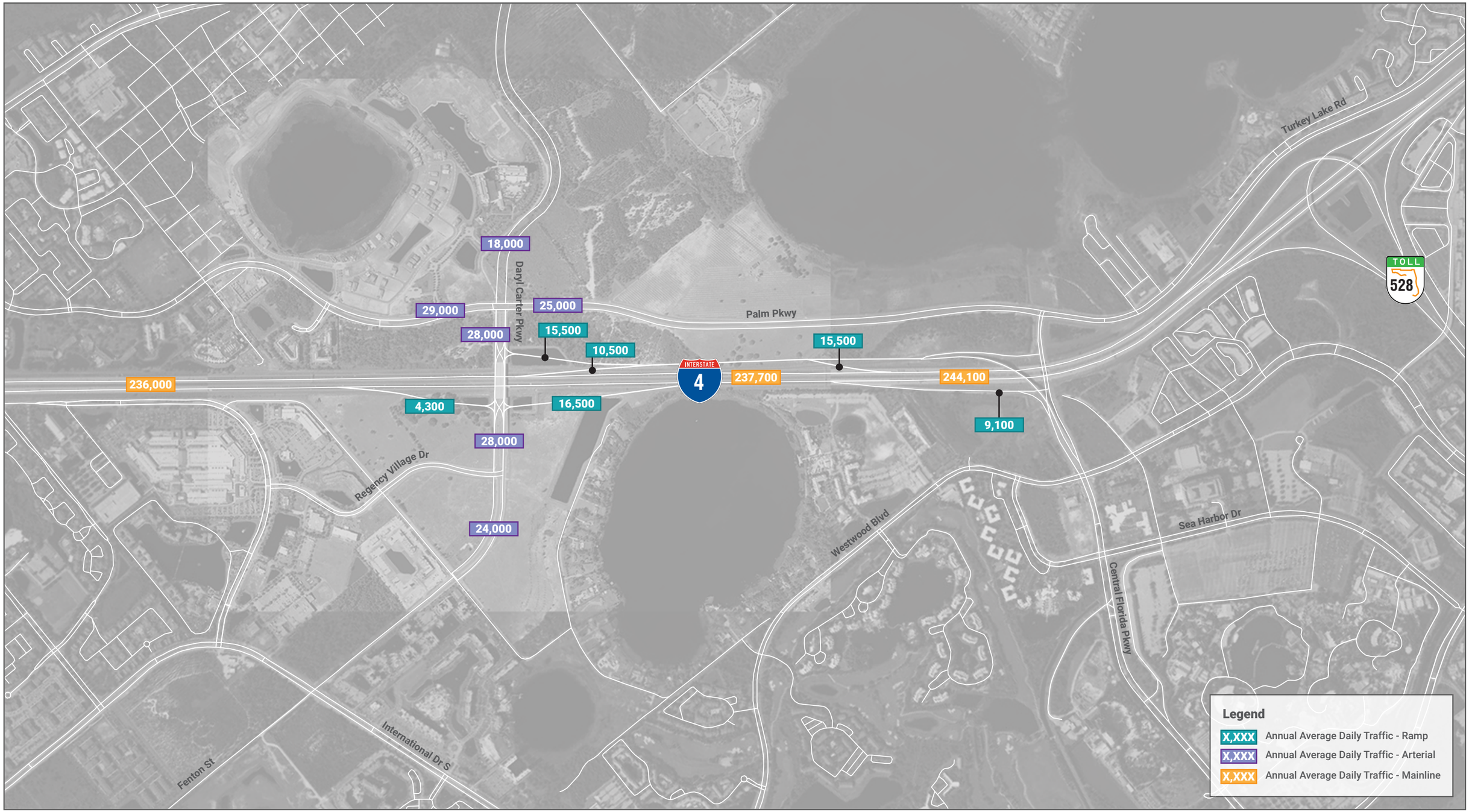
FIGURE 16 | **2045 Build Annual Average Daily Traffic**


25,500
45,500
28,500
40,000
22,000
11,000
276,000
6,100
23,500
40,000
34,500
INTERSTATE
4
282,400
22,000
291,900
12,500
Daryl Carter Pkwy
Palm Pkwy
Turkey Lake Rd
TOLL
528
Regency Village Dr
Westwood Blvd
Sea Harbor Dr
Central Florida Pkwy
International Dr S
Fenton St
Legend
X,XXX Annual Average Daily Traffic - Ramp
X,XXX Annual Average Daily Traffic - Arterial
X,XXX Annual Average Daily Traffic - Mainline
Express Lane
Scale in Feet
0
1,200
North

Scale in Feet
0 1,200 North

I-4 at SR 535 Interchange Modification Report

FIGURE 17 | **2025 No-Build Annual Average Daily Traffic**



Scale in Feet
0 1,200 North

FIGURE 17 | **2025 No-Build Annual Average Daily Traffic**

(2 of 2)

Scale in Feet
0 1,200 North

FDOT **I-4 at SR 535 Interchange Modification Report**

FIGURE 18 | **2025 Build Annual Average Daily Traffic**

Scale in Feet
0 1,200 North


Epcot Center Dr
Buena Vista Dr
Buena Vista Dr
Grand Cypress Blvd
Winter Garden Vineland Rd
Apopka Vineland Rd
Palm Pkwy
Hotel Plaza Blvd
Meadow Creek Dr
Vineland Ave
International Dr S
INTERSTATE
4
536
535
44,500
40,500
29,500
57,500
68,000
34,500
18,000
25,000
23,500
183,500
236,000
256,000
29,000
17,500
13,000
17,500
32,000
57,500
58,500
Legend
X,XXX Annual Average Daily Traffic - Ramp
X,XXX Annual Average Daily Traffic - Arterial
X,XXX Annual Average Daily Traffic - Mainline
Scale in Feet
0
1,200
North

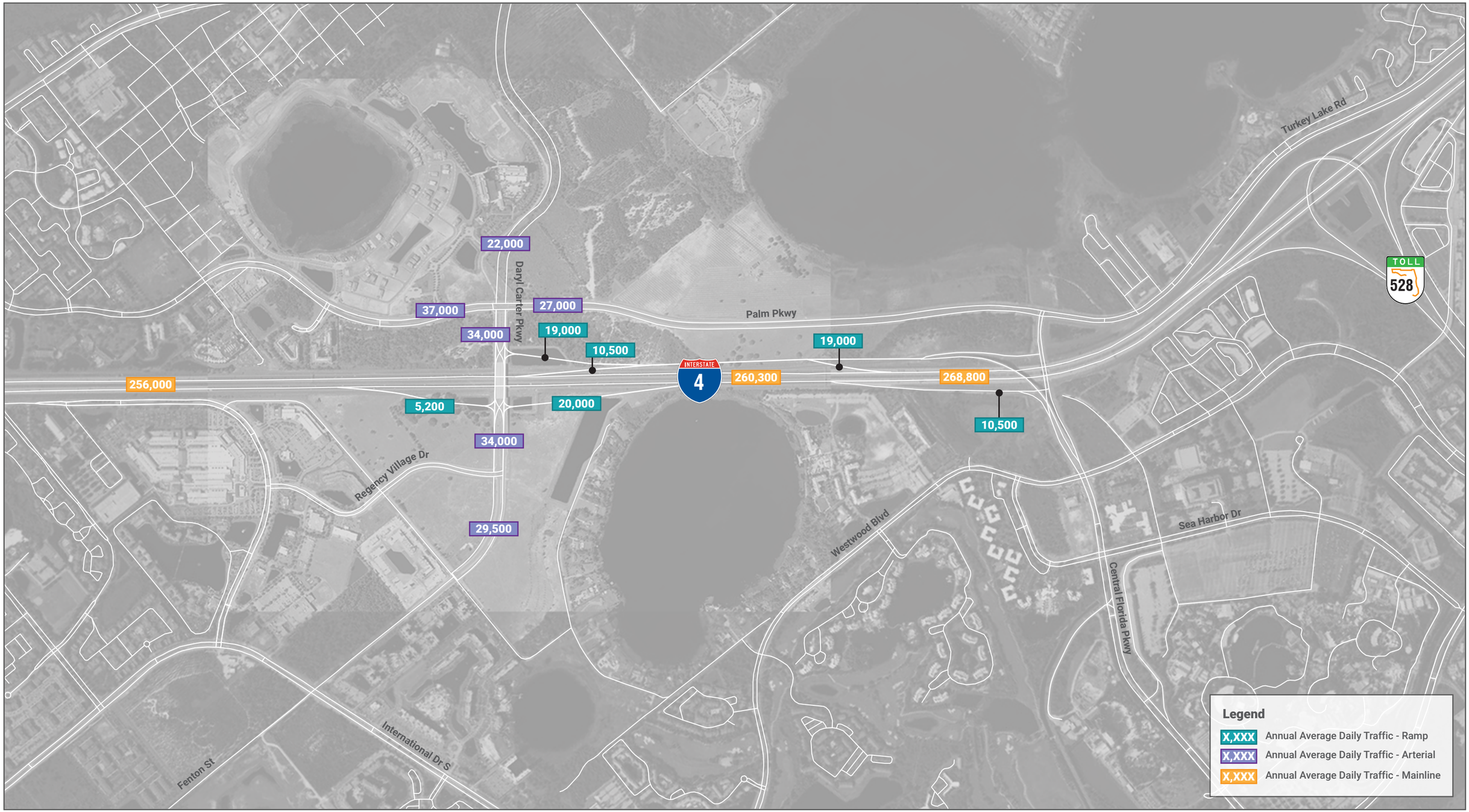
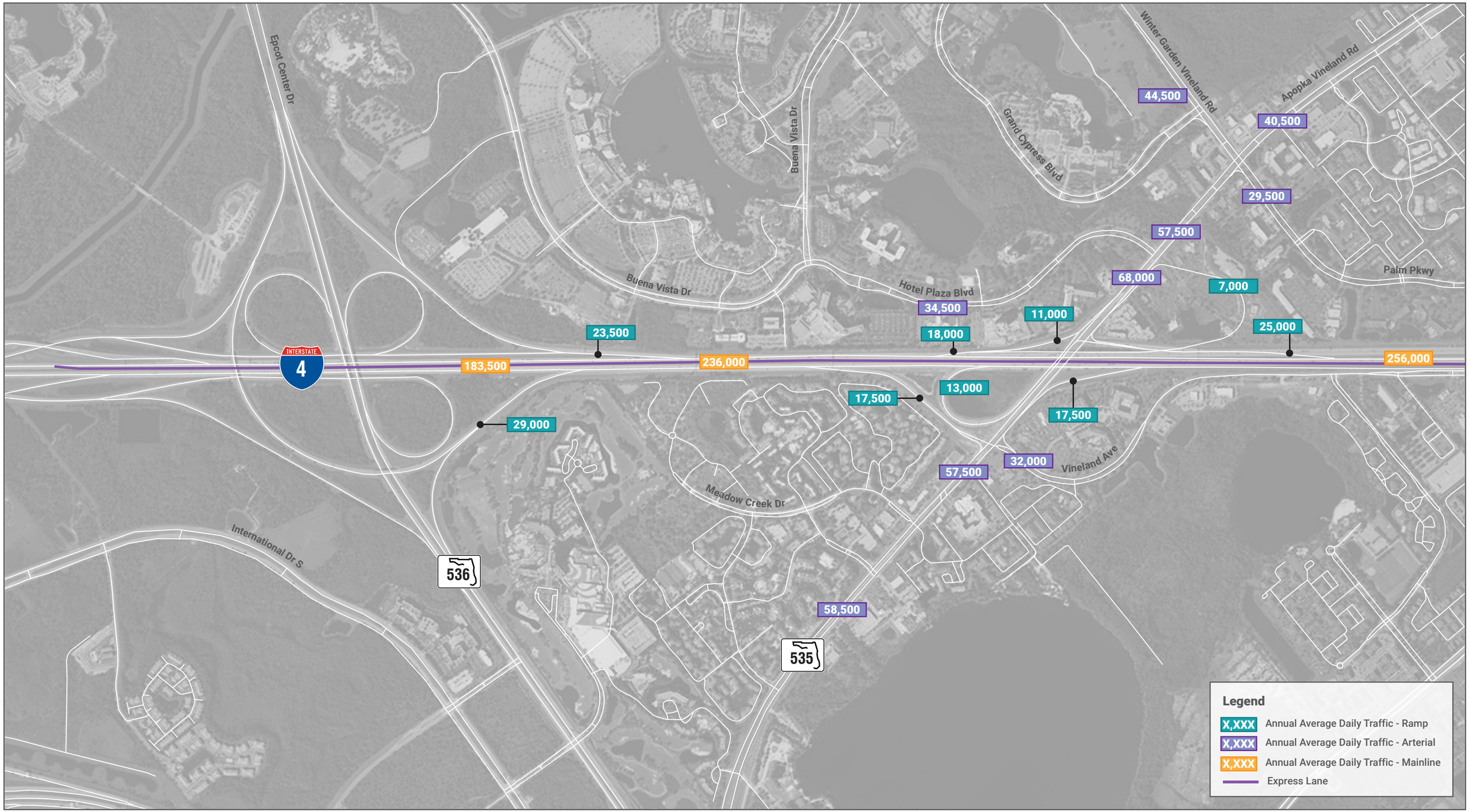


FIGURE 19 | **2035 No-Build Annual Average Daily Traffic**

(2 of 2)



I-4 at SR 535 Interchange Modification Report

FIGURE 20 | **2035 Build Annual Average Daily Traffic**


22,000
Daryl Carter Pkwy
37,000
27,000
Palm Pkwy
34,000
19,000
10,500
19,000
INTERSTATE
4
256,000
260,300
268,800
5,200
20,000
10,500
34,000
Regency Village Dr
29,500
Turkey Lake Rd
TOLL
528
Westwood Blvd
Sea Harbor Dr
Central Florida Pkwy
International Dr S
Fenton St
Legend
X,XXX Annual Average Daily Traffic - Ramp
X,XXX Annual Average Daily Traffic - Arterial
X,XXX Annual Average Daily Traffic - Mainline
Express Lane
Scale in Feet
0
1,200
North

8. DEVELOPMENT OF FUTURE INTERSECTION TURNING MOVEMENT VOLUMES

Design Year design-hour turning movement volumes were developed for two peak hours (i.e., AM and PM). Standard K and D factors were applied to the Design Year AADTs to estimate Directional Design Hour Volumes (DDHVs). A methodology that follows the iterative, growth-factoring procedures described in the *NCHRP Report 765* was used to convert future segment DDHVs into intersection turning movement volumes for the 2045 AM and PM peak hours. The *NCHRP Report 765* is a method consistent with the acceptable tools described in FDOT's *Project Traffic Forecasting Handbook* (2019). The inputs and raw outputs from the forecasting spreadsheet are included in **Appendix O**.

Ramp pairs were combined and treated as a traditional leg for forecasting purposes. This approach is consistent with the way a regular 4-leg intersection is forecasted using the NCHRP 765 methodologies except the mainline freeway volume is not included. This approach also offers an advantage of ensuring balanced volumes along the arterial between the ramp terminal intersections.

8.1. **Express Lane "Tube" Volume**

The Build scenario will include the addition of a single westbound buffer separate express lane (EL "Tube"). The tube begins west of the I-4 and Sand Lake Road interchange and continues through the AOI of this interchange project. Within the limits of the AOI, the express lane will not have access to or from the general use lanes (GULs); therefore, the express lane volume will remain the same within this project's AOI. The I-4 at Sand Lake Road IMR document received an affirmative determination from FHWA in December 2021 and included express lane volumes in the express lane "Tube" and a separate memo documenting the operations of the "Tube". For consistency with these documents, the express lane volume within the "Tube" was interpolated between the opening year and design year volumes of the Sand Lake Road IMR document and included in the Build scenario of this project. The excerpts including the express lane "Tube" volume projections from the Sand Lake Road IMR are included in **Appendix P** for reference.

8.2. **Volume Adjustments/Balancing**

The raw intersection turning movement volumes developed using the NCHRP 765 methodologies were reviewed against the existing turning movement volumes to ensure that volumes were not less in the future than the existing. Volumes along the arterials were balanced accordingly between ramp terminal intersections and between intersections where driveways do not exist.

Volumes along the mainline of I-4 were balanced using an anchor point along the facility. The I-4 mainline segment between SR 535 and Daryl Carter Parkway was selected as the anchor point for balancing along I-4 for consistency with the existing conditions. The forecasted DDHV along I-4 between SR 535 and Daryl Carter Parkway (summarized in **Table 37**) was anchored at this point and the downstream and upstream mainline values were calculated as ramp volumes exited or entered the

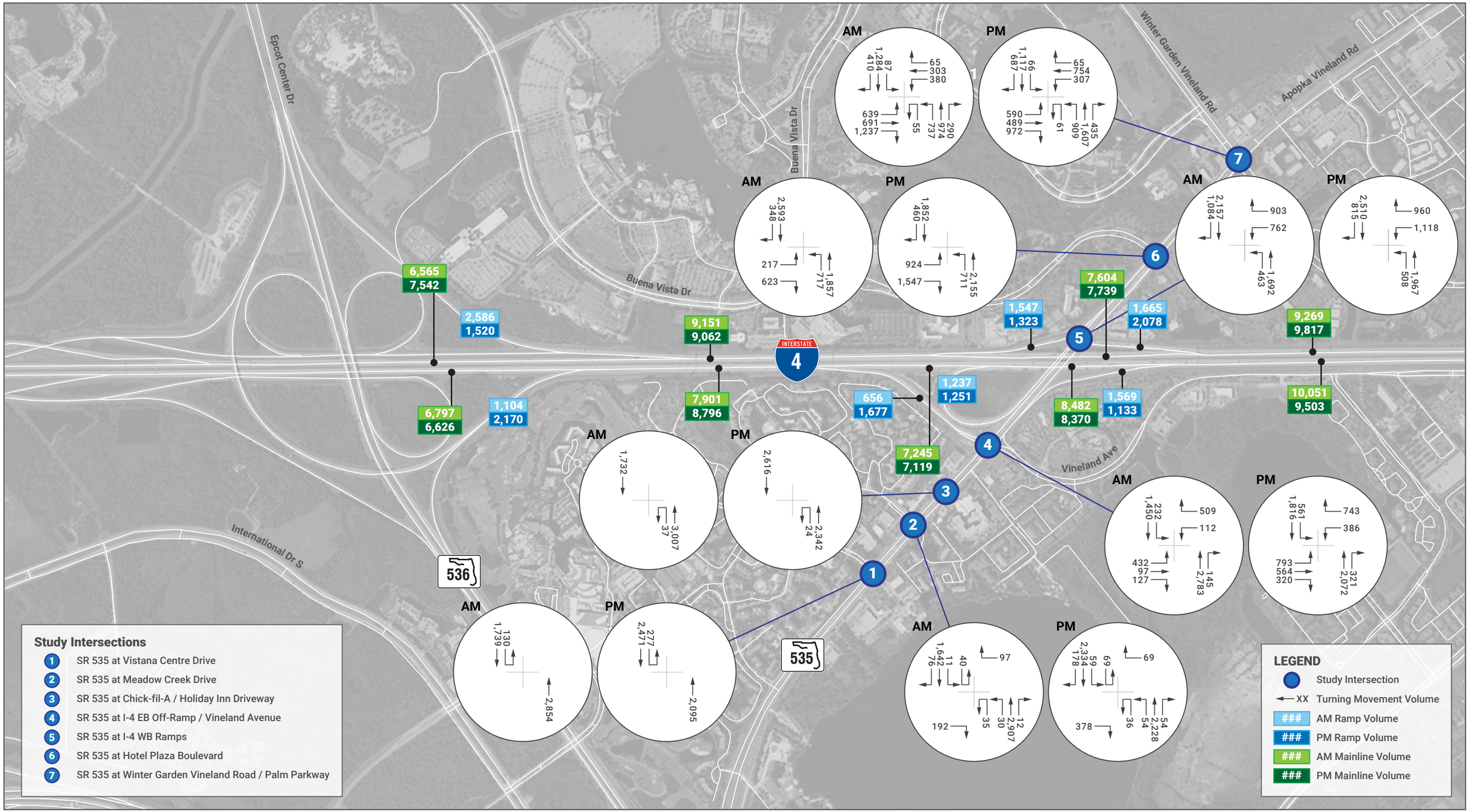
mainline at the study interchanges. This methodology is consistent between the No-Build and Build scenarios.

One set of peak hour volumes were developed for the 2045 AM and PM peak hours. The volumes for the No-Build scenario were balanced first. Changes to the geometry such as the restricted crossing U-turn (RCUT) intersections at Meadow Creek Drive were incorporated into the volume set. For example, eastbound left-turn vehicles projected at Meadow Creek Drive were rerouted as eastbound right-turns and routed to the next downstream intersection to make a U-turn maneuver before re-entering the Meadow Creek Drive intersection as a northbound through movement to complete the route.

The Build volumes were adjusted based on volume reassignment of the No-Build volumes to reflect the improvements as part of the Build scenario. For example, the Build alternative reroutes the northbound SR 535 to I-4 westbound on-ramp traffic through a new loop ramp. The traffic that would be making a northbound left-turn movement under the No-Build condition were rerouted as a northbound through movement to access the proposed loop ramp downstream along SR 535. It is important to note that the Build geometry is reflective of the Phase I interchange improvements only.

The following figures summarize the balanced Design Year (2045) AM and PM peak hour volumes for both the No-Build and the Build scenarios:

- 2045 No-Build Peak Hour Volumes – **Figure 21**
- 2045 Build Peak Hour Volumes – **Figure 22**



Study Intersections

1. SR 535 at Vistana Centre Drive
2. SR 535 at Meadow Creek Drive
3. SR 535 at Chick-fil-A / Holiday Inn Driveway
4. SR 535 at I-4 EB Off-Ramp / Vineland Avenue
5. SR 535 at I-4 WB Ramps
6. SR 535 at Hotel Plaza Boulevard
7. SR 535 at Winter Garden Vineland Road / Palm Parkway

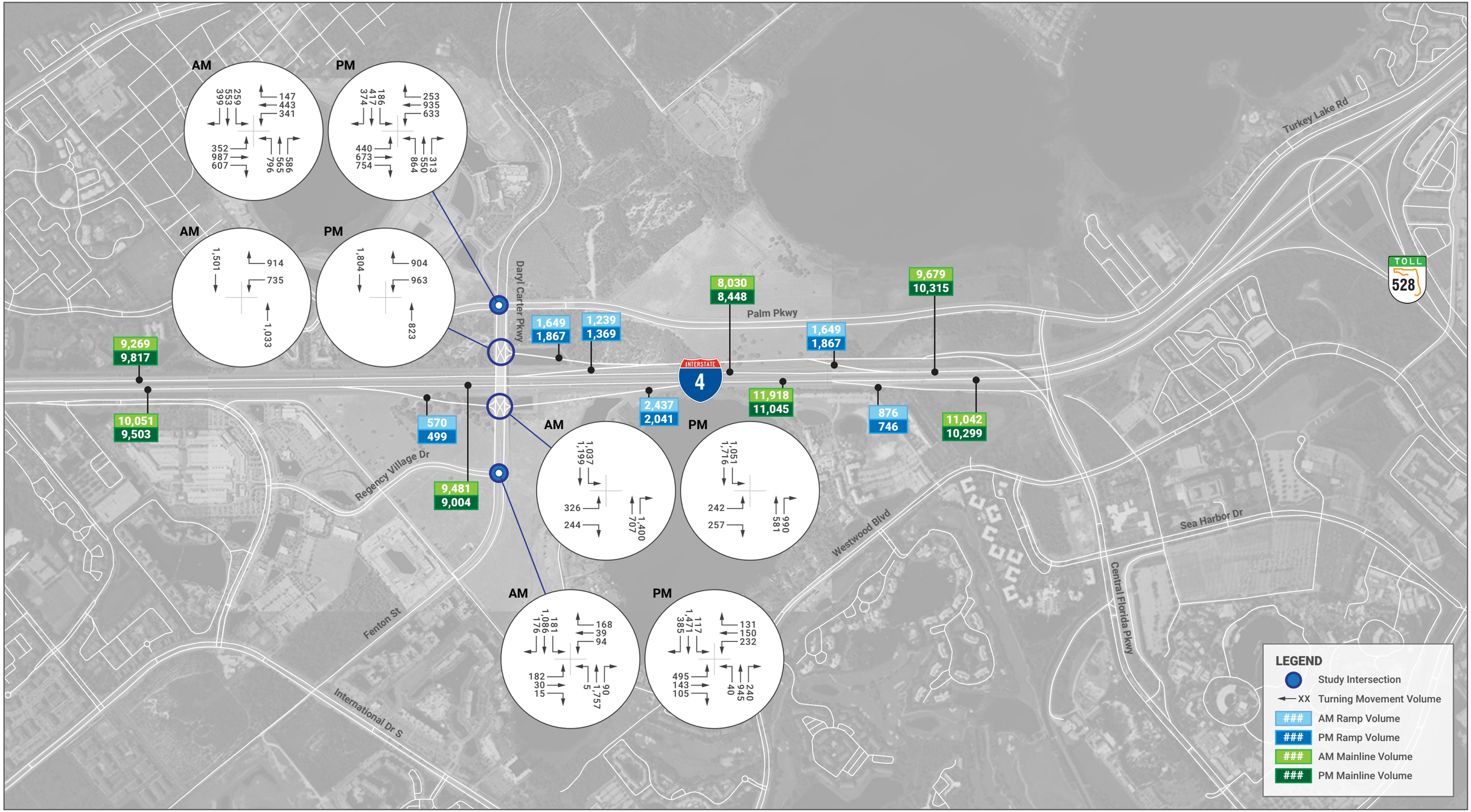
LEGEND

- Study Intersection
- XX Turning Movement Volume
- ### AM Ramp Volume
- ### PM Ramp Volume
- ### AM Mainline Volume
- ### PM Mainline Volume

Scale in Feet: 0 — 1,200 — North

I-4 at SR 535 Interchange Modification Report

FIGURE 21 | **2045 No-Build Peak Hour Volumes**



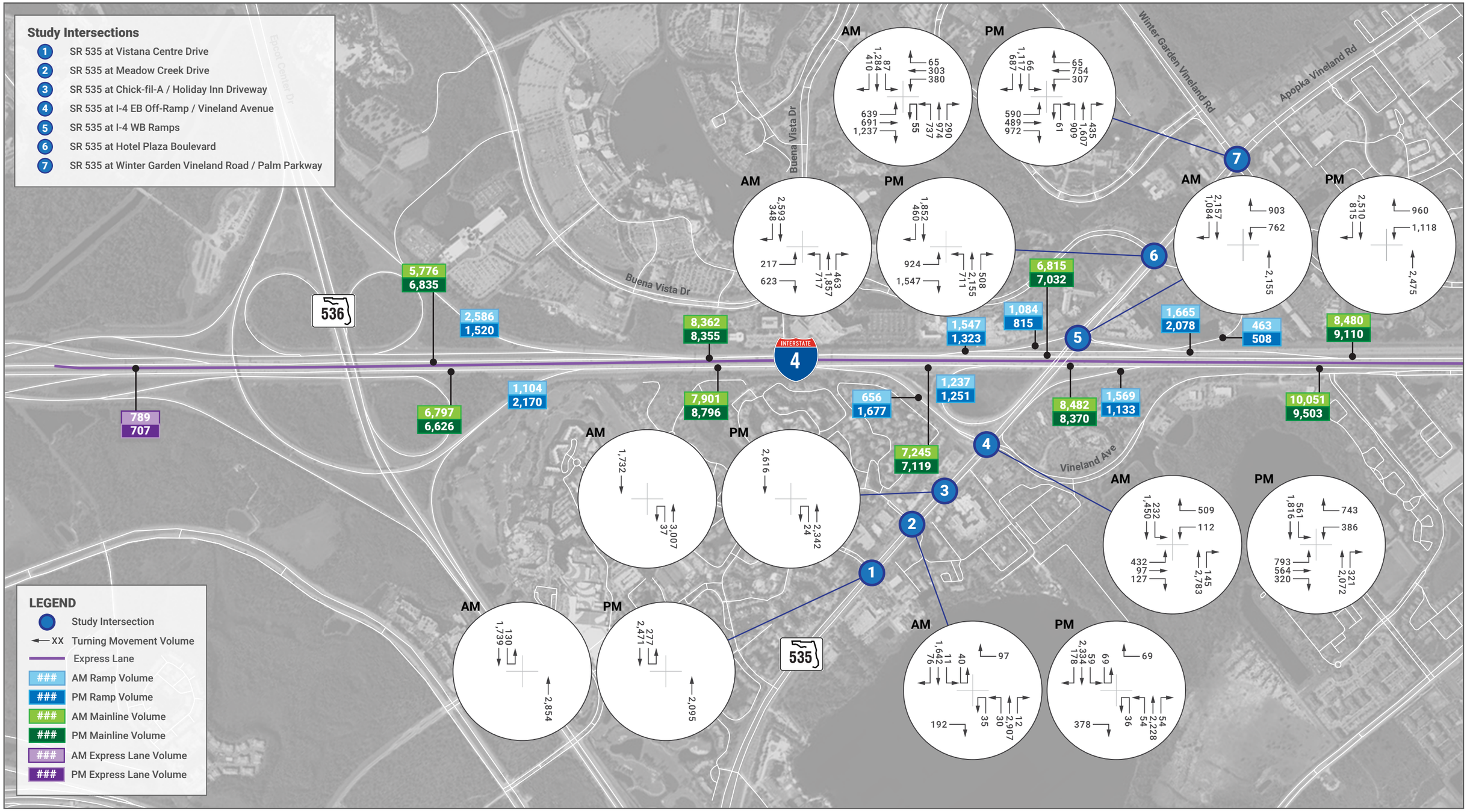
Scale in Feet
0 1,200 North

FDOT

I-4 at SR 535 Interchange Modification Report

FIGURE 21 | **2045 No-Build Peak Hour Volumes**

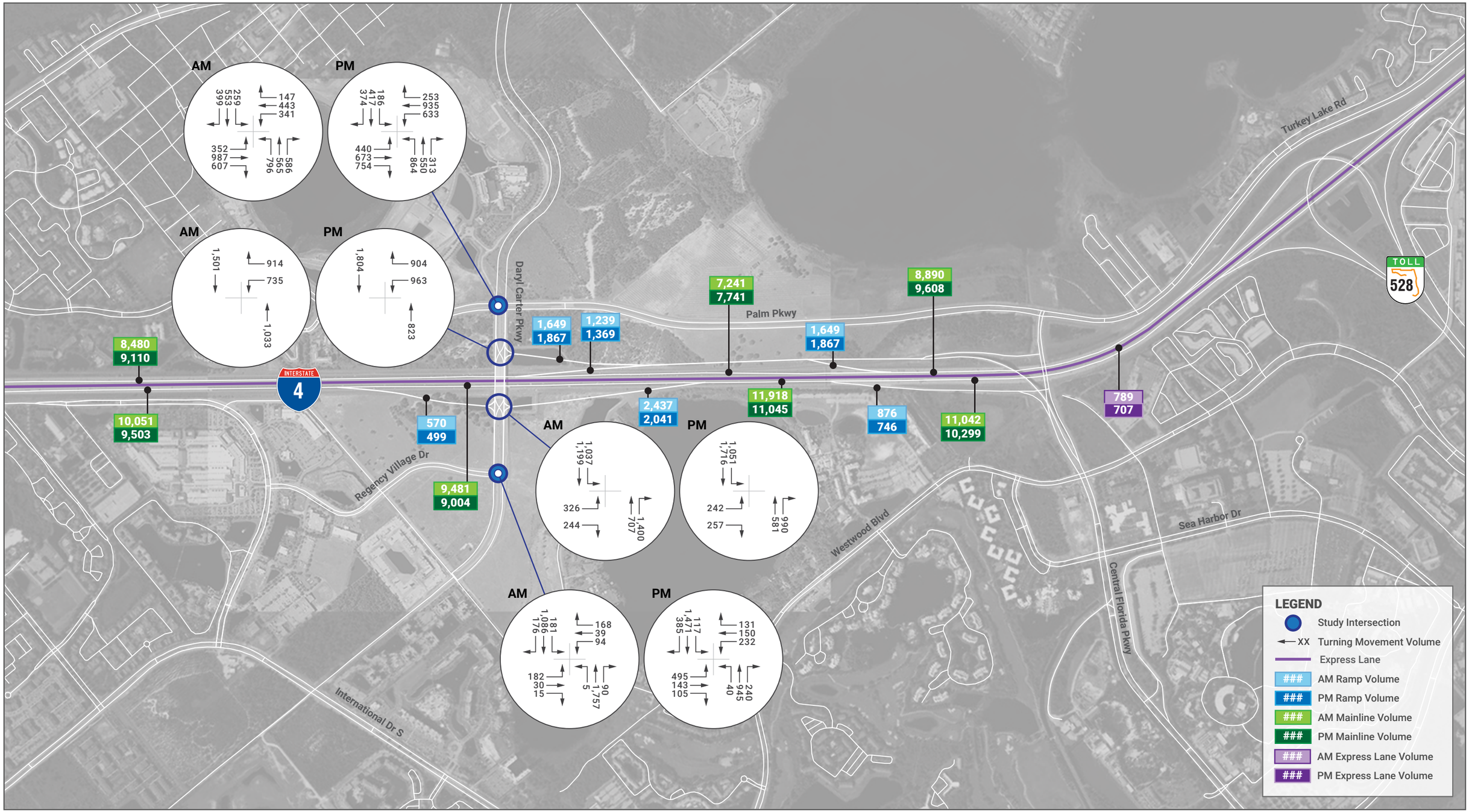
(2 of 2)



Scale in Feet
0 1,200 North

FDOT **I-4 at SR 535 Interchange Modification Report**

FIGURE 22 | **2045 Build Peak Hour Volumes**

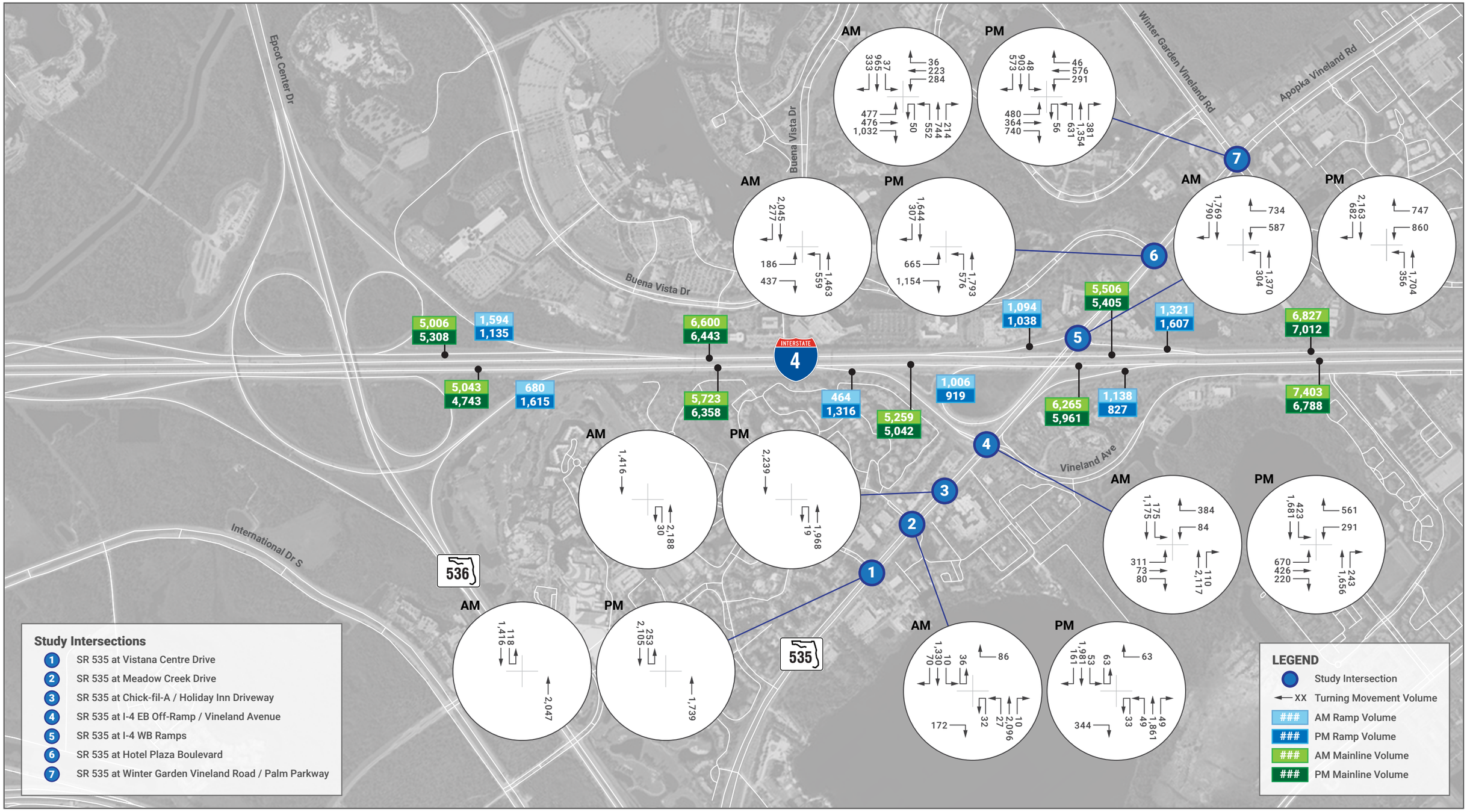

AM
147
443
341
259
553
399
352
987
607
796
565
586
PM
253
935
633
186
417
374
440
673
754
550
313
864
AM
914
735
1,501
1,033
PM
904
963
1,804
823
AM
1,037
1,199
326
244
1,400
707
PM
1,051
1,716
242
257
990
581
AM
181
1,086
176
168
39
94
182
30
15
1,757
90
5
PM
117
1,471
385
131
150
232
495
143
105
945
240
40
Daryl Carter Pkwy
Palm Pkwy
Turkey Lake Rd
Regency Village Dr
Westwood Blvd
Sea Harbor Dr
Central Florida Pkwy
International Dr S
INTERSTATE
4
TOLL
528
8,480
9,110
10,051
9,503
570
499
9,481
9,004
1,649
1,867
1,239
1,369
2,437
2,041
7,241
7,741
11,918
11,045
1,649
1,867
876
746
8,890
9,608
11,042
10,299
789
707
LEGEND
Study Intersection
XX Turning Movement Volume
Express Lane
AM Ramp Volume
PM Ramp Volume
AM Mainline Volume
PM Mainline Volume
AM Express Lane Volume
PM Express Lane Volume
Scale in Feet
0
1,200
North

Each of the study intersections were interpolated between the Existing (2019) and Design Year (2045) to estimate the Opening Year (2025) and Interim Year (2035) peak hour volumes.

For the I-4 mainline anchor point and existing ramps, the 2025 and 2035 volumes were estimated by interpolating between the 2019 and the 2045 volumes for the locations that exist today. For the new ramps at the I-4 at Daryl Carter Parkway interchange, volumes were estimated assuming that 70 percent of the design year volumes will be using the ramps/interchange in the opening year instead of interpolating between the opening and design years. This accounts for the immediate impact of opening the new interchange.

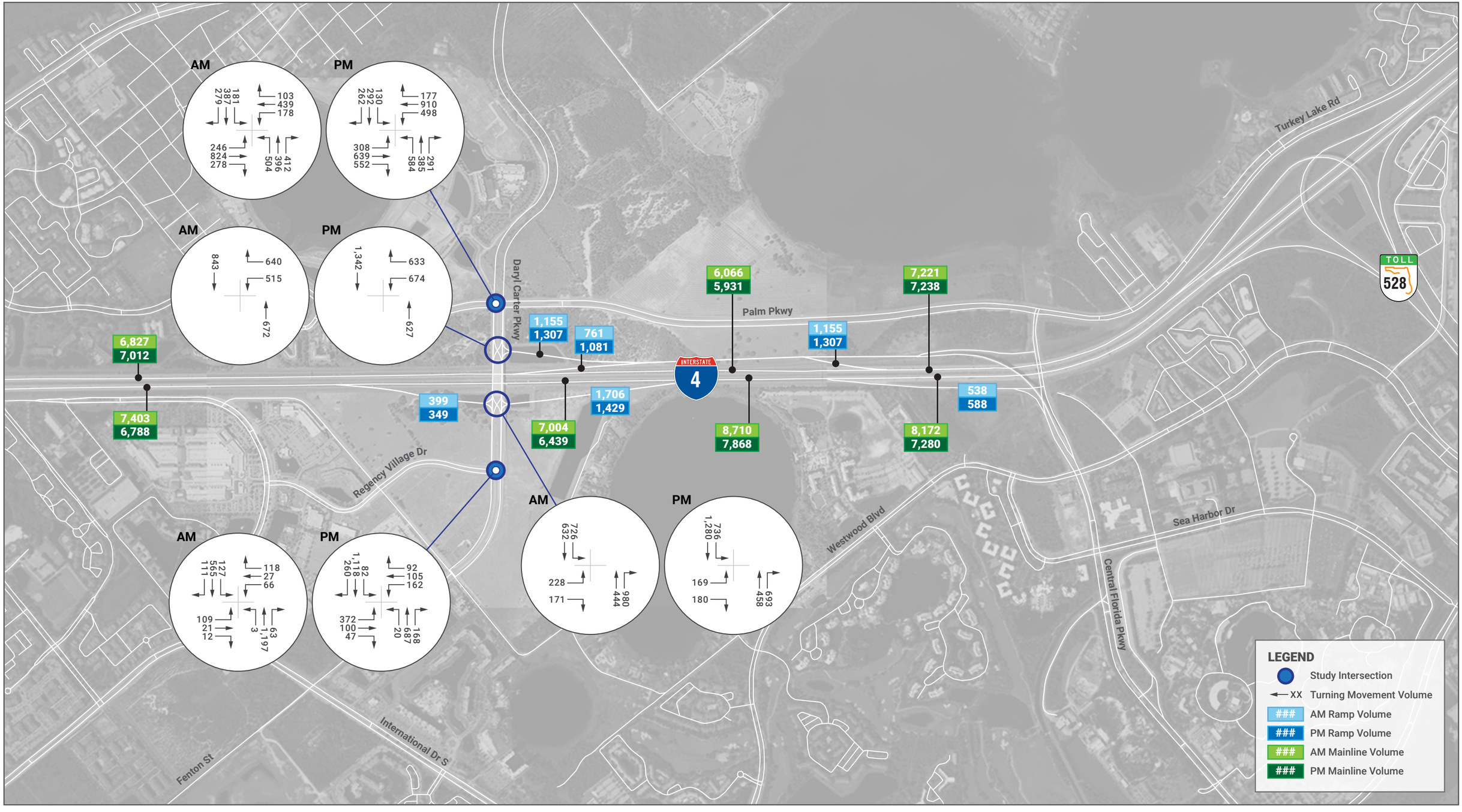
The following figure sets illustrate the Opening Year (2025) and Interim Year (2035) balanced peak hour volumes for the No-Build and Build scenarios.

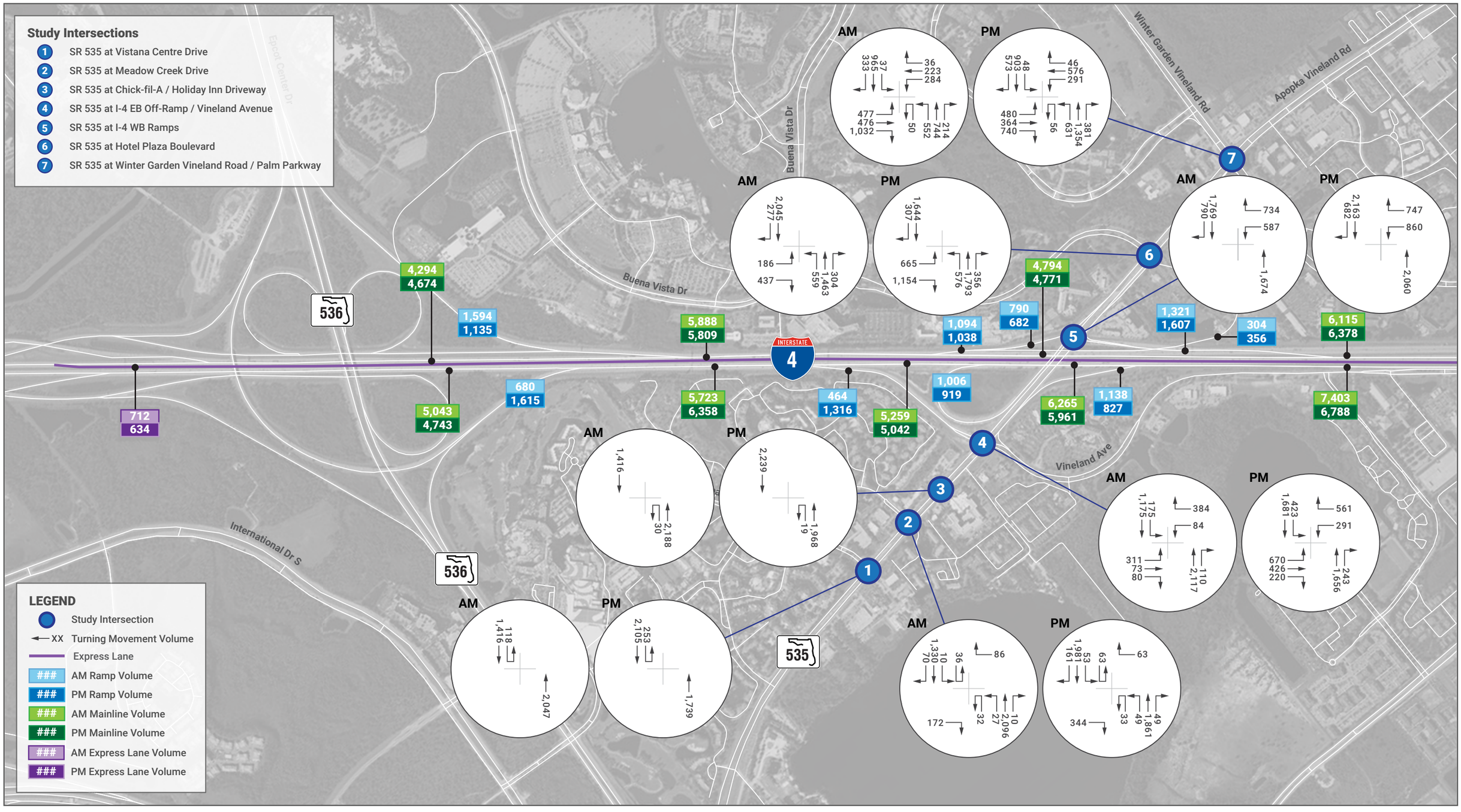
- 2025 No-Build Peak Hour Volumes – **Figure 23**
- 2025 Build Peak Hour Volumes – **Figure 24**
- 2035 No-Build Peak Hour Volumes – **Figure 25**
- 2035 Build Peak Hour Volumes – **Figure 26**

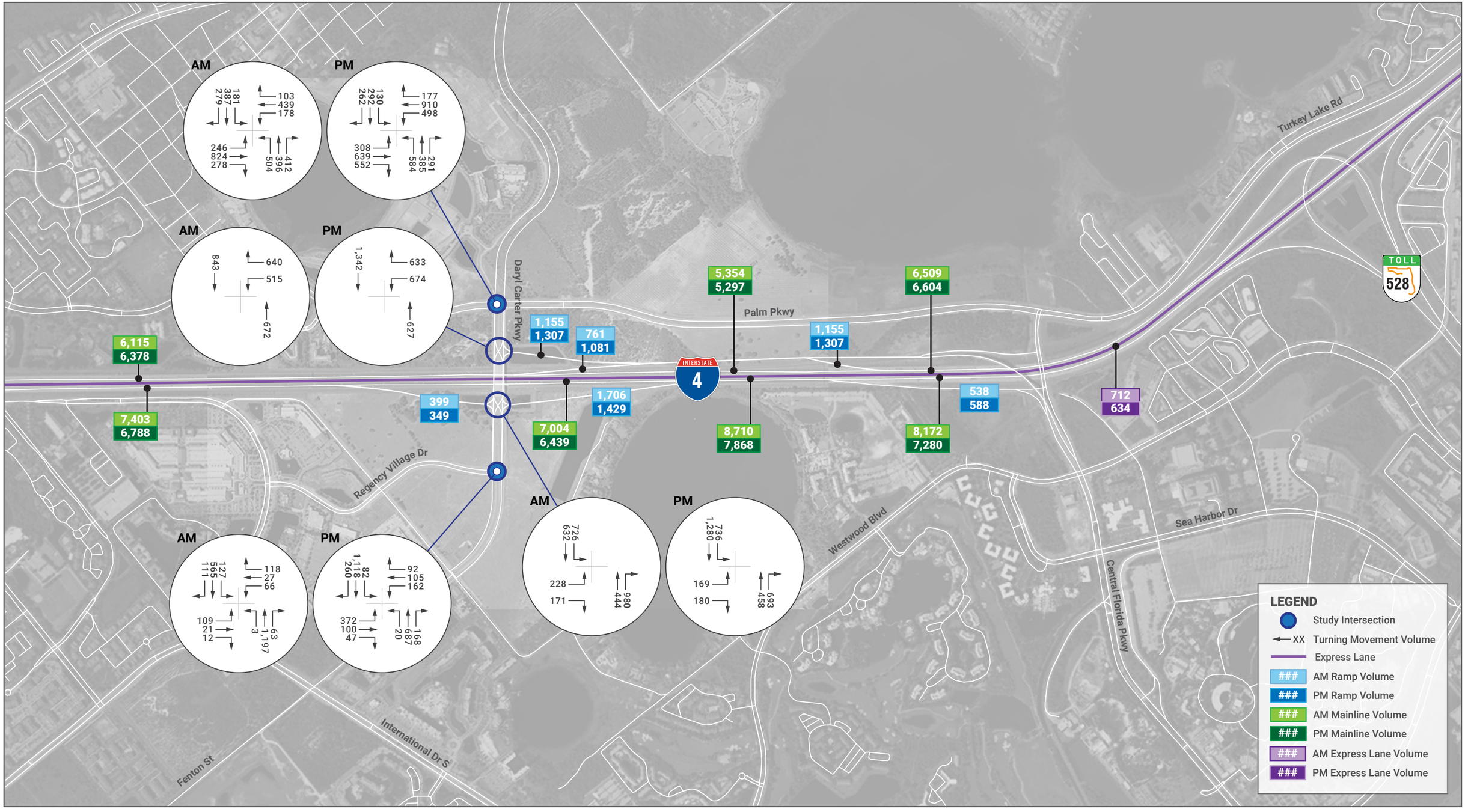


I-4 at SR 535 Interchange Modification Report

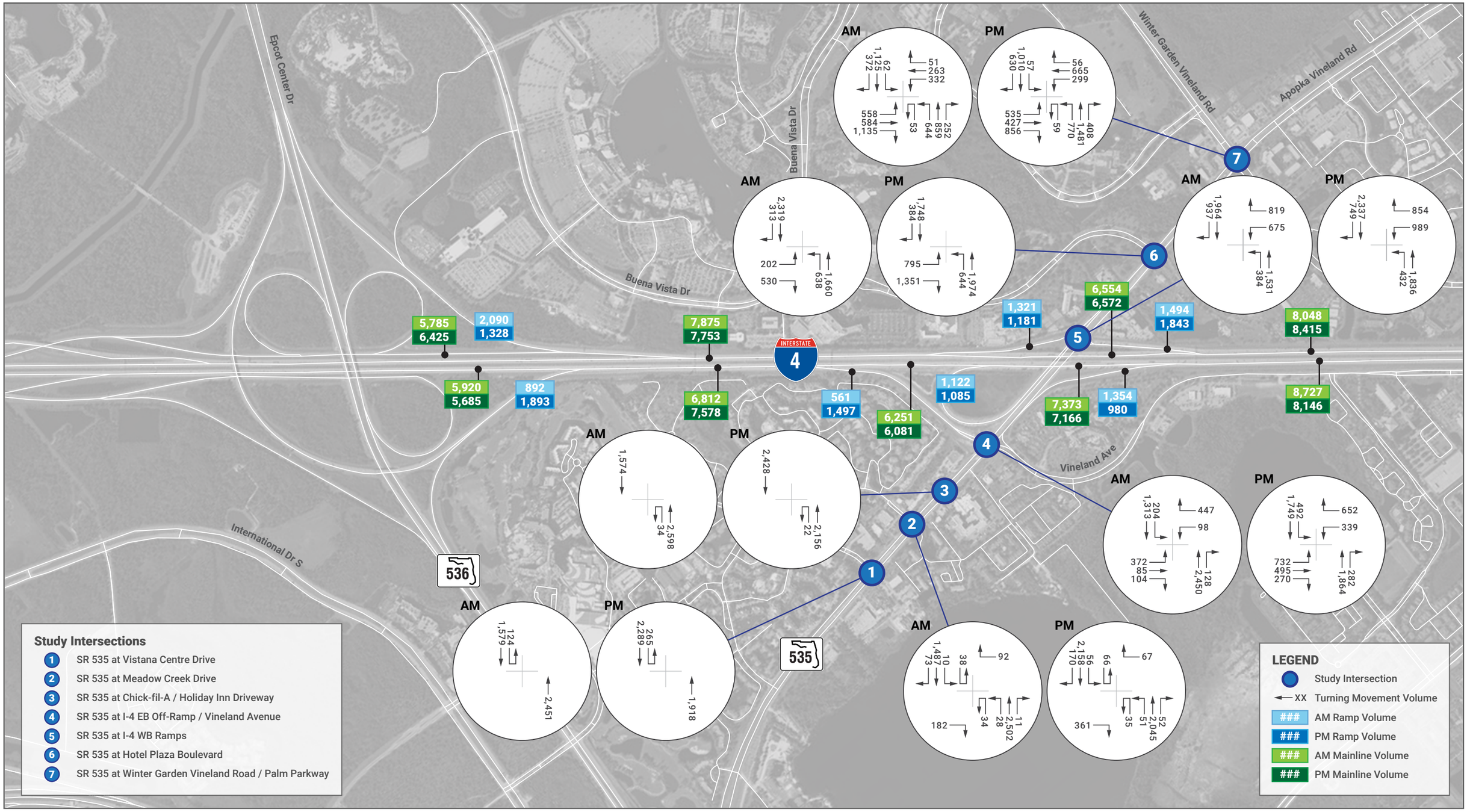
FIGURE 23 | **2025 No Build Peak Hour Volumes**


AM
PM
181
387
279
103
439
178
246
824
278
396
504
412
130
292
262
177
910
498
308
639
552
385
584
291
AM
PM
843
640
515
672
1,342
633
674
627
Daryl Carter Pkwy
Palm Pkwy
Turkey Lake Rd
TOLL
528
INTERSTATE
4
6,827
7,012
7,403
6,788
1,155
1,307
761
1,081
399
349
7,004
6,439
1,706
1,429
6,066
5,931
8,710
7,868
1,155
1,307
7,221
7,238
8,172
7,280
538
588
Regency Village Dr
AM
PM
127
565
111
118
27
66
109
21
12
63
1,197
3
1,118
260
82
92
105
162
372
100
47
168
687
20
AM
PM
726
632
228
171
980
444
1,280
736
169
180
693
458
Westwood Blvd
Sea Harbor Dr
Central Florida Pkwy
International Dr S
Fenton St
LEGEND
Study Intersection
XX Turning Movement Volume
AM Ramp Volume
PM Ramp Volume
AM Mainline Volume
PM Mainline Volume
Scale in Feet
0
1,200
North


Study Intersections
1 SR 535 at Vistana Centre Drive
2 SR 535 at Meadow Creek Drive
3 SR 535 at Chick-fil-A / Holiday Inn Driveway
4 SR 535 at I-4 EB Off-Ramp / Vineland Avenue
5 SR 535 at I-4 WB Ramps
6 SR 535 at Hotel Plaza Boulevard
7 SR 535 at Winter Garden Vineland Road / Palm Parkway
LEGEND
Study Intersection
XX Turning Movement Volume
Express Lane
AM Ramp Volume
PM Ramp Volume
AM Mainline Volume
PM Mainline Volume
AM Express Lane Volume
PM Express Lane Volume
Buena Vista Dr
Epcot Center Dr
Winter Garden Vineland Rd
Apopka Vineland Rd
Vineland Ave
International Dr S
536
535
INTERSTATE 4
AM
PM
712 634
4,294 4,674
1,594 1,135
5,043 4,743
680 1,615
5,888 5,809
5,723 6,358
464 1,316
5,259 5,042
1,094 1,038
1,006 919
4,794 4,771
790 682
6,265 5,961
1,138 827
1,321 1,607
304 356
6,115 6,378
7,403 6,788
Scale in Feet
0
1,200
North

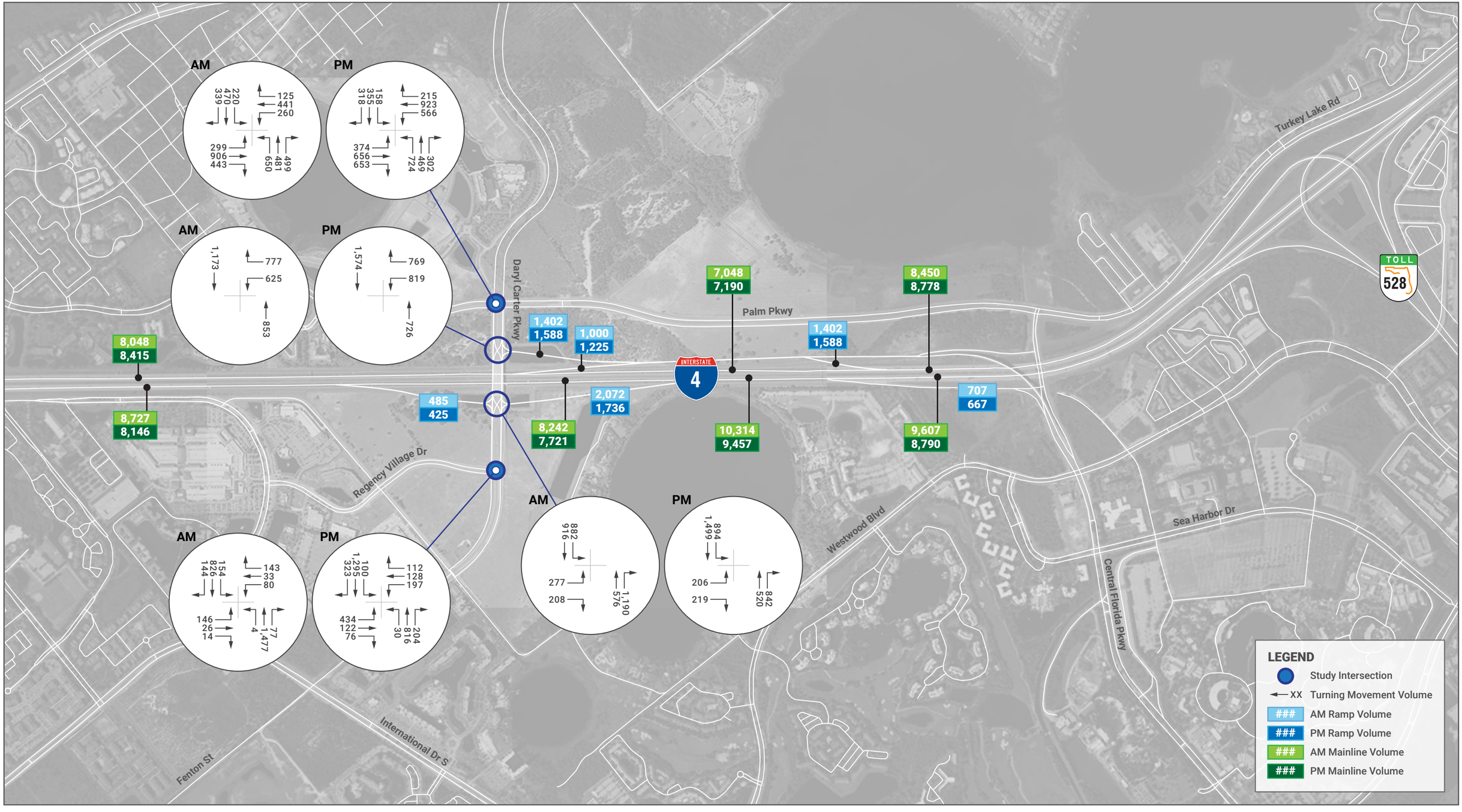


Scale in Feet
0 1,200 North



I-4 at SR 535 Interchange Modification Report

FIGURE 25 | **2035 No Build Peak Hour Volumes**


AM
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220
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299
906
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923
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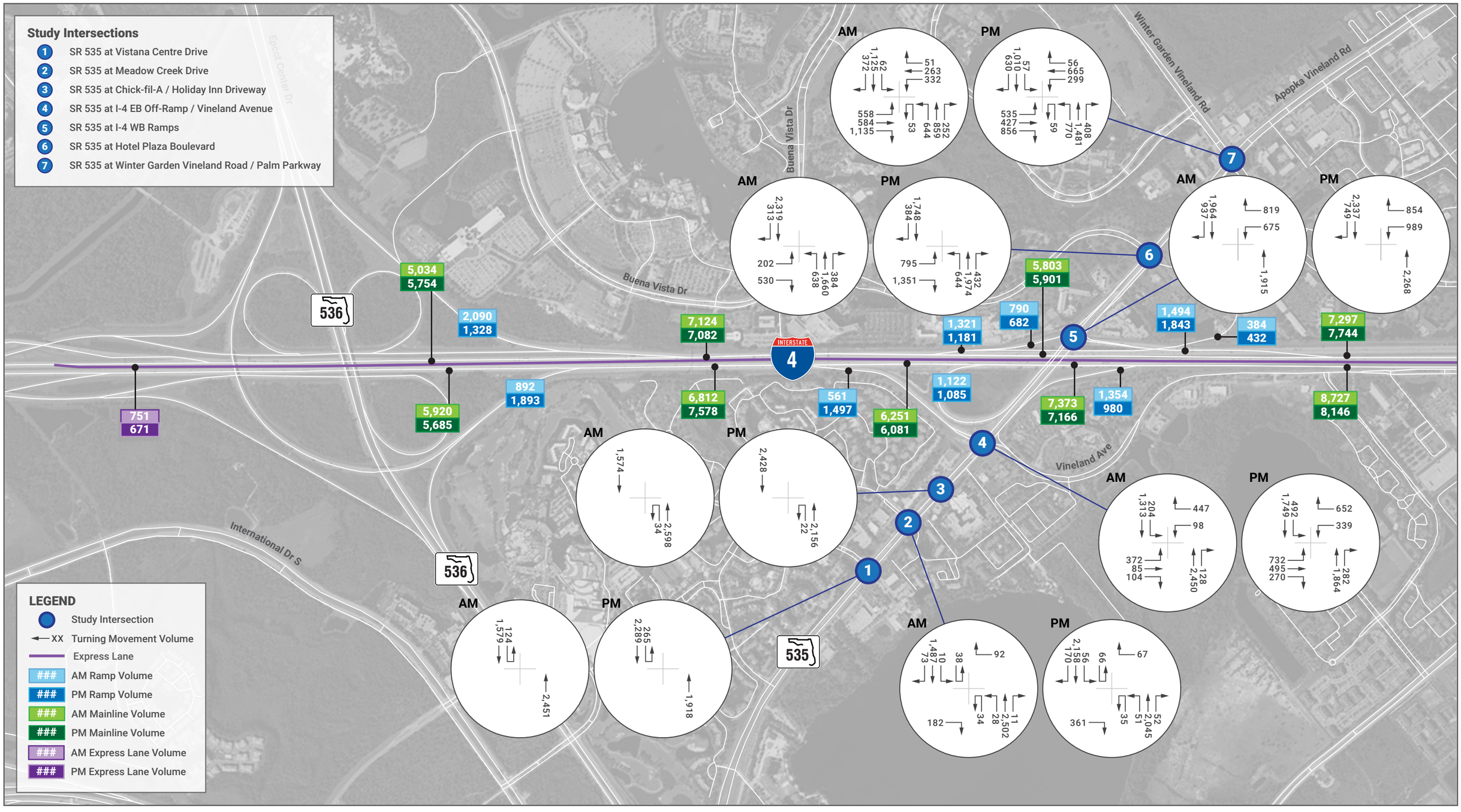
374
656
653
302
469
724
AM
PM
777
625
1,173
853
769
819
1,574
726
Daryl Carter Pkwy
Palm Pkwy
Turkey Lake Rd
INTERSTATE
4
TOLL
528
8,048
8,415
8,727
8,146
1,402
1,588
1,000
1,225
485
425
2,072
1,736
8,242
7,721
7,048
7,190
10,314
9,457
1,402
1,588
8,450
8,778
707
667
9,607
8,790
Regency Village Dr
AM
PM
882
916
277
208
1,190
576
894
1,499
206
219
842
520
Westwood Blvd
Sea Harbor Dr
Central Florida Pkwy
AM
PM
154
826
144
143
33
80
146
26
14
77
4
1,477
100
1,295
323
112
128
197
434
122
76
816
30
204
International Dr S
Fenton St
LEGEND
Study Intersection
XX Turning Movement Volume
AM Ramp Volume
PM Ramp Volume
AM Mainline Volume
PM Mainline Volume
Scale in Feet
0
1,200
North

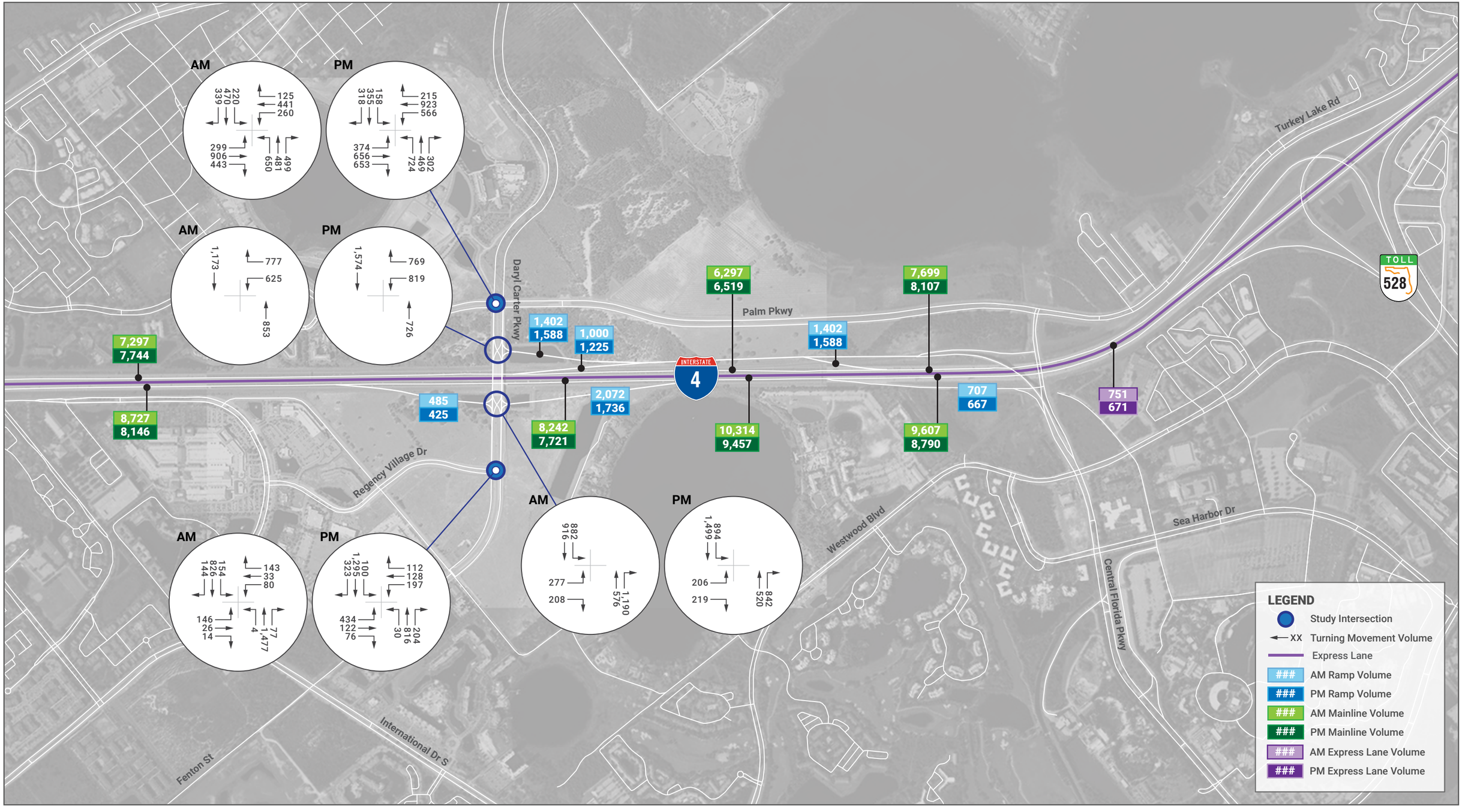


Scale in Feet
0 1,200 North

FDOT **I-4 at SR 535 Interchange Modification Report**

FIGURE 26 | **2035 Build Peak Hour Volumes**

(1 of 2)


AM
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906
443
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499
PM
215
923
566
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355
318
374
656
653
724
469
302
AM
1,173
777
625
853
PM
1,574
769
819
726
Daryl Carter Pkwy
Palm Pkwy
Turkey Lake Rd
INTERSTATE
4
TOLL
528
7,297
7,744
8,727
8,146
1,402
1,588
1,000
1,225
485
425
2,072
1,736
8,242
7,721
6,297
6,519
10,314
9,457
1,402
1,588
7,699
8,107
9,607
8,790
707
667
751
671
Regency Village Dr
AM
882
916
277
208
1,190
576
PM
894
1,499
206
219
842
520
Westwood Blvd
Sea Harbor Dr
Central Florida Pkwy
AM
154
826
144
143
33
80
146
26
14
77
4
1,477
PM
100
1,295
323
112
128
197
434
122
76
816
30
204
International Dr S
Fenton St
LEGEND
Study Intersection
XX Turning Movement Volume
Express Lane
AM Ramp Volume
PM Ramp Volume
AM Mainline Volume
PM Mainline Volume
AM Express Lane Volume
PM Express Lane Volume
Scale in Feet
0
1,200
North

9. FUTURE (NO-BUILD) OPERATIONAL ANALYSIS

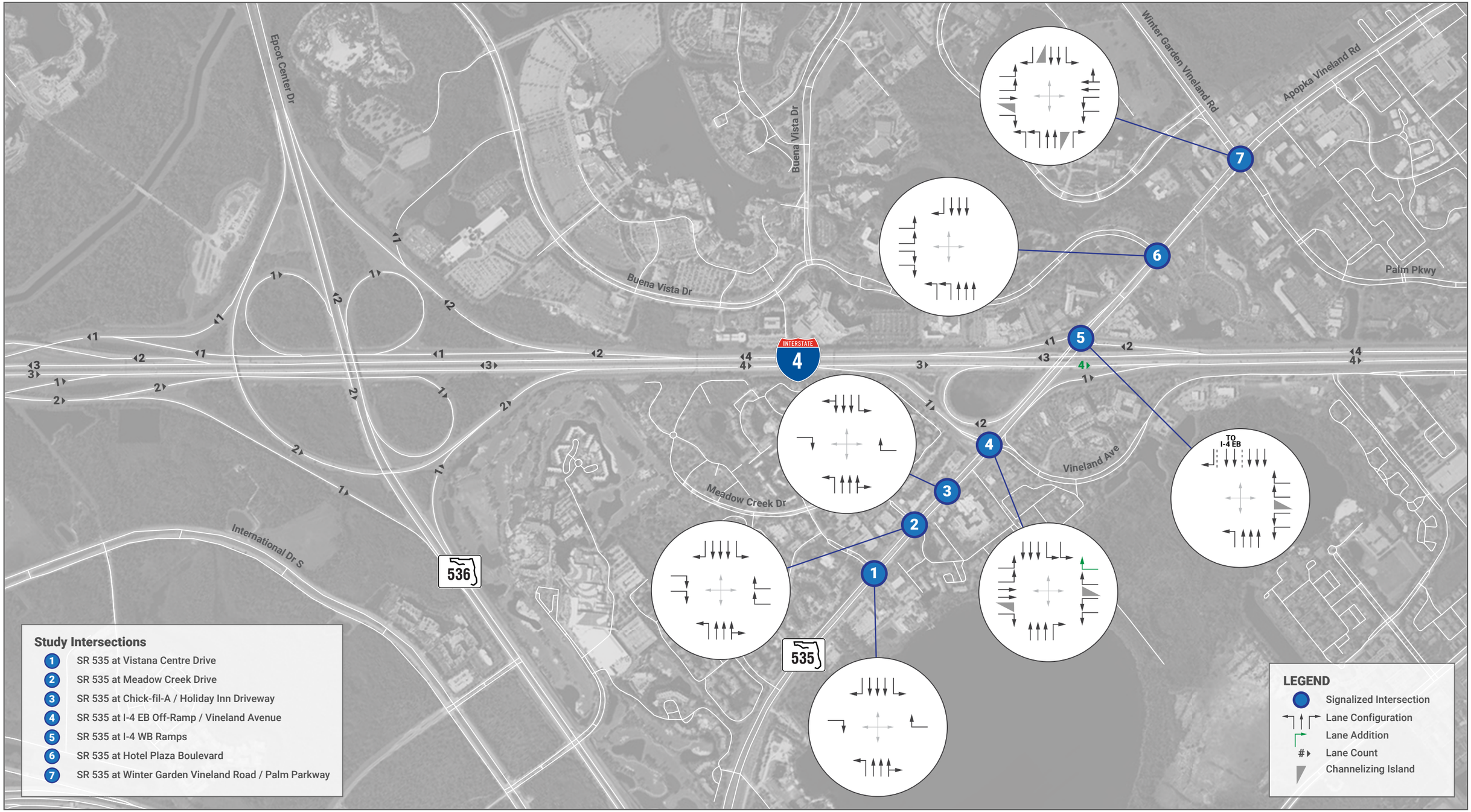
The following sections summarize the future No-Build operational analysis results for the intersection and freeway evaluations for both the AM and PM peak hours of the future years (2025, 2035, and 2045).

9.1. **Future No-Build Geometry**

Several geometric changes are underway or programmed between the existing condition and the No-Build condition in the future years. A summary of notable intersection geometric changes for the No-Build condition are described below. The future No-Build lane configurations along the I-4 mainline, at the gore points for each on-ramp and off-ramp, and at each of the study intersections are illustrated in **Figure 27**. The plans provided by FDOT and Orange County for the improvements are included in **Appendix Q** for reference.

- SR 535 at Meadow Creek Restricted Crossing U-Turn (RCUT)
    - The existing signalized intersection was converted to a signalized RCUT intersection utilizing the upstream and downstream median openings as signalized u-turn locations
- SR 535 at I-4 EB Off-Ramp/Vineland Avenue
    - An additional exclusive westbound right-turn lane was constructed, and the movement was brought under signal control
    - An auxiliary lane was constructed between the outside westbound right-turn lane and the downstream on-ramp to I-4 eastbound
- SR 535 at Hotel Plaza Boulevard
    - The development on the east leg of the intersection was closed, resulting in closure of the northbound right-turn and southbound left-turn into the development
- I-4 at Daryl Carter Parkway Interim Diverging Diamond Interchange
    - Construction of an interim ¾ DDI (no on-ramp to I-4 westbound)
    - Construction of an interim westbound C-D system combining the Central Florida Parkway on-ramps to I-4 westbound and the I-4 westbound off-ramp to Daryl Carter Parkway
    - Construction of a fourth lane along I-4 eastbound from the southbound SR 535 to I-4 eastbound on-ramp gore point through the downstream gore point at the northbound SR 535 to I-4 eastbound on-ramp
- Daryl Carter Parkway Extension
    - Daryl Carter Parkway was extended west of the Turkey Lake Road/Palm Parkway intersection
        - Addition of two exclusive eastbound left-turn lanes, two eastbound through lanes, and one exclusive eastbound right-turn lane
        - Addition of one exclusive southbound right-turn lane
        - Addition of two westbound through lanes

- Daryl Carter Parkway at Regency Village Drive
    - The intersection was converted to a signalized intersection and added a northern leg.
        - Addition of one exclusive southbound left-turn lane and one southbound shared through/right-turn lane
        - Converted one exclusive northbound right-turn lane into one northbound through lane

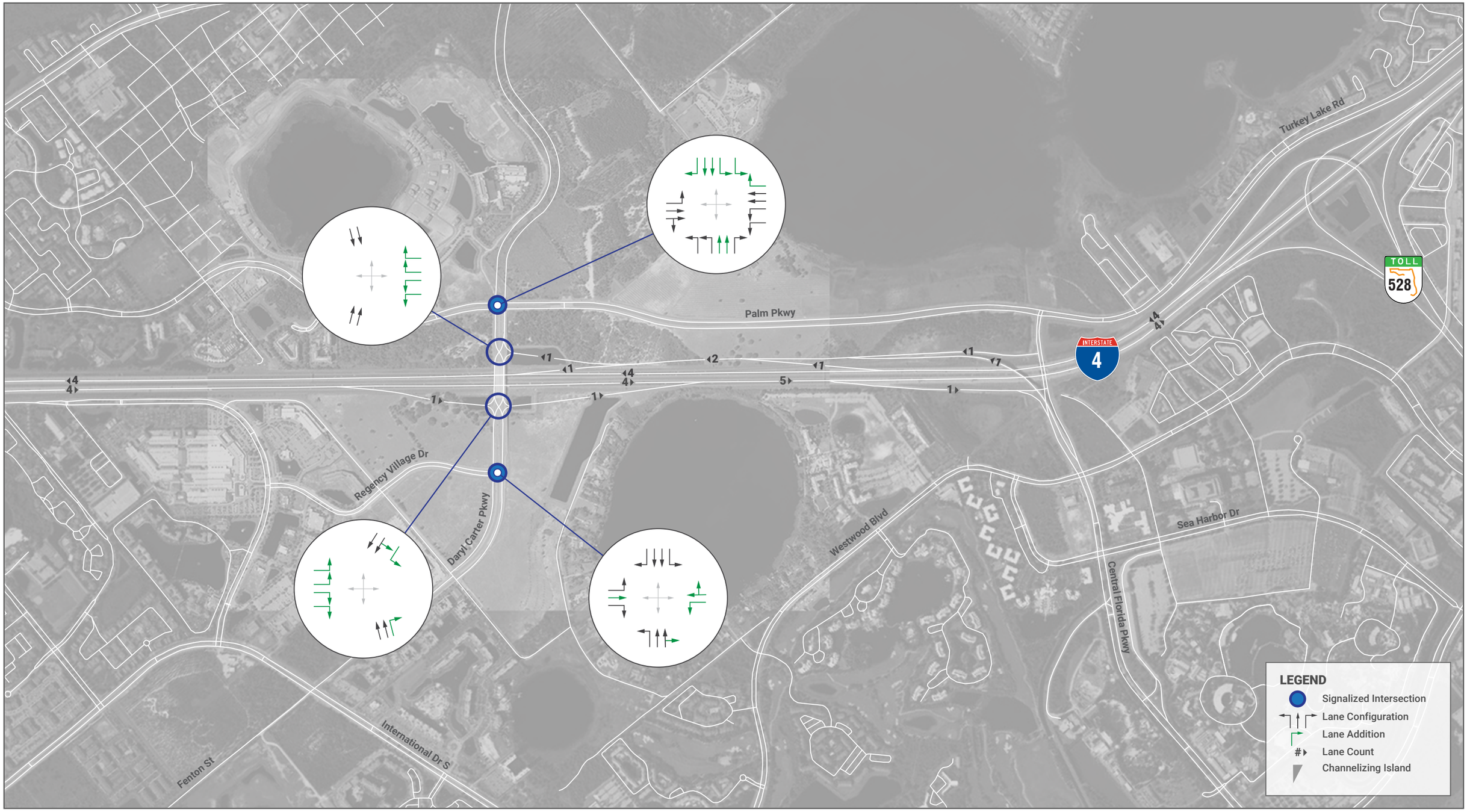


Scale in Feet
0 1,200 North

FDOT

I-4 at SR 535 Interchange Modification Report

FIGURE 27 | **Future No-Build Lane Configurations**


Palm Pkwy
Turkey Lake Rd
Regency Village Dr
Daryl Carter Pkwy
Westwood Blvd
Sea Harbor Dr
Central Florida Pkwy
International Dr S
Fenton St
INTERSTATE
4
TOLL
528
LEGEND
Signalized Intersection
Lane Configuration
Lane Addition
Lane Count
Channelizing Island
Scale in Feet
0
1,200
North

9.2. Future No-Build Microsimulation Evaluation

The following section summarizes the Opening Year (2025), Interim Year (2035), and Design Year (2045) No-Build AM and PM peak hour microsimulation analysis conducted using PTV VISSIM software.

9.2.1. Model Development and Assumptions

The future year microsimulation models were developed based on the existing (2019) microsimulation models, which were calibrated/validated against field measurements and approved by FDOT District 5. Per the approved MLOU, link variables, parameters and driver behavior settings in future scenarios were kept the same as the existing models.

The following summarizes the geometric assumptions for the future year No-Build VISSIM models:

- Lane configuration adjustments at the study intersections shown previously in **Figure 27** in Section 9.1 were made.
- Freeway mainline adjustments were made consistent with the I-4 at Daryl Carter Parkway project (see Bullet #4 in Section 9.1 for reference).

9.2.2. Signal Timings

Signal timing data was reviewed and incorporated into Synchro software prior to importing into Ring Barrier Controller (RBC) files for use in the VISSIM microsimulation analysis. As noted previously, there were geometric changes to several intersections between the existing year and future year. The timings for these intersections are included in **Appendix R**.

9.2.3. Routes and Demand Volumes

To develop the No-Build microsimulation analysis for the future year peak hours, new Origin-Destination (OD) inputs were developed. The VISUM ODME (Origin-Destination Matrix Estimation) procedure was used to develop the future year OD paths for the future year No-Build VISSIM simulations. The demand volumes developed in Section 8 were utilized as the demand volumes for each future analysis year. These volumes were input into PTV VISUM and an ODME was completed to develop OD routes for use in the VISSIM analysis. The volumes and routes were reviewed as part of the VISSIM efforts to verify the demands in VISSIM were consistent with the Design Traffic volumes. The truck percentages from the MLOU were incorporated into the VISSIM model accordingly.

9.2.4. VISSIM Simulation Parameters

Ten simulation runs were conducted for each of the future year peak period models for the No-Build scenario. The traffic demand profile of the peak period (AM and PM) as shown in **Appendix S**, was applied to convert the peak hour volume forecasts into 15-min analysis intervals. The vehicle inputs

were developed for each 15-minute analysis period within the peak period, as well as a 15-minute warm-up period and 15-minute cool-down period.

9.2.5. VISSIM Analysis Results

The following measures were collected to summarize traffic operations throughout the simulation model:

- Network-wide performance, such as average delay, average speed, total delay time, latent volume, and latent delay.
- Speed and density on the freeway links within the AOI in 15-minute increments.
- Average travel time.
- Volume, delay, estimated LOS, average queue length, and maximum queue length for the study area intersections.

The following summarizes the various performance measures and the observations of the models. It is important to note that the results reported are for the peak hour only. As described in the next section, the capacity constraints on the I-4 mainline have a large impact to the network. Because of the high projected demand in the future year and the capacity constraints along I-4, severe congestion is observed along the I-4 mainline. Moreover, the demand profile of I 4 during peak periods (3 hours) appears flat: there is no significant difference between the traffic demand prior to and after the peak hour and the traffic demand within the peak hour. Reporting of the peak period results will not provide different conclusions than those in the peak hour and will make interpretation of results more challenging as more latent demand and gridlock will occur within the peak periods. Reporting of the peak hour allows the ability to see tangible improvements along SR 535 (No-Build vs Build) and I-4 using this approach.

I-4 Mainline Capacity Constraints and Impacts to the Network

Latent demand along I-4 is prevalent in each of the future year No-Build simulation models but is most impactful in 2045. For example, the Design Year (2045) projected volumes significantly exceed the capacity of I-4 with projections of approximately 2,600 vehicles per hour per lane along some I-4 segments (I-4 westbound entry into the model). This demand is approximately 20% higher per lane than the typical capacity estimate for a freeway lane. The simulation model does not have the ability to load the network at this rate as the headways are not low enough to achieve those demands. As such, significant latent demand was observed in the peak hour in the 2035 and 2045 No-Build simulation models (as summarized in **Table 38**) with latent demands increasing as traffic increases in each of the analysis years.

Table 38: I-4 Latent Demand – Future Year No-Build Peak Hours

Entry Point	2025		2035		2045	
	AM	PM	AM	PM	AM	PM
I-4 EB	0	188	634	1,292	1,776	2,441
I-4 WB	0	0	1,275	2,138	3,001	4,011

The mainline I-4 congestion also impacts other parts of the network within the AOI including the westbound C-D system between Central Florida Parkway and Daryl Carter Parkway, I-4 EB on-ramp from SR 535 and I-4 EB on-ramp from Daryl Carter Parkway. The bottlenecks and congestion observed along I-4 result in standstill traffic on the westbound C-D system, northbound SR 535, and northbound Daryl Carter Parkway as vehicles are unable to merge onto the freeway. The simulation confirmed that capacity improvements, such as those identified in the I-4 BtU South Section SAMR and PD&E Study, are needed along I-4.

No-Build Network Performance Results

Network wide statistics for the 2025, 2035, and 2045 AM and PM peak hour are shown in **Table 39**, **Table 40**, and **Table 41**, respectively. Significant latent demand and latent delay were observed in each of the future year peak hours, especially in 2035 and 2045. Average delays, speeds, and total delay at a network level are all expected to worsen as demands increase in each of the future analysis years.

Table 39: VISSIM Network Wide Statistics – Opening Year (2025) No-Build Peak Hours

Network Wide Statistics	No-Build 2025 AM Peak Hour	No-Build 2025 PM Peak Hour
Average Delay (sec)	171.4	174.9
Average Speed (mph)	32.3	30.1
Total Delay (hr)	1,277	1,481
Active Vehicles (at end of peak hour)	4,128	4,182
Vehicles Arrived (during peak hour)	22,689	26,309
Total Peak Hour Vehicles (Active + Arrived)	26,817	30,491
Latent Demand (at end of peak hour)	405	684
Latent Delay (hr)	124	200

Table 40: VISSIM Network Wide Statistics – Interim Year (2035) No-Build Peak Hours

Network Wide Statistics	No-Build 2035 AM Peak Hour	No-Build 2035 PM Peak Hour
Average Delay (sec)	337.1	268.3
Average Speed (mph)	22.0	23.9
Total Delay (hr)	2,735	2,377
Active Vehicles (at end of peak hour)	5,953	4,720
Vehicles Arrived (during peak hour)	23,256	27,170
Total Peak Hour Vehicles (Active + Arrived)	29,209	31,890
Latent Demand (at end of peak hour)	3,003	4,700
Latent Delay (hr)	764	1,774

Table 41: VISSIM Network Wide Statistics – Design Year (2045) No-Build Peak Hours

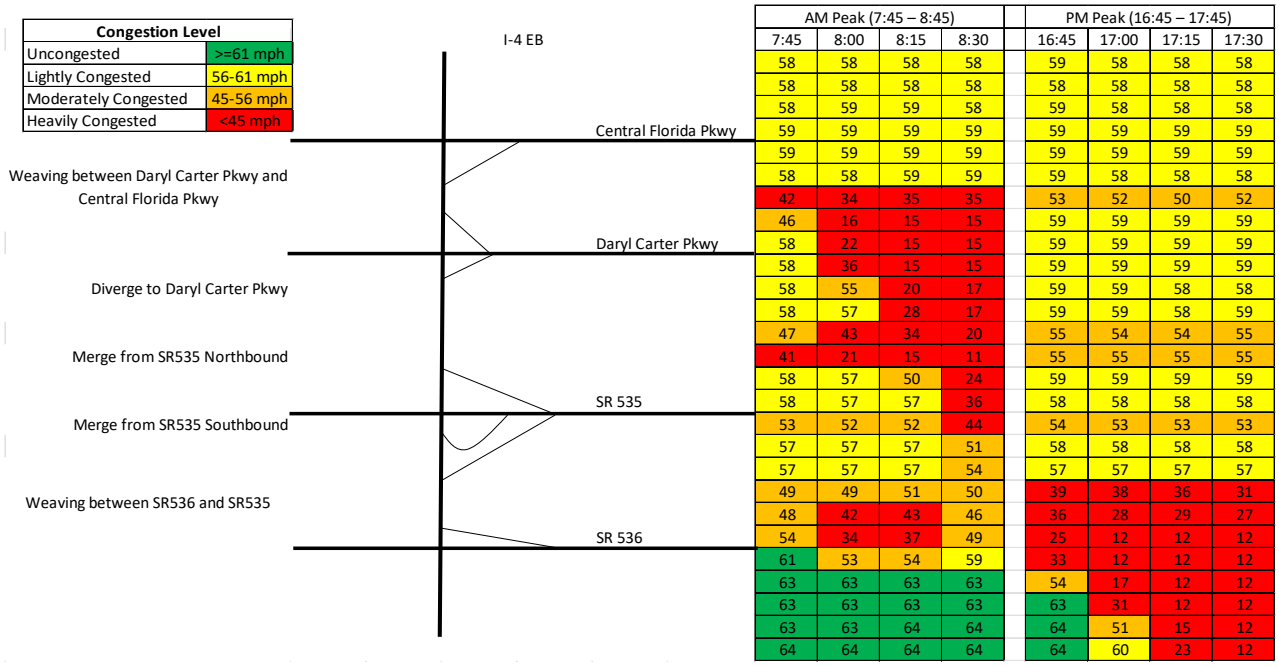
Network Wide Statistics	No-Build 2045 AM Peak Hour	No-Build 2045 PM Peak Hour
Average Delay (sec)	404.9	335.0
Average Speed (mph)	19.2	20.6
Total Delay (hr)	3,361	3,077
Active Vehicles (at end of peak hour)	6,463	5,899
Vehicles Arrived (during peak hour)	23,429	27,168
Total peak hour vehicles (Active + Arrived)	29,892	33,067
Latent Demand (at end of peak hour)	7,403	9,269
Latent Delay (hr)	2,722	4,206

No Build VISSIM Link Evaluation Results

Speed contours for the I-4 study corridor for the future year peak hours between SR 536 and Daryl Carter Parkway are shown in **Figure 28** to **Figure 33**. The speed contours utilize the congestion level thresholds in Table 9-12 of the latest FDOT Traffic Analysis Handbook. The density contours along I-4 eastbound and westbound for the future years are illustrated in **Figure 34** through **Figure 39**.

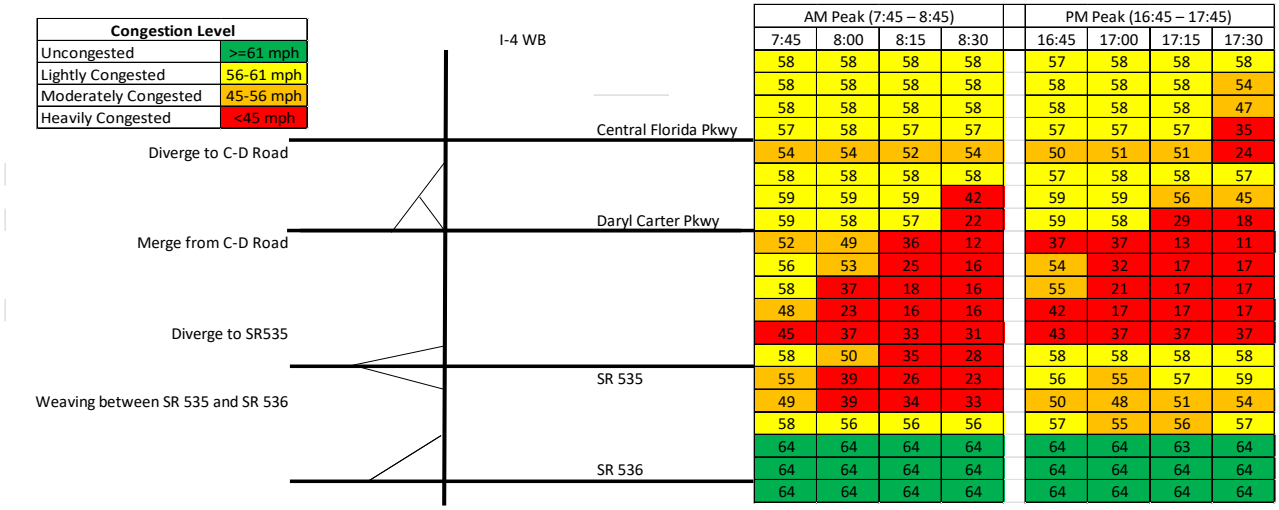
Despite the latent demand along I-4 that is unable to enter the network, the capacity constraints along I-4 still result in severe congestion along the I-4 mainline. The main bottlenecks in the eastbound are observed within the weaving segment between Daryl Carter Parkway and Central Florida Parkway and within the weaving segment between SR 536 and SR 535 during both peak hours.

The westbound I-4 contours (**Figure 33**) illustrate heavy congestion (speed less than 45 mph) from the beginning of the AOI to the weave between SR 535 and SR 536 during both 2045 peak hours. It is important to note that both directions of the I-4 mainline are impacted by upstream capacity constraints and the limitations of the model to process the demands as previously described. Caution should be used in interpreting these results due to the significant amount of latent demand for the I-4 mainline.



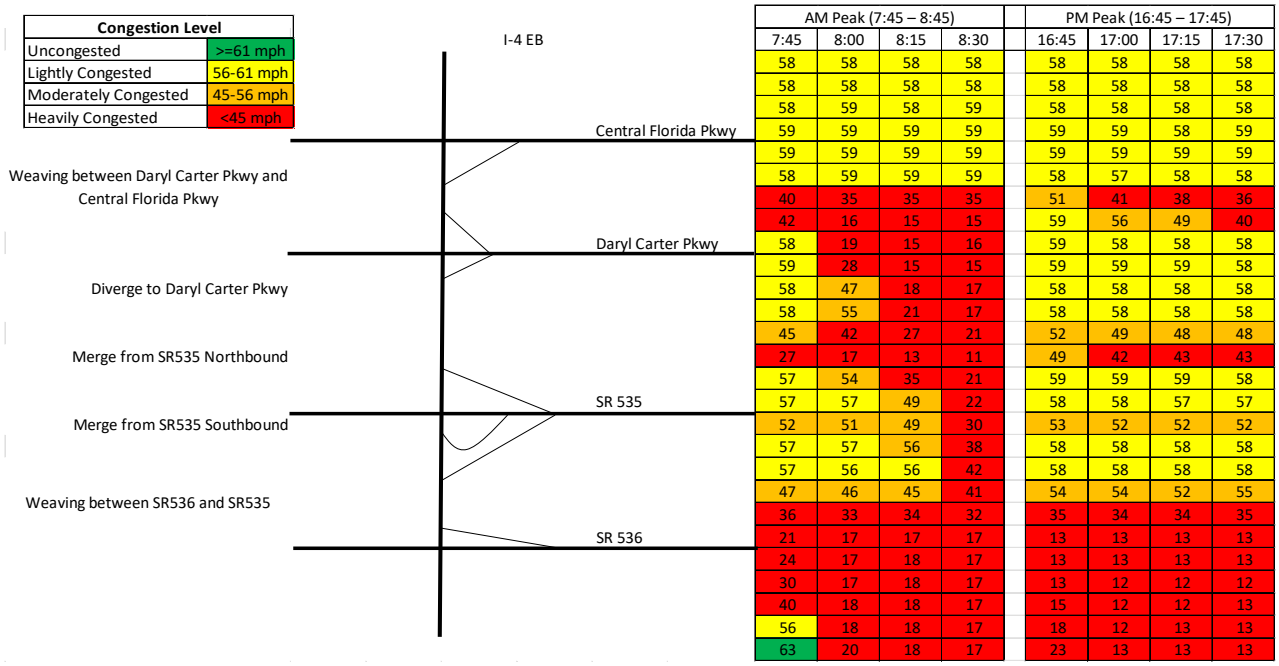
AM Peak (7:45 – 8:45)				PM Peak (16:45 – 17:45)			
7:45	8:00	8:15	8:30	16:45	17:00	17:15	17:30
58	58	58	58	59	58	58	58
58	58	58	58	58	58	58	58
58	59	59	58	59	58	58	58
59	59	59	59	59	59	59	59
59	59	59	59	59	59	59	59
58	58	59	59	59	58	58	58
42	34	35	35	53	52	50	52
46	16	15	15	59	59	59	59
58	22	15	15	59	59	59	59
58	36	15	15	59	59	59	59
58	55	20	17	59	59	58	58
58	57	28	17	59	59	58	59
47	43	34	20	55	54	54	55
41	21	15	11	55	55	55	55
58	57	50	24	59	59	59	59
58	57	57	36	58	58	58	58
53	52	52	44	54	53	53	53
57	57	57	51	58	58	58	58
57	57	57	54	57	57	57	57
49	49	51	50	39	38	36	31
48	42	43	46	36	28	29	27
54	34	37	49	25	12	12	12
61	53	54	59	33	12	12	12
63	63	63	63	54	17	12	12
63	63	63	63	63	31	12	12
63	63	64	64	64	51	15	12
64	64	64	64	64	60	23	12

Figure 28: 2025 No-Build AM and PM I-4 EB Speed Contours



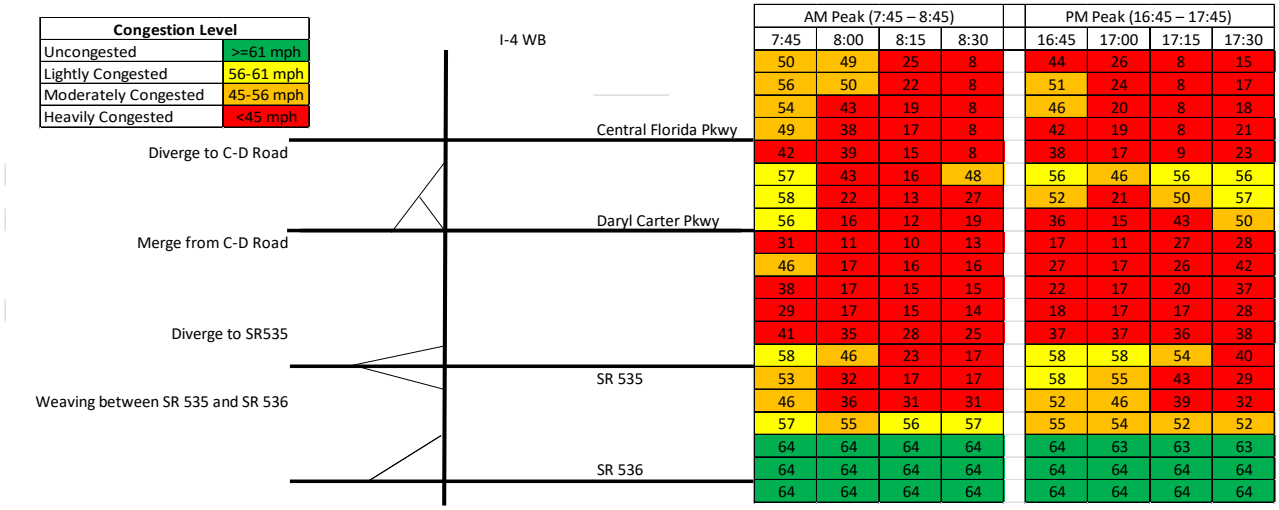
AM Peak (7:45 – 8:45)				PM Peak (16:45 – 17:45)			
7:45	8:00	8:15	8:30	16:45	17:00	17:15	17:30
58	58	58	58	57	58	58	58
58	58	58	58	58	58	58	54
58	58	58	58	58	58	58	47
57	58	57	57	57	57	57	35
54	54	52	54	50	51	51	24
58	58	58	58	57	58	58	57
59	59	59	42	59	59	56	45
59	58	57	22	59	58	29	18
52	49	36	12	37	37	13	11
56	53	25	16	54	32	17	17
58	37	18	16	55	21	17	17
48	23	16	16	42	17	17	17
45	37	33	31	43	37	37	37
58	50	35	28	58	58	58	58
55	39	26	23	56	55	57	59
49	39	34	33	50	48	51	54
58	56	56	56	57	55	56	57
64	64	64	64	64	64	63	64
64	64	64	64	64	64	64	64
64	64	64	64	64	64	64	64

Figure 29: 2025 No-Build AM and PM I-4 WB Speed Contours



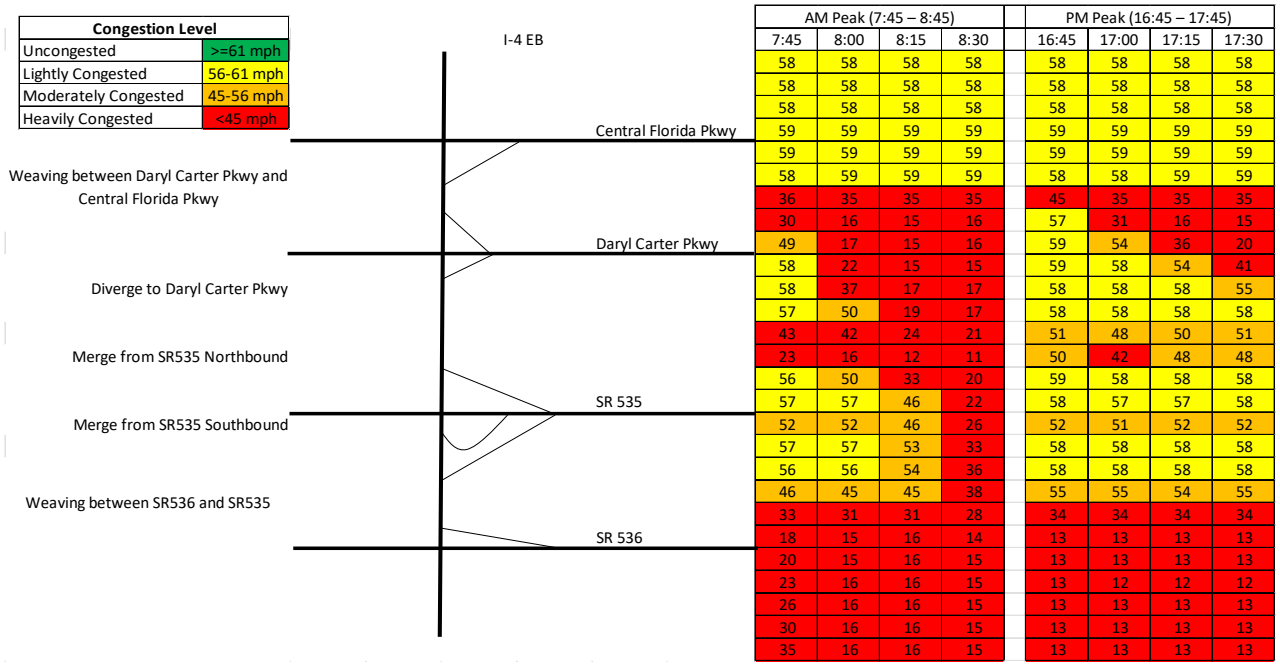
AM Peak (7:45 – 8:45)				PM Peak (16:45 – 17:45)			
7:45	8:00	8:15	8:30	16:45	17:00	17:15	17:30
58	58	58	58	58	58	58	58
58	58	58	58	58	58	58	58
58	59	58	59	58	58	58	58
59	59	59	59	59	59	58	59
59	59	59	59	59	59	59	59
58	59	59	59	58	57	58	58
40	35	35	35	51	41	38	36
42	16	15	15	59	56	49	40
58	19	15	16	59	58	58	58
59	28	15	15	59	59	59	58
58	47	18	17	58	58	58	58
58	55	21	17	58	58	58	58
45	42	27	21	52	49	48	48
27	17	13	11	49	42	43	43
57	54	35	21	59	59	59	58
57	57	49	22	58	58	57	57
52	51	49	30	53	52	52	52
57	57	56	38	58	58	58	58
57	56	56	42	58	58	58	58
47	46	45	41	54	54	52	55
36	33	34	32	35	34	34	35
21	17	17	17	13	13	13	13
24	17	18	17	13	13	13	13
30	17	18	17	13	12	12	12
40	18	18	17	15	12	12	13
56	18	18	17	18	12	13	13
63	20	18	17	23	13	13	13

Figure 30: 2035 No-Build AM and PM I-4 EB Speed Contours



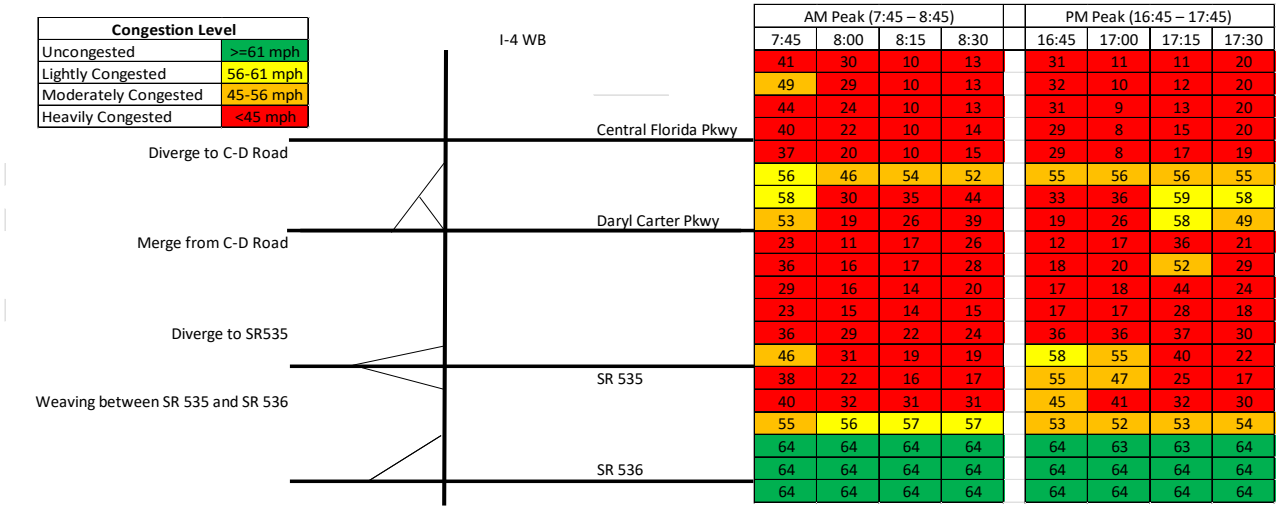
AM Peak (7:45 – 8:45)				PM Peak (16:45 – 17:45)			
7:45	8:00	8:15	8:30	16:45	17:00	17:15	17:30
50	49	25	8	44	26	8	15
56	50	22	8	51	24	8	17
54	43	19	8	46	20	8	18
49	38	17	8	42	19	8	21
42	39	15	8	38	17	9	23
57	43	16	48	56	46	56	56
58	22	13	27	52	21	50	57
56	16	12	19	36	15	43	50
31	11	10	13	17	11	27	28
46	17	16	16	27	17	26	42
38	17	15	15	22	17	20	37
29	17	15	14	18	17	17	28
41	35	28	25	37	37	36	38
58	46	23	17	58	58	54	40
53	32	17	17	58	55	43	29
46	36	31	31	52	46	39	32
57	55	56	57	55	54	52	52
64	64	64	64	64	63	63	63
64	64	64	64	64	64	64	64
64	64	64	64	64	64	64	64

Figure 31: 2035 No-Build AM and PM I-4 WB Speed Contours



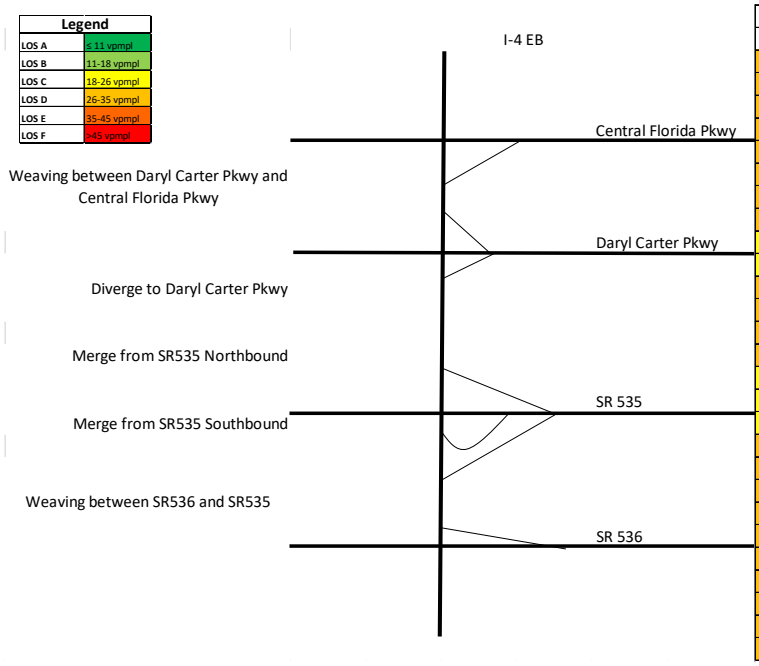
AM Peak (7:45 – 8:45)				PM Peak (16:45 – 17:45)			
7:45	8:00	8:15	8:30	16:45	17:00	17:15	17:30
58	58	58	58	58	58	58	58
58	58	58	58	58	58	58	58
58	58	58	58	58	58	58	58
59	59	59	59	59	59	59	59
59	59	59	59	59	59	59	59
58	59	59	59	58	58	59	59
36	35	35	35	45	35	35	35
30	16	15	16	57	31	16	15
49	17	15	16	59	54	36	20
58	22	15	15	59	58	54	41
58	37	17	17	58	58	58	55
57	50	19	17	58	58	58	58
43	42	24	21	51	48	50	51
23	16	12	11	50	42	48	48
56	50	33	20	59	58	58	58
57	57	46	22	58	57	57	58
52	52	46	26	52	51	52	52
57	57	53	33	58	58	58	58
56	56	54	36	58	58	58	58
46	45	45	38	55	55	54	55
33	31	31	28	34	34	34	34
18	15	16	14	13	13	13	13
20	15	16	15	13	13	13	13
23	16	16	15	13	12	12	12
26	16	16	15	13	13	13	13
30	16	16	15	13	13	13	13
35	16	16	15	13	13	13	13

Figure 32: 2045 No-Build AM and PM I-4 EB Speed Contours



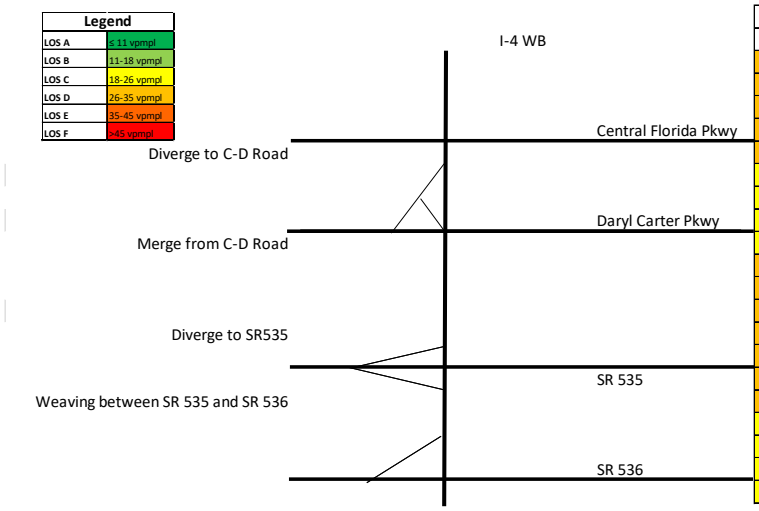
AM Peak (7:45 – 8:45)				PM Peak (16:45 – 17:45)			
7:45	8:00	8:15	8:30	16:45	17:00	17:15	17:30
41	30	10	13	31	11	11	20
49	29	10	13	32	10	12	20
44	24	10	13	31	9	13	20
40	22	10	14	29	8	15	20
37	20	10	15	29	8	17	19
56	46	54	52	55	56	56	55
58	30	35	44	33	36	59	58
53	19	26	39	19	26	58	49
23	11	17	26	12	17	36	21
36	16	17	28	18	20	52	29
29	16	14	20	17	18	44	24
23	15	14	15	17	17	28	18
36	29	22	24	36	36	37	30
46	31	19	19	58	55	40	22
38	22	16	17	55	47	25	17
40	32	31	31	45	41	32	30
55	56	57	57	53	52	53	54
64	64	64	64	64	63	63	64
64	64	64	64	64	64	64	64
64	64	64	64	64	64	64	64

Figure 33: 2045 No-Build AM and PM I-4 WB Speed Contours



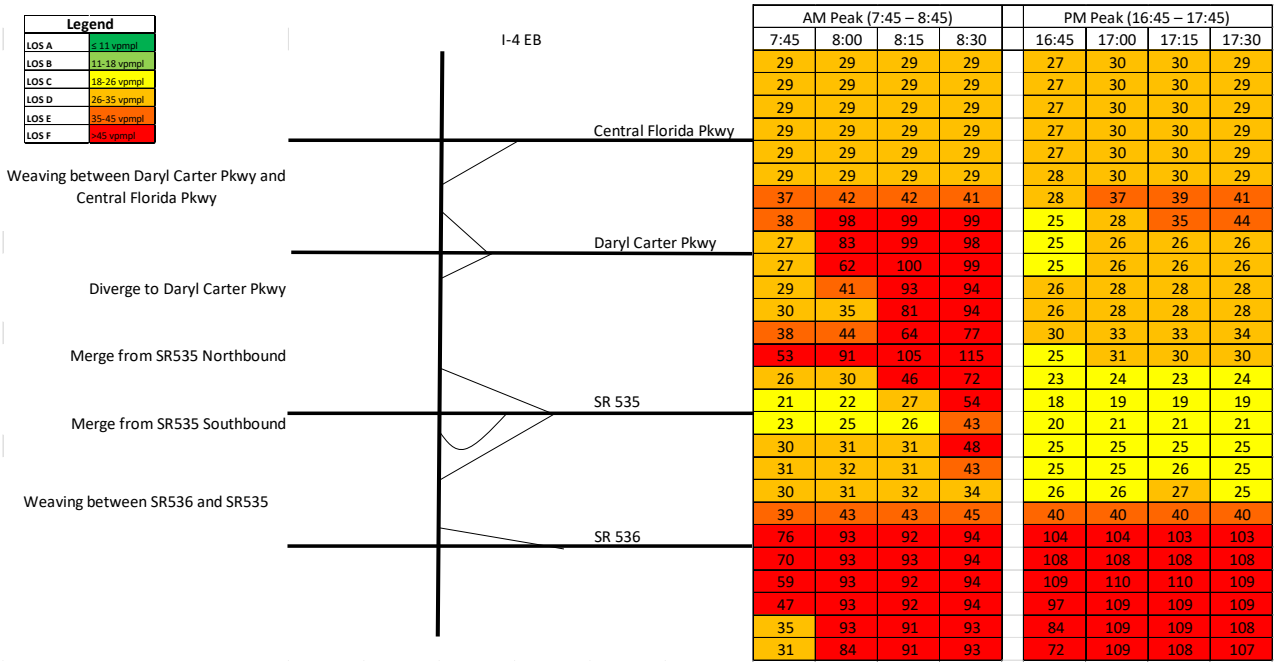
AM Peak (7:45 – 8:45)				PM Peak (16:45 – 17:45)			
7:45	8:00	8:15	8:30	16:45	17:00	17:15	17:30
27	29	29	29	26	27	28	28
27	29	29	29	26	28	28	28
27	29	29	29	26	27	28	28
27	29	29	29	26	27	28	28
27	29	29	29	26	27	28	28
28	29	29	29	26	27	28	28
33	42	42	42	25	27	28	27
33	96	99	99	24	24	24	24
26	73	100	99	24	24	24	24
26	48	100	100	24	24	24	24
28	33	82	94	26	26	26	25
28	32	63	94	26	26	26	25
34	43	53	79	27	28	27	27
33	70	94	116	22	22	22	21
25	28	31	64	23	22	22	22
20	22	22	37	18	18	18	17
22	24	24	29	19	19	19	19
29	31	30	34	26	24	24	24
29	31	30	33	26	25	25	24
28	29	28	28	37	42	41	47
29	35	33	31	39	50	48	51
32	55	51	40	66	107	106	106
27	33	32	29	53	110	111	111
26	27	26	26	31	94	112	113
26	27	26	26	25	59	109	111
26	27	26	26	25	34	97	110
26	27	26	26	25	26	73	110

Figure 34: 2025 No-Build AM and PM I-4 EB Density Contours



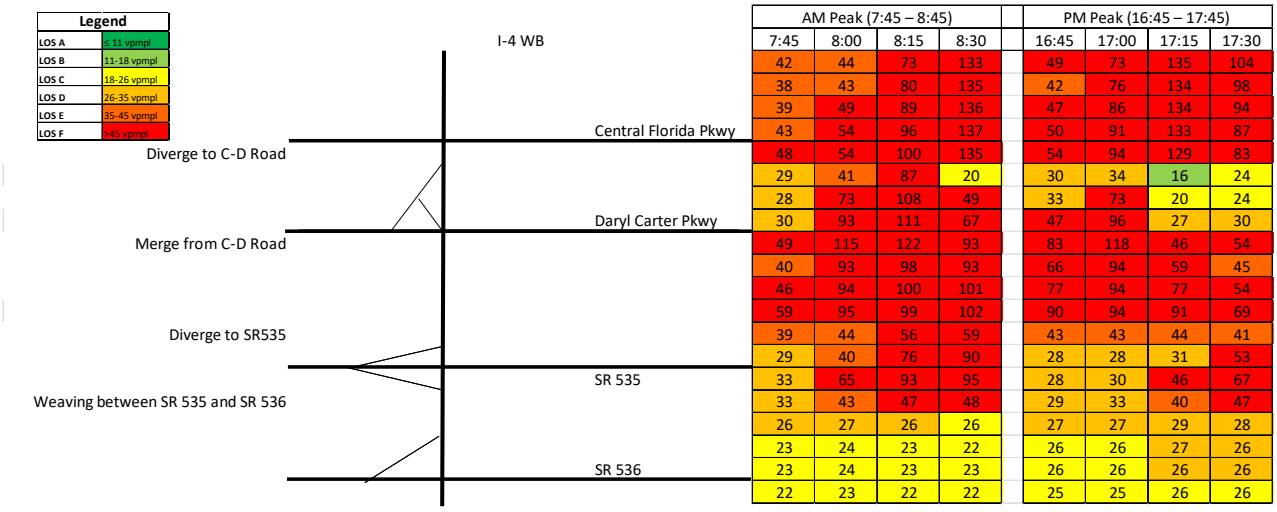
AM Peak (7:45 – 8:45)				PM Peak (16:45 – 17:45)			
7:45	8:00	8:15	8:30	16:45	17:00	17:15	17:30
31	31	31	32	33	30	32	30
31	31	31	31	32	30	32	33
31	31	31	31	32	30	32	40
31	31	31	32	33	31	33	53
33	33	35	34	37	34	37	71
26	26	26	27	26	25	26	23
25	26	26	39	26	25	27	34
25	26	26	72	26	25	56	80
25	28	42	106	38	39	99	114
29	32	70	97	32	56	93	95
28	50	88	98	32	81	94	95
35	79	95	98	41	93	95	95
34	43	49	51	37	43	43	43
28	37	57	71	28	28	28	27
30	54	78	83	29	31	28	27
29	40	45	46	29	32	30	27
24	27	27	26	25	27	27	25
22	24	24	24	25	25	26	25
22	24	24	24	25	25	25	25
21	24	23	23	24	25	25	24

Figure 35: 2025 No-Build AM and PM I-4 WB Density Contours



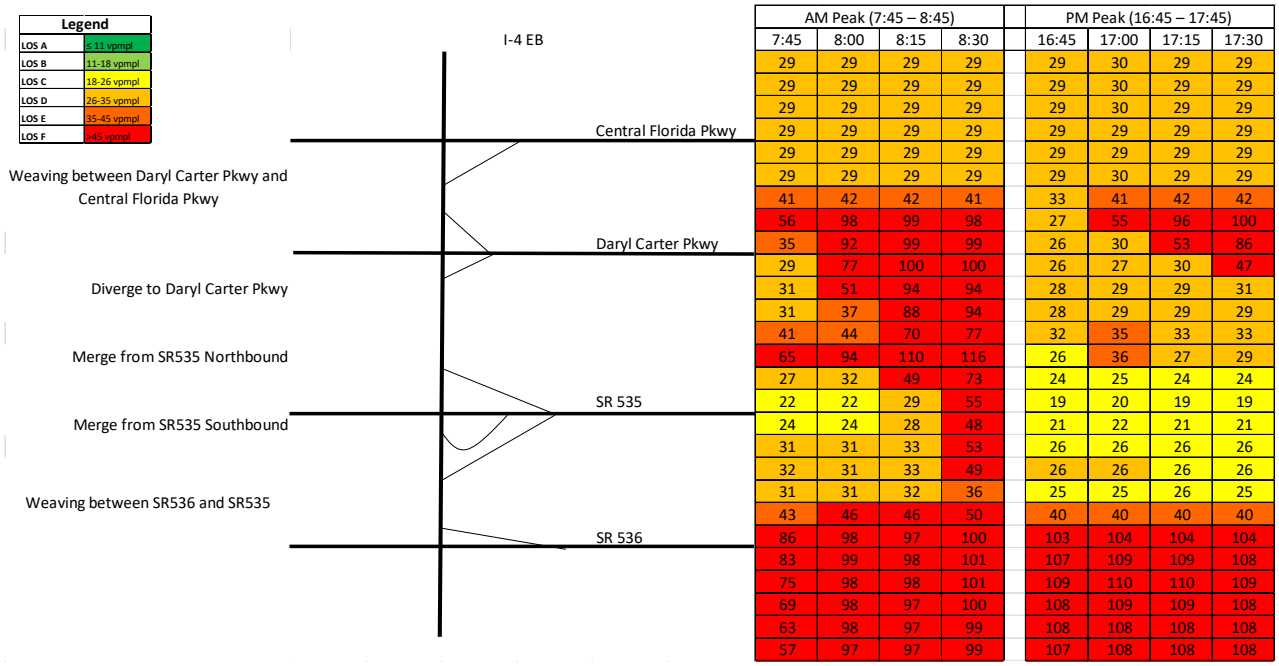
AM Peak (7:45 – 8:45)				PM Peak (16:45 – 17:45)			
7:45	8:00	8:15	8:30	16:45	17:00	17:15	17:30
29	29	29	29	27	30	30	29
29	29	29	29	27	30	30	29
29	29	29	29	27	30	30	29
29	29	29	29	27	30	30	29
29	29	29	29	27	30	30	29
29	29	29	29	28	30	30	29
37	42	42	41	28	37	39	41
38	98	99	99	25	28	35	44
27	83	99	98	25	26	26	26
27	62	100	99	25	26	26	26
29	41	93	94	26	28	28	28
30	35	81	94	26	28	28	28
38	44	64	77	30	33	33	34
53	91	105	115	25	31	30	30
26	30	46	72	23	24	23	24
21	22	27	54	18	19	19	19
23	25	26	43	20	21	21	21
30	31	31	48	25	25	25	25
31	32	31	43	25	25	26	25
30	31	32	34	26	26	27	25
39	43	43	45	40	40	40	40
76	93	92	94	104	104	103	103
70	93	93	94	108	108	108	108
59	93	92	94	109	110	110	109
47	93	92	94	97	109	109	109
35	93	91	93	84	109	109	108
31	84	91	93	72	109	108	107

Figure 36: 2035 No-Build AM and PM I-4 EB Density Contours



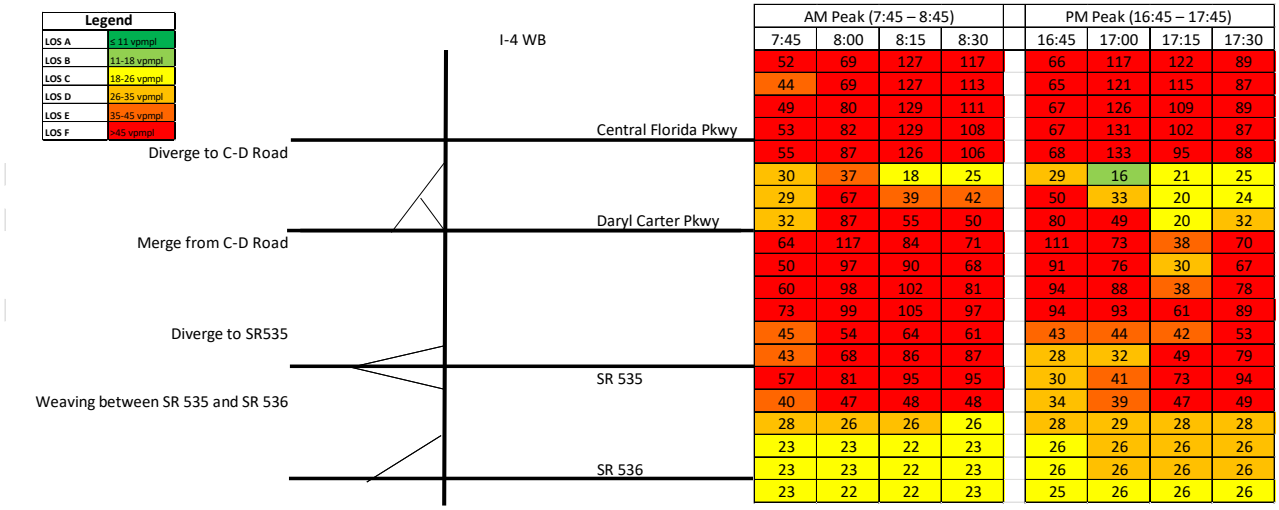
AM Peak (7:45 – 8:45)				PM Peak (16:45 – 17:45)			
7:45	8:00	8:15	8:30	16:45	17:00	17:15	17:30
42	44	73	133	49	73	135	104
38	43	80	135	42	76	134	98
39	49	89	136	47	86	134	94
43	54	96	137	50	91	133	87
48	54	100	135	54	94	129	83
29	41	87	20	30	34	16	24
28	73	108	49	33	73	20	24
30	93	111	67	47	96	27	30
49	115	122	93	83	118	46	54
40	93	98	93	66	94	59	45
46	94	100	101	77	94	77	54
59	95	99	102	90	94	91	69
39	44	56	59	43	43	44	41
29	40	76	90	28	28	31	53
33	65	93	95	28	30	46	67
33	43	47	48	29	33	40	47
26	27	26	26	27	27	29	28
23	24	23	22	26	26	27	26
23	24	23	23	26	26	26	26
22	23	22	22	25	25	26	26

Figure 37: 2035 No-Build AM and PM I-4 WB Density Contours



AM Peak (7:45 – 8:45)				PM Peak (16:45 – 17:45)			
7:45	8:00	8:15	8:30	16:45	17:00	17:15	17:30
29	29	29	29	29	30	29	29
29	29	29	29	29	30	29	29
29	29	29	29	29	30	29	29
29	29	29	29	29	29	29	29
29	29	29	29	29	29	29	29
29	29	29	29	29	30	29	29
41	42	42	41	33	41	42	42
56	98	99	98	27	55	96	100
35	92	99	99	26	30	53	86
29	77	100	100	26	27	30	47
31	51	94	94	28	29	29	31
31	37	88	94	28	29	29	29
41	44	70	77	32	35	33	33
65	94	110	116	26	36	27	29
27	32	49	73	24	25	24	24
22	22	29	55	19	20	19	19
24	24	28	48	21	22	21	21
31	31	33	53	26	26	26	26
32	31	33	49	26	26	26	26
31	31	32	36	25	25	26	25
43	46	46	50	40	40	40	40
86	98	97	100	103	104	104	104
83	99	98	101	107	109	109	108
75	98	98	101	109	110	110	109
69	98	97	100	108	109	109	108
63	98	97	99	108	108	108	108
57	97	97	99	107	108	108	108

Figure 38: 2045 No-Build AM and PM I-4 EB Density Contours



AM Peak (7:45 – 8:45)				PM Peak (16:45 – 17:45)			
7:45	8:00	8:15	8:30	16:45	17:00	17:15	17:30
52	69	127	117	66	117	122	89
44	69	127	113	65	121	115	87
49	80	129	111	67	126	109	89
53	82	129	108	67	131	102	87
55	87	126	106	68	133	95	88
30	37	18	25	29	16	21	25
29	67	39	42	50	33	20	24
32	87	55	50	80	49	20	32
64	117	84	71	111	73	38	70
50	97	90	68	91	76	30	67
60	98	102	81	94	88	38	78
73	99	105	97	94	93	61	89
45	54	64	61	43	44	42	53
43	68	86	87	28	32	49	79
57	81	95	95	30	41	73	94
40	47	48	48	34	39	47	49
28	26	26	26	28	29	28	28
23	23	22	23	26	26	26	26
23	23	22	23	26	26	26	26
23	22	22	23	25	26	26	26

Figure 39: 2045 No-Build AM and PM I-4 WB Density Contours

No-Build VISSIM Travel Time Results

Travel time markers were coded into the network to measure the trip travel time along the I-4 mainline, along SR 535, and from SR 535 to the I-4 ramps at the interchange. **Table 42** through **Table 44** summarize the travel time performance of different routes within the AOI for the 2025, 2035, and 2045 peak hours. The start/end markers of each route are shown in **Appendix S**.

The travel time results suggest that traffic on SR 535 will experience significant delay, especially within the interchange area, which is consistent with the intersection node results and general observations of the No-Build VISSIM models. The travel times along northbound SR 535 are expected to be more than double the average free-flow travel time along the corridor in the 2045 peak hours.

The travel time results along I-4 also suggest that traffic on the interstate will experience delays. The travel times along westbound I-4 are expected to be more than double the average free-flow travel time along the corridor in the future year peak hours (more than triple during the 2035 and 2045 AM peak hours). The travel times along eastbound I-4 are expected to be more than double the average free-flow travel time along the corridor in each of the future year AM peak hours and about 50 percent higher in the 2045 PM peak hour.

Table 42: VISSIM Corridor Travel Time Results – Opening Year (2025) No-Build Peak Hours

Travel Time Measurement	No-Build 2025 AM Peak Hour (min)	No-Build 2025 PM Peak Hour (min)
I-4 EB	6.2	4.1
I-4 WB	6.4	6.3
SR 535 NB	6.3	7.5
SR 535 SB	3.8	5.7
SR 535 NB to I-4 EB Ramp	3.1	3.4
SR 535 NB to I-4 WB Ramp	4.2	4.9
SR 535 SB to I-4 WB Ramp	2.1	2.9
SR 535 SB to I-4 EB Ramp	2.0	2.8

*Note: The average free-flow travel time along the SR 535 corridor (end-to-end within the study limits) is approximately 4.5 min and the average free-flow travel time along the I-4 corridor (end-to-end within the study limits) is approximately 3 min based on HERE data.

Table 43: VISSIM Corridor Travel Time Results – Interim Year (2035) No-Build Peak Hours

Travel Time Measurement	No-Build 2035 AM Peak Hour (min)	No-Build 2035 PM Peak Hour (min)
I-4 EB	6.7	4.3
I-4 WB	9.5	8.1
SR 535 NB	7.5	7.9
SR 535 SB	4.3	5.9
SR 535 NB to I-4 EB Ramp	5.5	3.9
SR 535 NB to I-4 WB Ramp	4.6	4.9
SR 535 SB to I-4 WB Ramp	2.4	3.8
SR 535 SB to I-4 EB Ramp	2.2	3.5

*Note: The average free-flow travel time along the SR 535 corridor (end-to-end within the study limits) is approximately 4.5 min and the average free-flow travel time along the I-4 corridor (end-to-end within the study limits) is approximately 3 min based on HERE data.

Table 44: VISSIM Corridor Travel Time Results – Design Year (2045) No-Build Peak Hours

Travel Time Measurement	No-Build 2045 AM Peak Hour (min)	No-Build 2045 PM Peak Hour (min)
I-4 EB	7.0	5.0
I-4 WB	9.6	8.5
SR 535 NB	8.8	9.5
SR 535 SB	4.1	6.3
SR 535 NB to I-4 EB Ramp	7.6	7.1
SR 535 NB to I-4 WB Ramp	6.6	7.6
SR 535 SB to I-4 WB Ramp	2.2	3.6
SR 535 SB to I-4 EB Ramp	2.5	3.6

*Note: The average free-flow travel time along the SR 535 corridor (end-to-end within the study limits) is approximately 4.5 min and the average free-flow travel time along the I-4 corridor (end-to-end within the study limits) is approximately 3 min based on HERE data.

No-Build Intersection Node Performance Results

The 2025, 2035, and 2045 node performance measures at the study intersections along SR 535 are summarized in **Table 45** through **Table 53** including the simulated volume, delay, average queue length, maximum queue length, and estimated LOS of intersection. The tables also include the turn lane lengths for the exclusive turn lanes which were estimated by measuring from the stop bar to the end of the taper. Queue lengths were rounded to the nearest foot.

It is important to note that the LOS from simulation is an estimate and is not the same as the LOS derived in the Highway Capacity Manual. Many of the study intersections are impacted by capacity constraints along I-4 previously described in this section. The intersection node results for the intersections along Daryl Carter Parkway are included in **Appendix S** for reference.

As summarized in **Table 45** through **Table 53**, the following intersections along SR 535 are expected to operate at LOS F:

- 2035 and 2045
    - SR 535 at Hotel Plaza Boulevard (PM peak hour)
    - SR 535 at Palm Parkway (both AM and PM peak hours)

The maximum queue for the northbound left-turn movement from SR 535 to I-4 westbound spills out of the turn lane during each of the future year peak hours. This results in northbound congestion along SR 535 as exhibited by the northbound SR 535 corridor travel times described previously. This is a primary driver of the improvements proposed as part of the Build scenario summarized in Section 9.

Table 45: 2025 No-Build Peak Hour Node Evaluation Results – SR 535 at Meadow Creek Drive and I-4 EB Off-Ramp/Vineland Avenue

Intersection	Movement	AM Peak Hour				PM Peak Hour				Turn Lane Length (feet)
		Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	
SR 535 @ Meadow Creek Drive	EBR	167	79.7	66	236	335	85.7	129	324	-
	WBR	80	74.7	27	134	59	70.6	18	87	-
	SBT	1,254	2.8	7	93	1,876	6.7	23	191	-
	SBR	61	4.5	1	42	160	9.0	5	95	215
	SBL	10	24.2	2	61	50	20.4	3	98	275
	SBU	32	39.2	2	61	59	18.2	3	98	275
	NBU	30	10.3	0	23	32	21.2	1	69	275
	NBL	27	7.3	0	23	52	18.3	1	69	275
	NBR	9	13.2	87	655	50	15.8	67	547	-
	NBT	2,000	10.9	87	655	1,812	14.4	67	547	-
	Intersection	**3,670**	**12.8**	**LOS B***		**4,485**	**17.3**	**LOS B***		**-**
SR 535 @ I-4 EB Off-Ramp/ Vineland Avenue	EBR	81	3.4	1	65	182	14.6	16	224	900
	EBL	299	83.2	92	327	533	121.1	887	1,683	375
	EBT	67	70.4	21	105	353	99.0	112	662	-
	SBT	1,128	20.1	48	278	1,586	29.2	103	570	-
	SBL	157	84.2	48	168	394	90.0	111	340	750
	WBL	82	88.0	31	119	295	89.6	95	308	-
	WBR	347	56.3	163	722	537	50.0	170	657	-
	NBT	1,915	24.6	211	795	1,669	43.3	263	794	-
	NBR	95	15.4	1	119	245	19.4	5	165	350
	Intersection	**4,171**	**33.8**	**LOS C***		**5,795**	**54.2**	**LOS D***		**-**

***Note:** Estimated LOS from VISSIM. Distance to the I-4 EB gore point from the stop bar is approximately 2,100 feet.

Table 46: 2025 No-Build Peak Hour Node Evaluation Results – SR 535 at I-4 WB Ramps and Hotel Plaza Boulevard

Intersection	Movement	AM Peak Hour				PM Peak Hour				Turn Lane Length (feet)
		Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	
SR 535@ I-4 WB Ramps	WBL	562	58.2	118	434	819	65.5	203	684	-
	WBR	650	59.2	144	558	677	61.8	159	593	-
	NBL	283	87.0	152	539	352	77.9	181	803	325
	NBT	1,262	10.8	33	400	1,570	10.6	32	321	-
	SBT (to I-4 EB)	959	13.2	21	333	869	14.5	31	504	-
	SBR	756	15.0	39	648	649	15.3	42	632	700
	SBT (SR 535)	733	27.7	51	342	1,161	45.9	129	601	-
	Intersection	**5,204**	**29.6**	**LOS C***		**6,097**	**35.3**	**LOS D***		**-**
SR 535 @ Hotel Plaza Boulevard	NBT	1,311	15.1	44	369	1,658	41.4	164	823	-
	NBL	518	81.0	137	448	515	78.7	130	452	550
	EBR	437	58.1	90	354	1,129	44.5	207	1,377	-
	EBL	171	174.1	116	292	622	87.5	221	1,060	-
	SBT	2,013	32.2	296	1,076	1,622	69.9	423	1,259	-
	SBR	257	23.9	7	133	291	40.1	15	296	350
	Intersection	**4,708**	**40.0**	**LOS D***		**5,837**	**58.1**	**LOS E***		**-**

***Note:** Estimated LOS from VISSIM. Distance to the I-4 WB gore point from the stop bar is approximately 1,265 feet.

Table 47: 2025 No-Build Peak Hour Node Evaluation Results – SR 535 at Palm Parkway

Intersection	Movement	AM Peak Hour				PM Peak Hour				Turn Lane Length (feet)
		Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	
SR 535 @ Palm Pkwy	NBU	45	82.8	138	469	49	84.7	152	519	950
	NBR	215	4.4	0	37	351	7.8	0	55	950
	NBL	543	72.4	138	469	597	76.4	152	519	950
	NBT	702	38.3	86	480	1,294	43.7	201	1,025	-
	WBL	282	107.1	121	395	284	131.9	157	640	330
	WBT	224	61.0	55	234	561	95.2	252	882	-
	WBR	34	42.2	72	259	45	88.5	274	907	-
	EBR	998	43.1	295	1,351	731	6.2	5	264	-
	EBT	469	102.4	564	1,426	361	72.5	191	856	-
	EBL	465	88.2	184	902	463	117.9	250	868	-
	SBT	947	64.3	244	902	851	80.7	354	1,525	-
	SBL	36	79.4	10	109	46	193.0	118	1,152	170
	SBR	328	8.2	0	34	537	15.1	1	173	460
	Intersection	**5,288**	**59.5**	**LOS E***		**6,170**	**60.8**	**LOS E***		**-**

***Note:** Estimated LOS from VISSIM

Table 48: 2035 No-Build Peak Hour Node Evaluation Results – SR 535 at Meadow Creek Drive and I-4 EB Off-Ramp/Vineland Avenue

Intersection	Movement	AM Peak Hour				PM Peak Hour				Turn Lane Length (feet)
		Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	
SR 535 @ Meadow Creek Drive	EBR	176	80.8	68	243	354	101.5	155	365	-
	WBR	74	135.6	50	223	64	72.0	19	100	-
	SBT	1,232	6.0	13	273	1,863	1.4	4	82	-
	SBR	58	4.9	1	44	151	3.1	1	42	215
	SBL	9	46.1	7	99	48	48.9	17	155	275
	SBU	31	54.7	7	99	62	59.0	17	155	275
	NBU	28	20.3	0	35	33	18.0	1	69	275
	NBL	24	12.5	0	35	52	19.3	1	69	275
	NBR	8	27.7	313	745	52	18.2	72	479	-
	NBT	1,941	35.9	313	745	2,022	13.6	72	479	-
	Intersection	**3,580**	**29.2**	**LOS C***		**4,699**	**16.9**	**LOS B***		**-**
SR 535 @ I-4 EB Off-Ramp/ Vineland Avenue	EBR	87	3.1	1	76	191	9.1	8	178	900
	EBL	299	83.5	90	344	515	107.1	485	1,649	375
	EBT	66	71.6	22	99	351	90.3	113	751	-
	SBT	1,133	4.0	10	208	1,498	10.9	29	381	-
	SBL	169	94.4	56	175	408	82.6	106	344	750
	WBL	69	124.5	25	148	349	88.8	107	394	-
	WBR	349	121.8	436	1,577	633	53.0	224	782	-
	NBT	1,848	58.4	442	820	1,829	53.0	361	796	-
	NBR	85	41.8	1	119	264	33.0	4	162	350
	Intersection	**4,105**	**51.9**	**LOS D***		**6,039**	**51.1**	**LOS D***		**-**

***Note:** Estimated LOS from VISSIM. Distance to the I-4 EB gore point from the stop bar is approximately 2,100 feet.

Table 49: 2035 No-Build Peak Hour Node Evaluation Results – SR 535 at I-4 WB Ramps and Hotel Plaza Boulevard

Intersection	Movement	AM Peak Hour				PM Peak Hour				Turn Lane Length (feet)
		Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	
SR 535@ I-4 WB Ramps	WBL	534	59.4	114	418	725	65.2	175	606	-
	WBR	617	58.8	136	507	607	64.0	146	565	-
	NBL	304	63.5	120	588	414	85.3	262	947	325
	NBT	1,208	15.9	51	523	1,600	19.7	141	883	-
	SBT (to I-4 EB)	1,004	15.3	26	355	994	17.6	46	555	-
	SBR	839	17.1	60	814	695	17.7	59	650	700
	SBT (SR 535)	767	29.2	55	348	1,166	47.0	134	572	-
	Intersection	**5,273**	**30.1**	**LOS C***		**6,200**	**38.3**	**LOS D***		**-**
SR 535 @ Hotel Plaza Boulevard	NBT	1,268	15.7	43	385	1,609	38.9	144	758	-
	NBL	488	79.8	124	441	532	70.8	116	427	550
	EBR	522	63.5	120	444	1,304	55.3	613	1,675	-
	EBL	177	248.5	181	417	721	208.8	934	1,670	-
	SBT	2,103	39.1	432	1,248	1,588	91.5	680	1,475	-
	SBR	269	31.2	9	196	339	58.3	86	1,229	350
	Intersection	**4,826**	**47.0**	**LOS D***		**6,094**	**80.0**	**LOS F***		**-**

***Note:** Estimated LOS from VISSIM. Distance to the I-4 WB gore point from the stop bar is approximately 1,265 feet.

Table 50: 2035 No-Build Peak Hour Node Evaluation Results – SR 535 at Palm Parkway

Intersection	Movement	AM Peak Hour				PM Peak Hour				Turn Lane Length (feet)
		Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	
SR 535 @ Palm Pkwy	NBU	49	91.8	162	497	47	91.5	184	564	950
	NBR	212	4.5	0	35	342	6.9	0	45	950
	NBL	530	87.2	162	497	654	82.4	184	564	950
	NBT	679	42.4	93	470	1,280	43.3	195	935	-
	WBL	304	223.3	356	955	273	181.9	256	912	330
	WBT	260	71.4	96	418	623	138.2	607	1,454	-
	WBR	47	56.7	113	443	54	135.7	630	1,473	-
	EBR	994	61.2	1,284	1,697	815	23.0	217	1,278	-
	EBT	518	139.8	1,340	1,700	419	94.7	452	1,389	-
	EBL	496	143.3	1,287	1,700	483	201.4	705	1,418	-
	SBT	1,022	120.7	1,065	1,673	893	95.4	575	1,666	-
	SBL	59	121.2	521	1,167	54	208.8	322	1,406	170
	SBR	345	39.9	0	45	561	23.2	10	381	460
	Intersection	**5,512**	**93.9**	**LOS F***		**6,497**	**80.7**	**LOS F***		**-**

***Note:** Estimated LOS from VISSIM.

Table 51: 2045 No-Build Peak Hour Node Evaluation Results – SR 535 at Meadow Creek Drive and I-4 EB Off-Ramp/Vineland Avenue

Intersection	Movement	AM Peak Hour				PM Peak Hour				Turn Lane Length (feet)
		Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	
SR 535 @ Meadow Creek Drive	EBR	180	82.9	72	252	370	111.8	173	403	-
	WBR	78	174.7	62	237	67	74.0	21	102	-
	SBT	1,218	5.0	9	190	1,797	8.6	27	210	-
	SBR	56	3.6	1	35	132	9.1	5	97	215
	SBL	7	74.7	12	111	46	45.0	8	111	275
	SBU	31	148.1	12	111	66	36.1	8	111	275
	NBU	29	42.7	0	32	33	23.6	1	64	275
	NBL	21	18.9	0	32	52	30.5	1	64	275
	NBR	6	64.8	433	760	45	67.8	392	755	-
	NBT	1,858	60.9	433	760	2,058	55.1	392	755	-
	Intersection	**3,484**	**44.5**	**LOS D***		**4,666**	**39.9**	**LOS D***		**-**
SR 535 @ I-4 EB Off-Ramp/ Vineland Avenue	EBR	89	3.5	1	75	197	8.6	9	175	900
	EBL	247	163.3	164	474	423	120.8	313	1,465	375
	EBT	66	70.5	21	108	355	84.5	105	540	-
	SBT	1,086	19.1	44	276	1,362	28.3	82	452	-
	SBL	169	89.7	53	175	409	84.2	110	357	750
	WBL	76	170.1	29	169	389	102.0	131	651	-
	WBR	372	142.2	540	1,660	713	74.2	382	1,069	-
	NBT	1,735	70.8	507	829	1,874	67.9	469	829	-
	NBR	75	43.6	1	112	261	46.8	3	144	350
	Intersection	**3,915**	**69.8**	**LOS E***		**5,982**	**64.8**	**LOS E***		**-**

***Note:** Estimated LOS from VISSIM. Distance to the I-4 EB gore point from the stop bar is approximately 2,100 feet.

Table 52: 2045 No-Build Peak Hour Node Evaluation Results – SR 535 at I-4 WB Ramps and Hotel Plaza Boulevard

Intersection	Movement	AM Peak Hour				PM Peak Hour				Turn Lane Length (feet)
		Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	
SR 535@ I-4 WB Ramps	WBL	497	60.3	108	406	694	65.7	169	609	-
	WBR	548	58.5	119	445	564	62.6	132	530	-
	NBL	304	83.2	155	609	432	94.5	288	1,037	325
	NBT	1,085	12.6	35	501	1,539	14.5	75	781	-
	SBT (to I-4 EB)	1,014	20.1	25	331	1,058	19.3	49	519	-
	SBR	885	20.6	45	672	703	19.4	74	885	700
	SBT (SR 535)	754	29.1	51	291	1,080	47.4	126	626	-
	Intersection	**5,087**	**31.8**	**LOS C***		**6,070**	**37.8**	**LOS D***		**-**
SR 535 @ Hotel Plaza Boulevard	NBT	1,202	14.7	40	380	1,641	39.3	151	818	-
	NBL	461	74.8	111	432	550	74.2	129	557	550
	EBR	611	64.3	135	551	1,223	63.0	822	1,697	-
	EBL	178	324.4	251	554	682	245.5	1,184	1,698	-
	SBT	2,050	41.0	293	1,079	1,677	87.8	748	1,435	-
	SBR	268	24.5	9	215	409	55.7	355	1,387	350
	Intersection	**4,769**	**50.3**	**LOS D***		**6,182**	**84.0**	**LOS F***		**-**

***Note:** Estimated LOS from VISSIM. Distance to the I-4 WB gore point from the stop bar is approximately 1,265 feet.

Table 53: 2045 No-Build Peak Hour Node Evaluation Results – SR 535 at Palm Parkway

Intersection	Movement	AM Peak Hour				PM Peak Hour				Turn Lane Length (feet)
		Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	
SR 535 @ Palm Pkwy	NBU	50	87.1	139	495	53	99.7	223	653	950
	NBR	208	4.3	0	44	331	7.1	0	52	950
	NBL	502	78.4	139	495	677	94.1	223	653	950
	NBT	648	39.9	83	498	1,245	42.0	180	984	-
	WBL	302	313.0	780	1,627	249	169.4	372	882	330
	WBT	267	115.0	479	1,583	645	155.8	1,050	1,670	-
	WBR	54	105.5	498	1,594	56	155.9	1,063	1,670	-
	EBR	952	57.1	1,379	1,701	824	54.8	1,054	1,691	-
	EBT	534	152.9	1,429	1,701	446	143.1	1,194	1,689	-
	EBL	496	151.3	1,419	1,701	488	241.9	1,260	1,689	-
	SBT	1,027	127.8	1,262	1,688	916	119.0	866	1,674	-
	SBL	70	127.8	808	1,373	52	233.1	297	1,105	170
	SBR	335	45.4	0	72	557	35.1	6	323	460
	Intersection	**5,445**	**104.2**	**LOS F***		**6,537**	**98.3**	**LOS F***		**-**

***Note:** Estimated LOS from VISSIM

The maximum queue for the I-4 westbound off-ramp to SR 535 was approximately 685 feet and the maximum queue for the I-4 eastbound off-ramp to SR 535 was approximately 1,685 feet. Both maximum queue lengths are expected to extend into the section of the off-ramp designated for deceleration.

- I-4 westbound off-ramp to SR 535
    - Stop bar to gore length – 1,265 feet
        - Portion of ramp designated for deceleration – 615 feet (Table 105 of AASHTO Green Book)
        - Remaining distance for storage – 650 feet
- I-4 eastbound off-ramp to SR 535
    - Stop bar to gore length – 2,100 feet
        - Portion of ramp designated for deceleration – 615 feet (Table 105 of AASHTO Green Book)
        - Remaining distance for storage – 1,485 feet

The maximum queues observed along the off-ramps were reported in 2025 as this analysis year is the least impacted by the upstream latent demands and capacity constraints on the I-4 mainline. As demands increase in 2035 and 2045, the maximum queue lengths along the off-ramp shorten versus the 2025 results as volumes are constrained upstream. While the simulation did not show these queues extending onto the I-4 mainline, there are severe capacity constraints upstream and latent demand along I-4 eastbound and westbound. It is expected that the queues along both SR 535 off-ramps would be more severe and potentially would impact the I-4 mainline had the upstream capacity constraints not existed in the simulation. Consideration should be given by the District to program the Phase II improvements when funding is available as the Phase II improvements are expected to address the potential queuing issues along the I-4 eastbound off-ramp.

9.3. Future No-Build Operational Summary

Based on the operational analyses conducted for the future year No-Build AM and PM peak hours, the VISSIM results show severe congestion throughout the network. The following summarizes the key findings from the future year No-Build simulation analyses.

- The simulation analysis resulted in severe latent demand and capacity constraints on the I-4 mainline and SR 535 arterial impacting:
    - Westbound C-D system from Central Florida Parkway and Daryl Carter Parkway
    - Eastbound on-ramp from northbound SR 535
    - Eastbound on-ramp from Daryl Carter Parkway
    - Intersection of SR 535 and Palm Parkway
- Travel times along westbound I-4 are expected to be more than double the average free flow travel time along corridor, ranging between approximately 8 and 10 minutes. It should be noted that this does not include the latent demand/delay at the entry point of the westbound I-4.
- An overall intersection LOS F was observed at the following intersections along SR 535:
    - SR 535 at Hotel Plaza Boulevard
    - SR 535 at Palm Parkway
- The queues along the eastbound off-ramp at SR 535 are expected to encroach into the portion of the off-ramp designated for deceleration.
    - The maximum queue observed in VISSIM was approximately 1,685 feet. The distance to the gore point from the stop bar is approximately 2,100 feet with 615 feet of that length designated for deceleration (based on Table 10-5 of the AASHTO Green Book). This leaves approximately 1,485 feet for storage.
    - I-4 eastbound was capacity constrained upstream and it is expected that had the constraint not existed upstream, the queues from SR 535 would have impacted the I-4 eastbound mainline.
    - Additional improvements will be considered and evaluated as part of Phase II of interchange improvements at SR 535. The analysis indicates that queuing along the eastbound off-ramp will encroach into the portion of the off-ramp designated for deceleration and is expected to impact the mainline as volumes increase into the interim year (2035). At this time, it is not known when additional funding will become available to construct the Phase II interchange improvements; however, this is a top priority in the District. FDOT will coordinate with the appropriate agencies and will conduct the appropriate documentation for the Phase II improvements when funding is made available and plans to program Phase II within the next 10 years pending available funds..
- The queues along the westbound off-ramp at SR 535 are expected to encroach into the portion of the off-ramp designated for deceleration.
    - The maximum queue observed in VISSIM was approximately 685 feet. The distance to the gore point from the stop bar is approximately 1,265 feet with 615 feet of that length

designated for deceleration (based on Table 10-5 of the AASHTO Green Book). This leaves approximately 650 feet for storage.

  - I-4 westbound was capacity constrained upstream and it is expected that had the constraint not existed upstream, the queues from SR 535 would have impacted the I-4 westbound mainline.

- The on-ramp (merge sections) to eastbound I-4 from SR 535 and Daryl Carter Parkway become capacity constraints for the northbound traffic along these arterials due the I-4 eastbound mainline congestion.
  - These mainline capacity constraints are expected to impact the adjacent signalized intersections along the corridors.
    - Queue spillback originating from the I-4 mainline was observed in the simulation analysis along SR 535 and Daryl Carter Parkway and resulted in severe congestion along the corridors.
- Travel times along SR 535 (e.g., northbound SR 535) are expected to be more than double the average free-flow travel time along the corridor with the average travel time range between approximately 9 and 10 minutes during the 2045 peak hours.
- The maximum queue for the northbound left-turn movement from SR 535 to I-4 westbound spills out of the turn lane during each of the future year peak hours. This results in northbound congestion along SR 535 as exhibited by the northbound SR 535 corridor travel times described previously.

10. FUTURE (BUILD) OPERATIONAL ANALYSIS

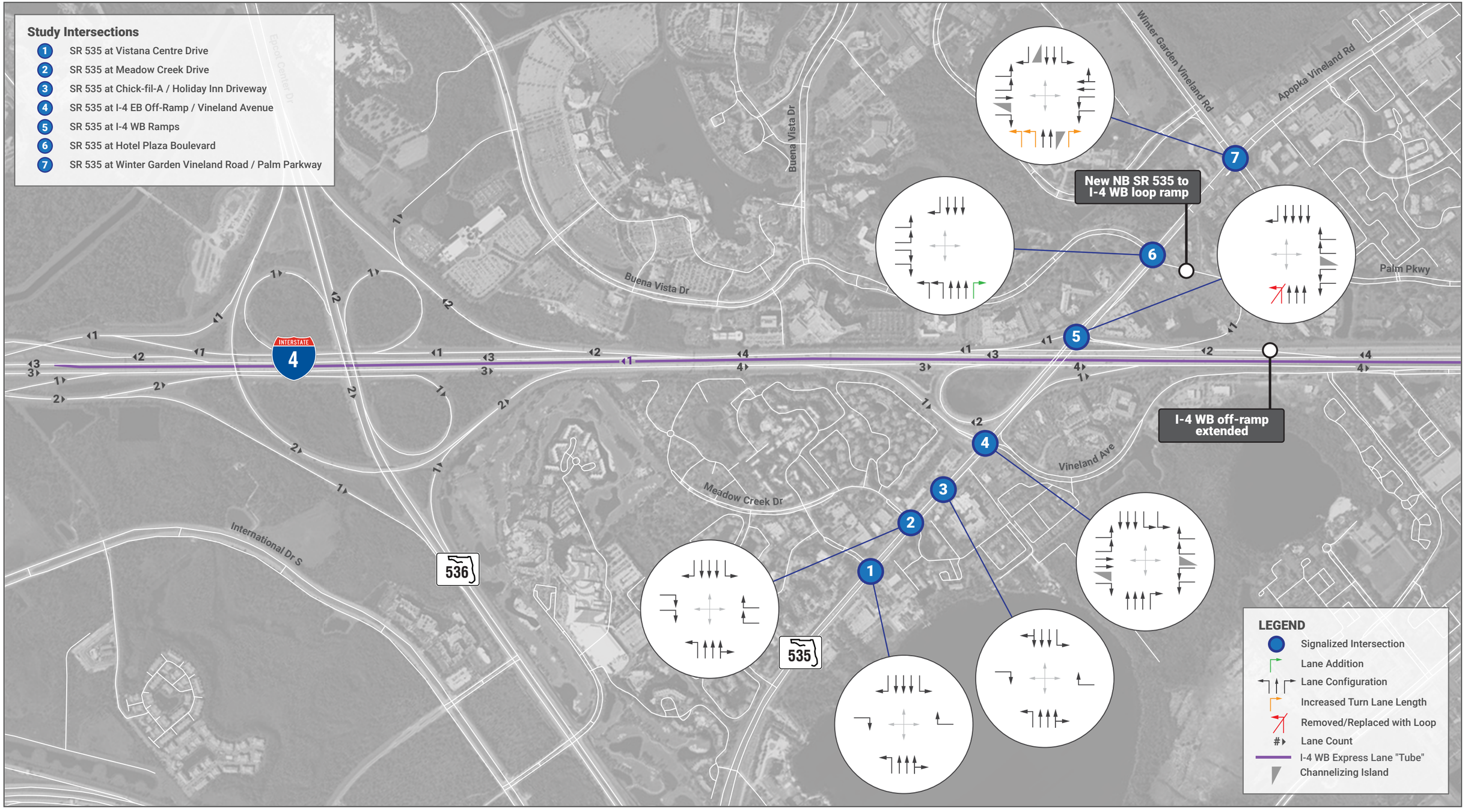
The following section summarizes the future Build operational analysis results for the intersection and freeway evaluations for both the AM and PM peak hours of the future years (2025, 2035, and 2045).

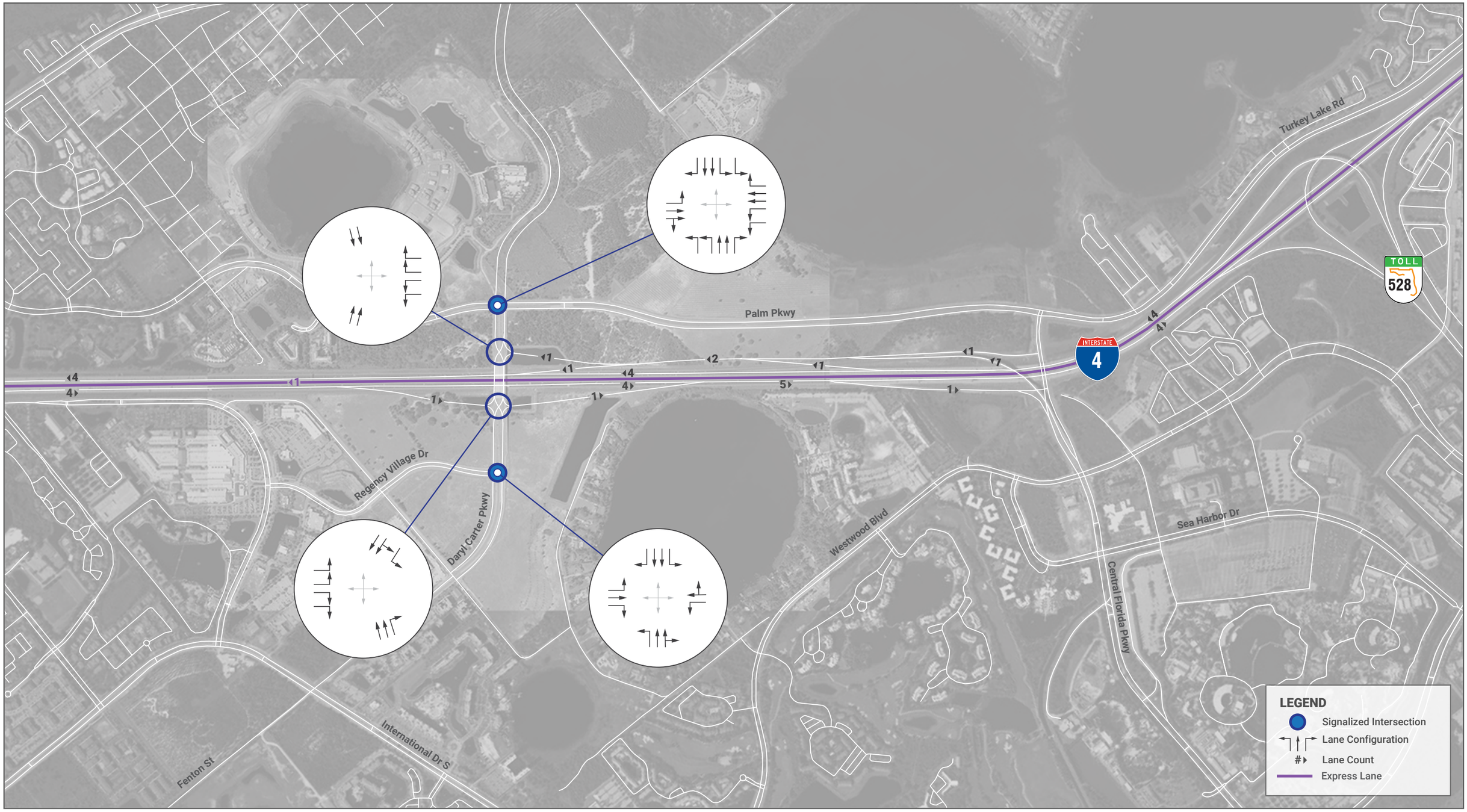
10.1. **Future Build Improvements**

In addition to the No-Build intersection lane additions listed in Section 9.1, the Build condition will include improvements to the I-4 WB ramps and Palm Parkway intersections along SR 535 and the westbound I-4 mainline (Phase I improvements). These improvements have the following geometric changes:

- I-4 westbound express lane "Tube"
    - Extension of the westbound I-4 Ultimate express lanes through the AOI.
        - Extension of one buffer separated express lane through the limits of the AOI.
        - No access is provided in/out of the express lanes within the express lane "Tube".
    - The evaluation of the I-4 westbound express lane "Tube" was conducted and approved by FHWA as part of a separate technical memorandum included as an attachment to the I-4 at Sand Lake Road IMR.
- SR 535 at I-4 WB Ramps
    - The existing northbound left-turn movement is rerouted under the proposed partial cloverleaf configuration. This movement will now travel through the intersection as a northbound through movement before using the new loop ramp to access I-4 westbound.
    - The off-ramp length is extended (gore point shifted further east) to a new ramp length (stop bar to I-4 gore point) of approximately 2,500 feet.
    - The barrier separation between the southbound through lanes and southbound SR 535 to I-4 eastbound loop on-ramp lanes is removed. Four southbound through lanes are included to facilitate southbound traffic at this intersection.
- SR 535 at Hotel Plaza Boulevard
    - An exclusive turn lane is added to access the proposed loop ramp to access I-4 westbound as noted at the I-4 WB Ramps intersection bullet previously.
- SR 535 at Palm Parkway
    - The northbound left-turn lane length is extended to approximately 1,150 feet (including the taper).
    - The northbound right-turn lane is extended back to just downstream of intersection of the Hotel Plaza Boulevard.

The future Build lane configurations along the I-4 mainline, at the gore points for each on-ramp and off-ramp, and at each of the study intersections are illustrated in **Figure 40**. An exhibit of the interchange improvements is included in **Appendix T**.




Palm Pkwy
Turkey Lake Rd
Regency Village Dr
Daryl Carter Pkwy
Westwood Blvd
Sea Harbor Dr
Central Florida Pkwy
International Dr S
Fenton St
INTERSTATE
4
TOLL
528
LEGEND
Signalized Intersection
Lane Configuration
Lane Count
Express Lane
Scale in Feet
0
1,200
North

10.2. Future Build Microsimulation Evaluation

The following section summarizes the Opening Year (2025), Interim Year (2035), and Design Year (2045) Build AM and PM peak hour microsimulation analysis conducted using PTV VISSIM software.

10.2.1. Model Development and Assumptions

In addition to the geometric modifications made within the No-Build models as described in Section 9.3.1, the following updates were made for the future year Build VISSIM models:

- Lane configuration adjustments were made at the study intersections shown previously in **Figure 40** in Section 10.1.
- The I-4 westbound mainline was updated to incorporate the westbound express lane "Tube".
    - Extension of one buffer separated express lane through the limits of the AOI.
    - No access is provided in/out of the express lanes within the express lane "Tube".

10.2.2. Signal Timings

Signal timings were incorporated into Synchro software prior to importing into Ring Barrier Controller (RBC) files for use in the VISSIM microsimulation analysis. The timings at the intersections along Daryl Carter Parkway were assumed to be consistent with those incorporated as part of the No-Build microsimulation analysis as there were no geometric improvements made as part of the Build scenario at these locations.

10.2.3. Routes and Demand Volumes

The same OD routes developed in VISUM ODME for the No-Build scenario were used as the OD routes for the future year Build VISSIM models. Based on the proposed geometric changes as part of the proposed Build scenario, certain routes were adjusted for consistency with the new geometry (e.g., northbound SR 535 to I-4 WB movement uses the new loop ramp under the Build scenario). The volumes and routes were reviewed to ensure the demands in VISSIM were consistent with the Design Traffic volumes.

10.2.4. VISSIM Simulation Parameters

For consistency with the future year No-Build VISSIM models, ten simulation runs were conducted for the future year Build scenarios. The simulation results summarized in this section are representative of the peak hour simulation models.

10.2.5. VISSIM Analysis Results

The future year Build VISSIM models were evaluated using the same performance measures as the No-Build VISSIM analysis including network performance, freeway link evaluations, corridor travel time results, and intersection node performance. The following summarizes the various performance measures and the observations in the models. Consistent with the No-Build results summarized in Section 9.2.5, the results reported in this section are for the peak hours only.

I-4 Mainline Capacity Constraints and Impacts to the Network

Consistent with the No-Build analysis, the Design Year (2045) projected volumes significantly exceed the capacity of I-4 with projections of approximately 2,400 vehicles per hour per lane along some I-4 segments in the Build analysis (I-4 westbound entry into the model). This demand is 200 vehicles per hour per lane less than the one in the No-Build analysis as approximately 700 vehicles are using the tube lane in the Build analysis. However, the demand is still higher than the typical capacity of the freeway lane and therefore, the simulation model does not have the ability to load the network at this rate. As such, significant latent demand was observed in the 2035 PM, 2045 AM and 2045 PM peak hour simulation models (as summarized in **Table 54**).

Table 54: I-4 Latent Demand – Future Year Build Peak Hours

Entry Point	2025		2035		2045	
	AM	PM	AM	PM	AM	PM
I-4 EB	0	183	640	1,295	1,784	2,446
I-4 WB	0	0	475	1,416	2,445	3,272

Build Network Performance Results

Network wide statistics for the 2025, 2035, and 2045 AM and PM peak hour are shown in **Table 55**, **Table 56**, and **Table 57**, respectively. Average delays, speeds, and total delay at a network level are all expected to worsen as demands increase in each of the future analysis years. Although significant latent demand and latent delay were still observed in each of the peak hours, the values are less than those in the No-Build models (due to the need for additional capacity along the I-4 mainline). The reduction of latent demands and latent delay observed in the Build scenario is primarily due to the operational improvements of the I-4 and SR 535 interchange improvements and the I-4 westbound express lane "Tube".

Table 55: VISSIM Network Wide Statistics – Opening Year (2025) Build Peak Hours

Network Wide Statistics	Build 2025 AM Peak Hour	Build 2025 PM Peak Hour
Average Delay (sec)	137.4	134.4
Average Speed (mph)	35.0	33.4
Total Delay (hr)	1,022	1,138
Active Vehicles (at end of peak hour)	3,535	3,476
Vehicles Arrived (during peak hour)	23,261	26,996
Total Peak Hour Vehicles (Active + Arrived)	26,796	30,472
Latent Demand (at end of peak hour)	397	681
Latent Delay (hr)	124	191

Table 56: VISSIM Network Wide Statistics – Interim Year (2035) Build Peak Hours

Network Wide Statistics	Build 2035 AM Peak Hour	Build 2035 PM Peak Hour
Average Delay (sec)	310.7	248.1
Average Speed (mph)	22.8	24.8
Total Delay (hr)	2,584	2,239
Active Vehicles (at end of peak hour)	6,248	4,641
Vehicles Arrived (during peak hour)	23,695	27,857
Total Peak Hour Vehicles (Active + Arrived)	29,943	32,498
Latent Demand (at end of peak hour)	2,228	3,999
Latent Delay (hr)	615	1,375

Table 57: VISSIM Network Wide Statistics – Design Year (2045) Build Peak Hours

Network Wide Statistics	Build 2045 AM Peak Hour	Build 2045 PM Peak Hour
Average Delay (sec)	370.9	310.6
Average Speed (mph)	20.1	21.5
Total Delay (hr)	3,125	2,905
Active Vehicles (at end of peak hour)	6,494	5,766
Vehicles Arrived (during peak hour)	23,850	27,909
Total peak hour vehicles (Active + Arrived)	30,344	33,675
Latent Demand (at end of peak hour)	6,842	8,544
Latent Delay (hr)	2,617	3,809

Build VISSIM Link Evaluation Results

Speed contours for the I-4 study corridor for the future year peak hours between SR 536 and Daryl Carter Parkway are shown in **Figure 41** to **Figure 46**. The speed contours utilize the congestion level thresholds in Table 9-12 of the latest FDOT Traffic Analysis Handbook. The density contours along I-4 eastbound and westbound for the future years are illustrated in **Figure 47** through **Figure 52**.

Despite the latent demand along I-4 that is unable to enter the network, the capacity constraints along I-4 still result in severe congestion along the I-4 mainline. The main bottlenecks in the eastbound are observed within the weaving segment between Daryl Carter Parkway and Central Florida Parkway and within the weaving segment between SR 536 and SR 535 during both peak hours.

The westbound I-4 contours illustrate heavy congestion (speed less than 45 mph) from the beginning of the AOI to the weave between SR 535 and SR 536 during both 2045 peak hours (**Figure 46**). As previously noted in the previous Build Network Performance section and in the following Build VISSIM Travel Time Results section, the westbound express lane “Tube” is providing an operational benefit for the westbound I-4 mainline lanes; however, the single westbound express lane does not mitigate the need for additional capacity along I-4 in the future.

It is important to note that both directions of the I-4 mainline are impacted by upstream capacity constraints and the limitations of the model to process the demands as previously described. As noted earlier in this section, severe latent demand was observed along I-4 eastbound and westbound during both the future years. Caution should be used in interpreting these results due to the significant amount of latent demand for the I-4 mainline.

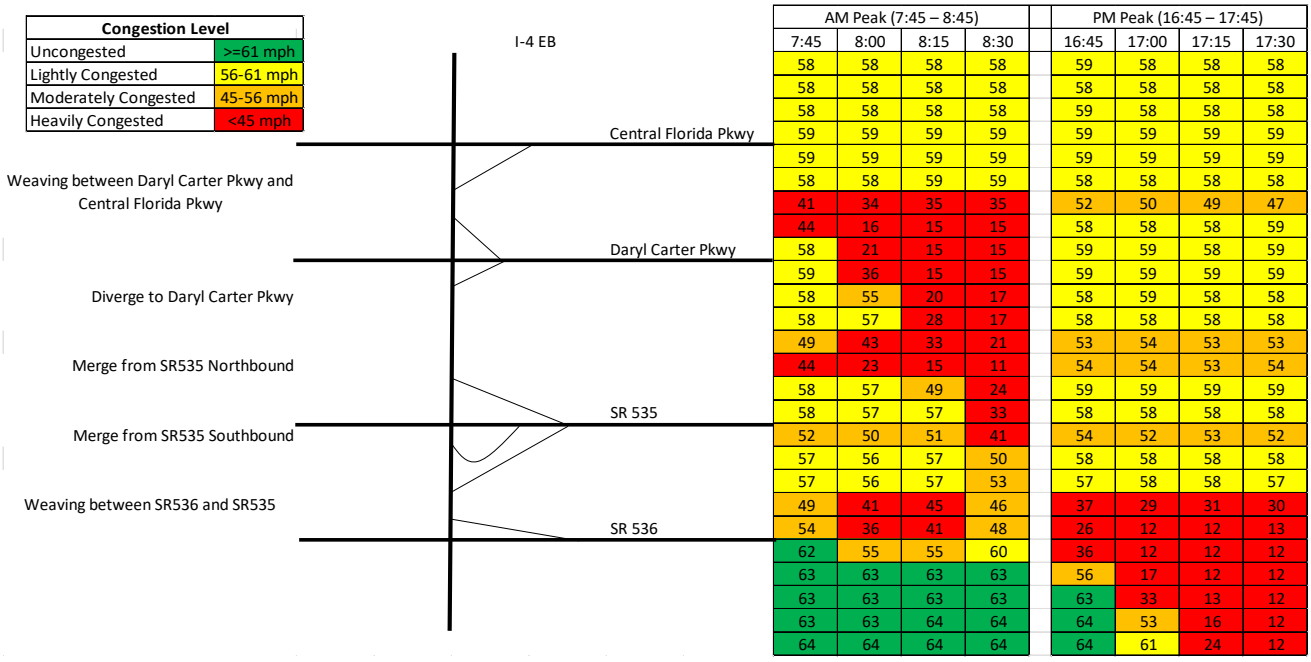


Figure 41: 2025 Build AM and PM I-4 EB Speed Contours

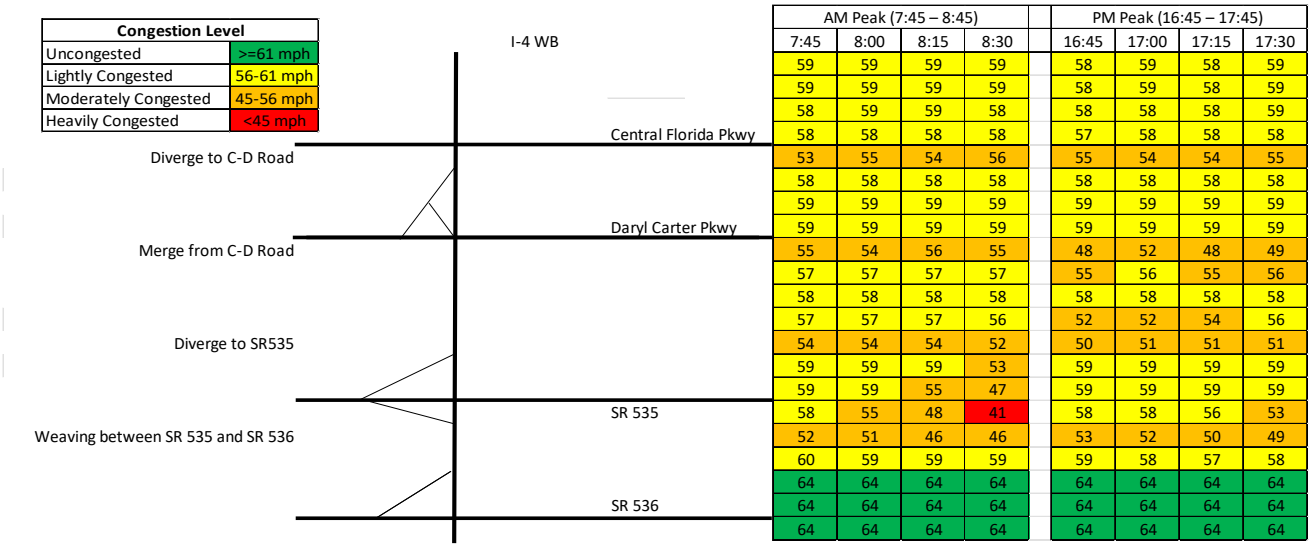
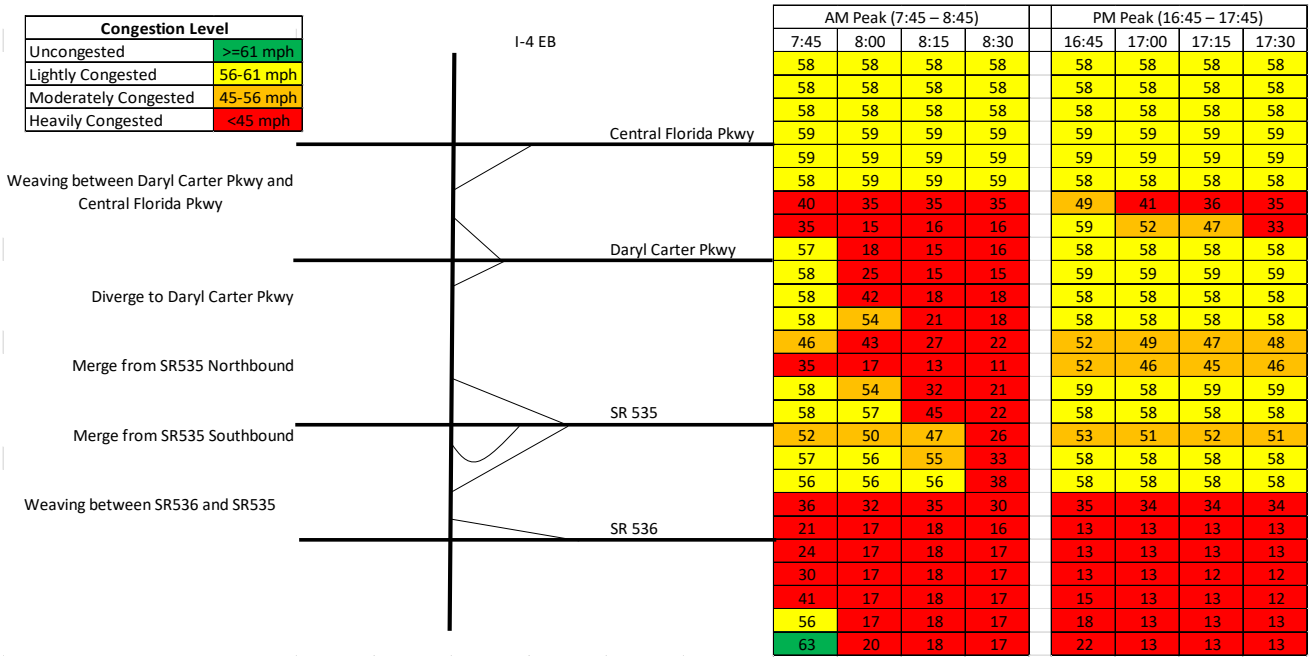
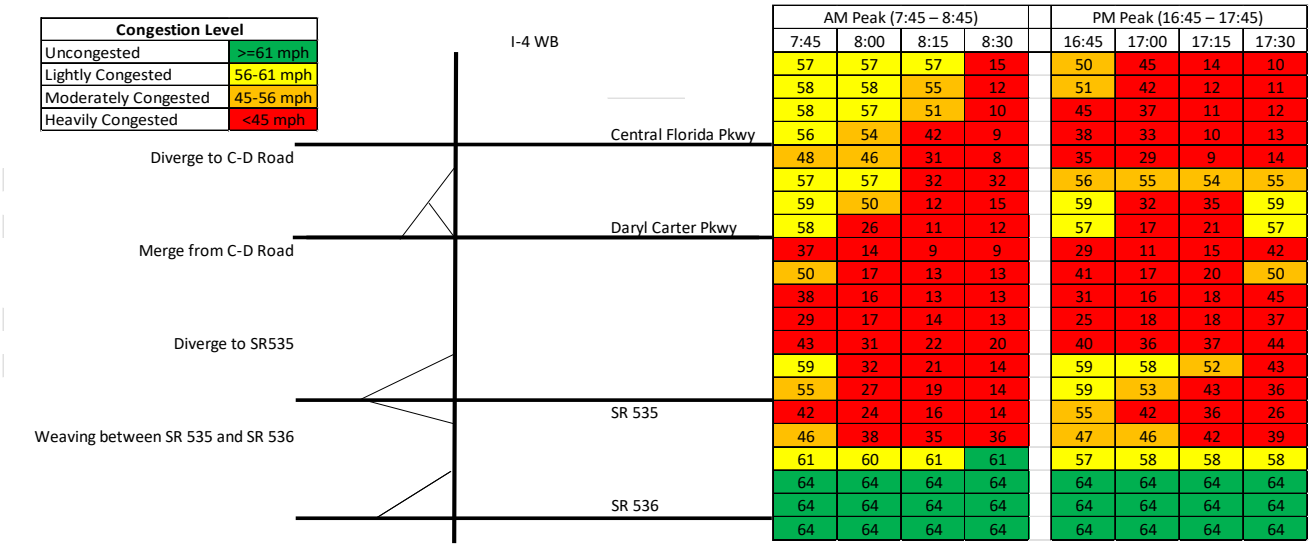


Figure 42: 2025 Build AM and PM I-4 WB Speed Contours



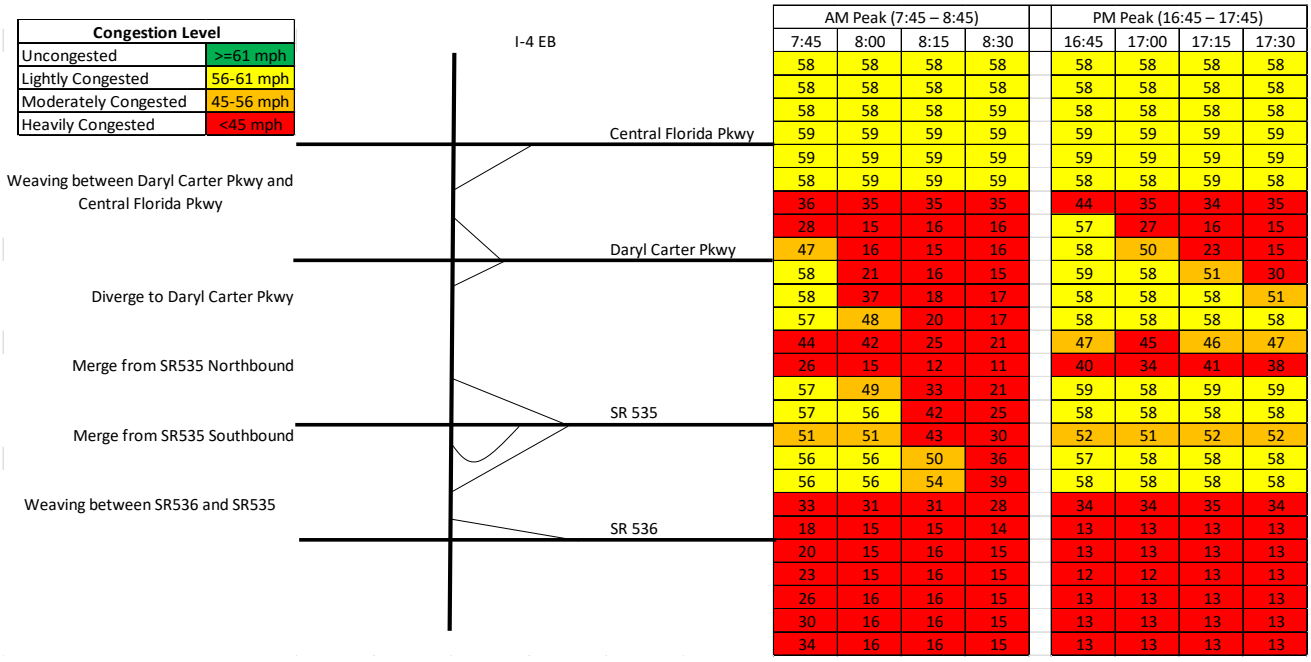
AM Peak (7:45 – 8:45)				PM Peak (16:45 – 17:45)			
7:45	8:00	8:15	8:30	16:45	17:00	17:15	17:30
58	58	58	58	58	58	58	58
58	58	58	58	58	58	58	58
58	58	58	58	58	58	58	58
59	59	59	59	59	59	59	59
59	59	59	59	59	59	59	59
58	59	59	59	58	58	58	58
40	35	35	35	49	41	36	35
35	15	16	16	59	52	47	33
57	18	15	16	58	58	58	58
58	25	15	15	59	59	59	59
58	42	18	18	58	58	58	58
58	54	21	18	58	58	58	58
46	43	27	22	52	49	47	48
35	17	13	11	52	46	45	46
58	54	32	21	59	58	59	59
58	57	45	22	58	58	58	58
52	50	47	26	53	51	52	51
57	56	55	33	58	58	58	58
56	56	56	38	58	58	58	58
36	32	35	30	35	34	34	34
21	17	18	16	13	13	13	13
24	17	18	17	13	13	13	13
30	17	18	17	13	13	12	12
41	17	18	17	15	13	13	12
56	17	18	17	18	13	13	13
63	20	18	17	22	13	13	13

Figure 43: 2035 Build AM and PM I-4 EB Speed Contours



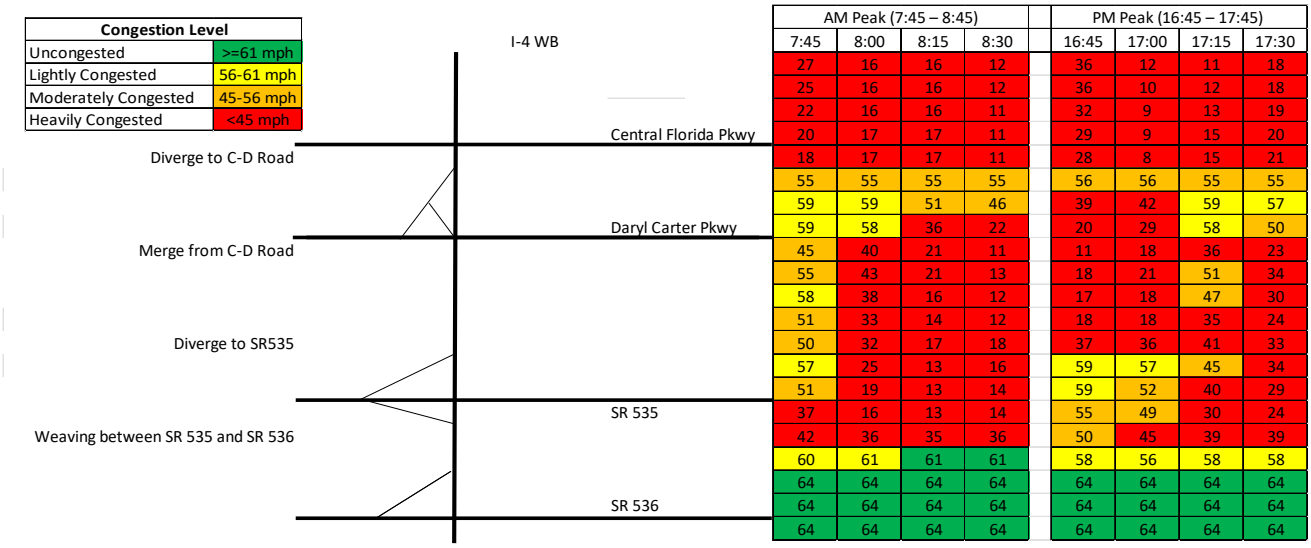
AM Peak (7:45 – 8:45)				PM Peak (16:45 – 17:45)			
7:45	8:00	8:15	8:30	16:45	17:00	17:15	17:30
57	57	57	15	50	45	14	10
58	58	55	12	51	42	12	11
58	57	51	10	45	37	11	12
56	54	42	9	38	33	10	13
48	46	31	8	35	29	9	14
57	57	32	32	56	55	54	55
59	50	12	15	59	32	35	59
58	26	11	12	57	17	21	57
37	14	9	9	29	11	15	42
50	17	13	13	41	17	20	50
38	16	13	13	31	16	18	45
29	17	14	13	25	18	18	37
43	31	22	20	40	36	37	44
59	32	21	14	59	58	52	43
55	27	19	14	59	53	43	36
42	24	16	14	55	42	36	26
46	38	35	36	47	46	42	39
61	60	61	61	57	58	58	58
64	64	64	64	64	64	64	64
64	64	64	64	64	64	64	64
64	64	64	64	64	64	64	64

Figure 44: 2035 Build AM and PM I-4 WB Speed Contours



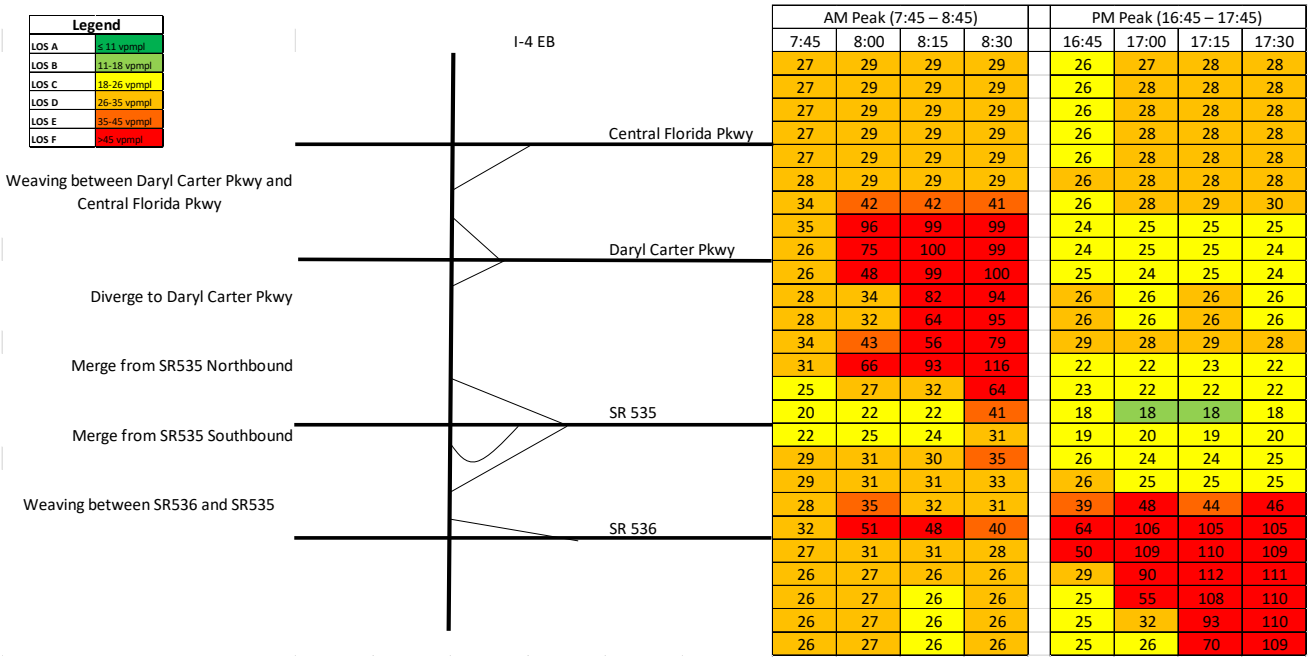
AM Peak (7:45 – 8:45)				PM Peak (16:45 – 17:45)			
7:45	8:00	8:15	8:30	16:45	17:00	17:15	17:30
58	58	58	58	58	58	58	58
58	58	58	58	58	58	58	58
58	58	58	59	58	58	58	58
59	59	59	59	59	59	59	59
59	59	59	59	59	59	59	59
58	59	59	59	58	58	59	58
36	35	35	35	44	35	34	35
28	15	16	16	57	27	16	15
47	16	15	16	58	50	23	15
58	21	16	15	59	58	51	30
58	37	18	17	58	58	58	51
57	48	20	17	58	58	58	58
44	42	25	21	47	45	46	47
26	15	12	11	40	34	41	38
57	49	33	21	59	58	59	59
57	56	42	25	58	58	58	58
51	51	43	30	52	51	52	52
56	56	50	36	57	58	58	58
56	56	54	39	58	58	58	58
33	31	31	28	34	34	35	34
18	15	15	14	13	13	13	13
20	15	16	15	13	13	13	13
23	15	16	15	12	12	13	13
26	16	16	15	13	13	13	13
30	16	16	15	13	13	13	13
34	16	16	15	13	13	13	13

Figure 45: 2045 Build AM and PM I-4 EB Speed Contours



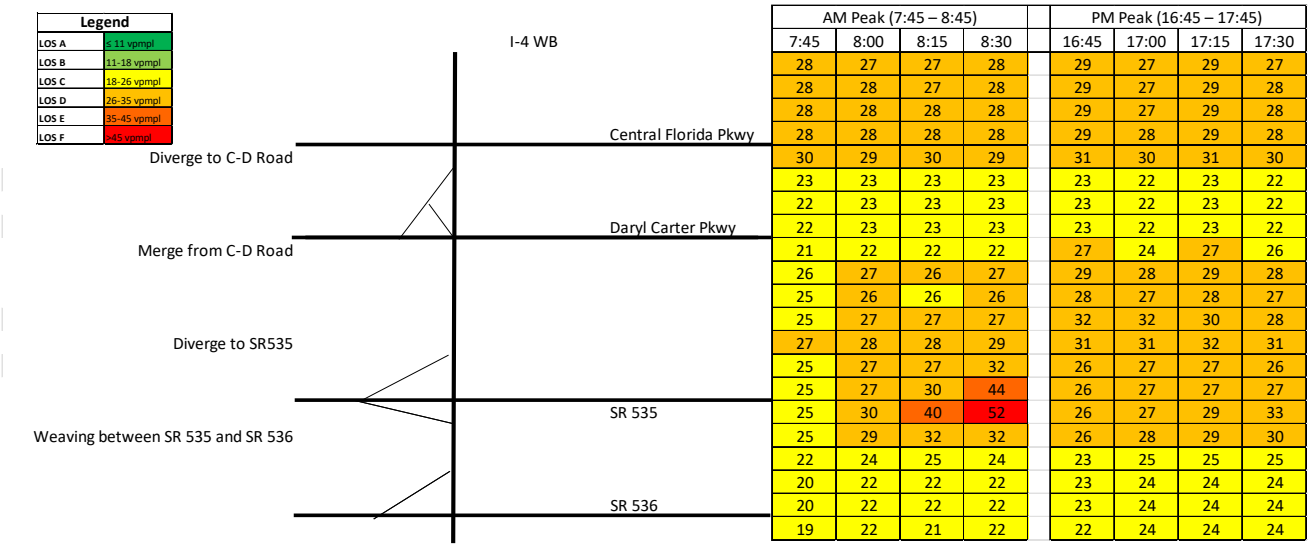
AM Peak (7:45 – 8:45)				PM Peak (16:45 – 17:45)			
7:45	8:00	8:15	8:30	16:45	17:00	17:15	17:30
27	16	16	12	36	12	11	18
25	16	16	12	36	10	12	18
22	16	16	11	32	9	13	19
20	17	17	11	29	9	15	20
18	17	17	11	28	8	15	21
55	55	55	55	56	56	55	55
59	59	51	46	39	42	59	57
59	58	36	22	20	29	58	50
45	40	21	11	11	18	36	23
55	43	21	13	18	21	51	34
58	38	16	12	17	18	47	30
51	33	14	12	18	18	35	24
50	32	17	18	37	36	41	33
57	25	13	16	59	57	45	34
51	19	13	14	59	52	40	29
37	16	13	14	55	49	30	24
42	36	35	36	50	45	39	39
60	61	61	61	58	56	58	58
64	64	64	64	64	64	64	64
64	64	64	64	64	64	64	64
64	64	64	64	64	64	64	64

Figure 46: 2045 Build AM and PM I-4 WB Speed Contours



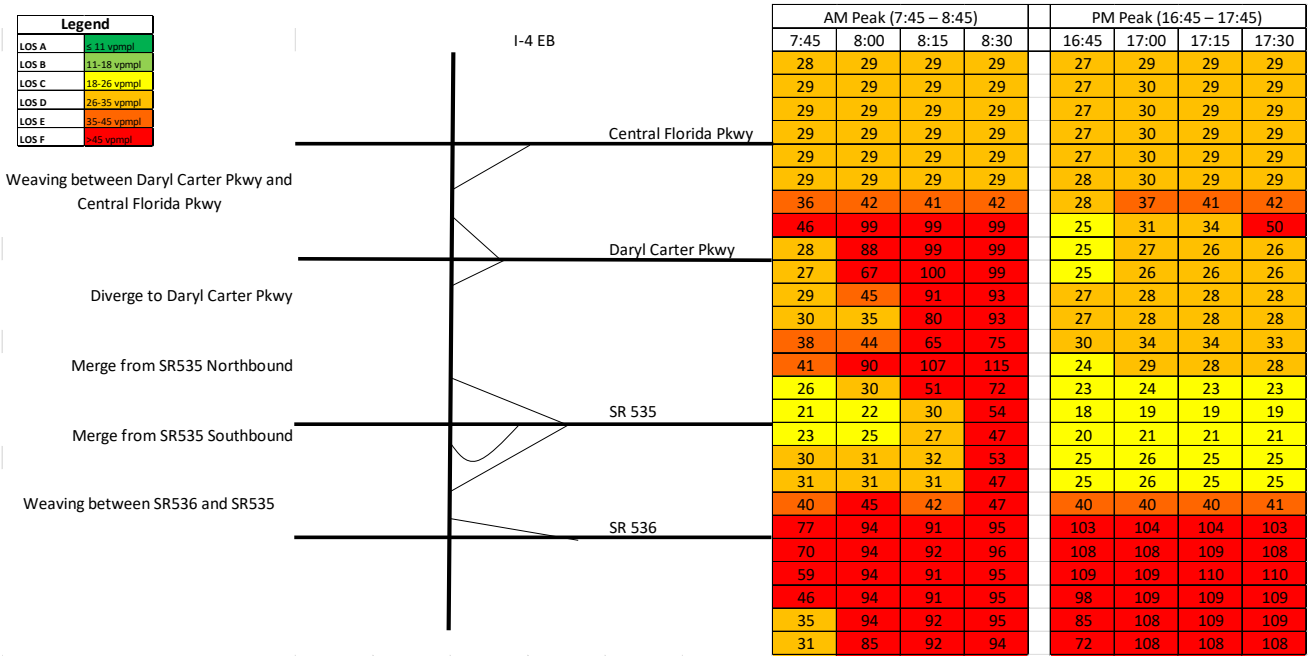
AM Peak (7:45 – 8:45)				PM Peak (16:45 – 17:45)			
7:45	8:00	8:15	8:30	16:45	17:00	17:15	17:30
27	29	29	29	26	27	28	28
27	29	29	29	26	28	28	28
27	29	29	29	26	28	28	28
27	29	29	29	26	28	28	28
27	29	29	29	26	28	28	28
28	29	29	29	26	28	28	28
34	42	42	41	26	28	29	30
35	96	99	99	24	25	25	25
26	75	100	99	24	25	25	24
26	48	99	100	25	24	25	24
28	34	82	94	26	26	26	26
28	32	64	95	26	26	26	26
34	43	56	79	29	28	29	28
31	66	93	116	22	22	23	22
25	27	32	64	23	22	22	22
20	22	22	41	18	18	18	18
22	25	24	31	19	20	19	20
29	31	30	35	26	24	24	25
29	31	31	33	26	25	25	25
28	35	32	31	39	48	44	46
32	51	48	40	64	106	105	105
27	31	31	28	50	109	110	109
26	27	26	26	29	90	112	111
26	27	26	26	25	55	108	110
26	27	26	26	25	32	93	110
26	27	26	26	25	26	70	109

Figure 47: 2025 Build AM and PM I-4 EB Density Contours



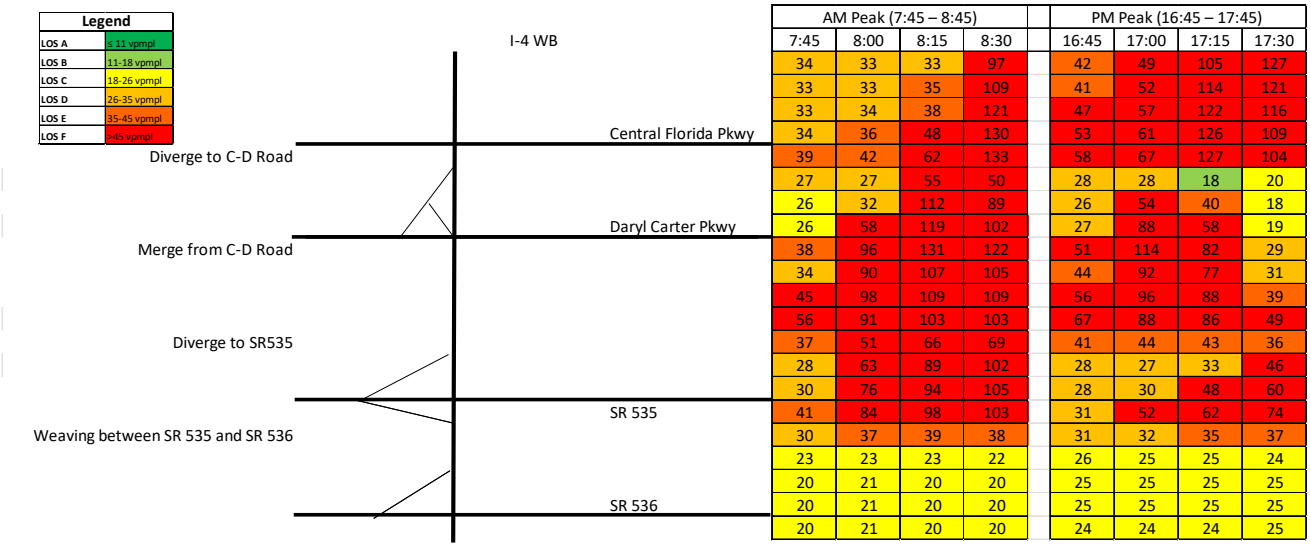
AM Peak (7:45 – 8:45)				PM Peak (16:45 – 17:45)			
7:45	8:00	8:15	8:30	16:45	17:00	17:15	17:30
28	27	27	28	29	27	29	27
28	28	27	28	29	27	29	28
28	28	28	28	29	27	29	28
28	28	28	28	29	28	29	28
30	29	30	29	31	30	31	30
23	23	23	23	23	22	23	22
22	23	23	23	23	22	23	22
22	23	23	23	23	22	23	22
21	22	22	22	27	24	27	26
26	27	26	27	29	28	29	28
25	26	26	26	28	27	28	27
25	27	27	27	32	32	30	28
27	28	28	29	31	31	32	31
25	27	27	32	26	27	27	26
25	27	30	44	26	27	27	27
25	30	40	52	26	27	29	33
25	29	32	32	26	28	29	30
22	24	25	24	23	25	25	25
20	22	22	22	23	24	24	24
20	22	22	22	23	24	24	24
19	22	21	22	22	24	24	24

Figure 48: 2025 Build AM and PM I-4 WB Density Contours



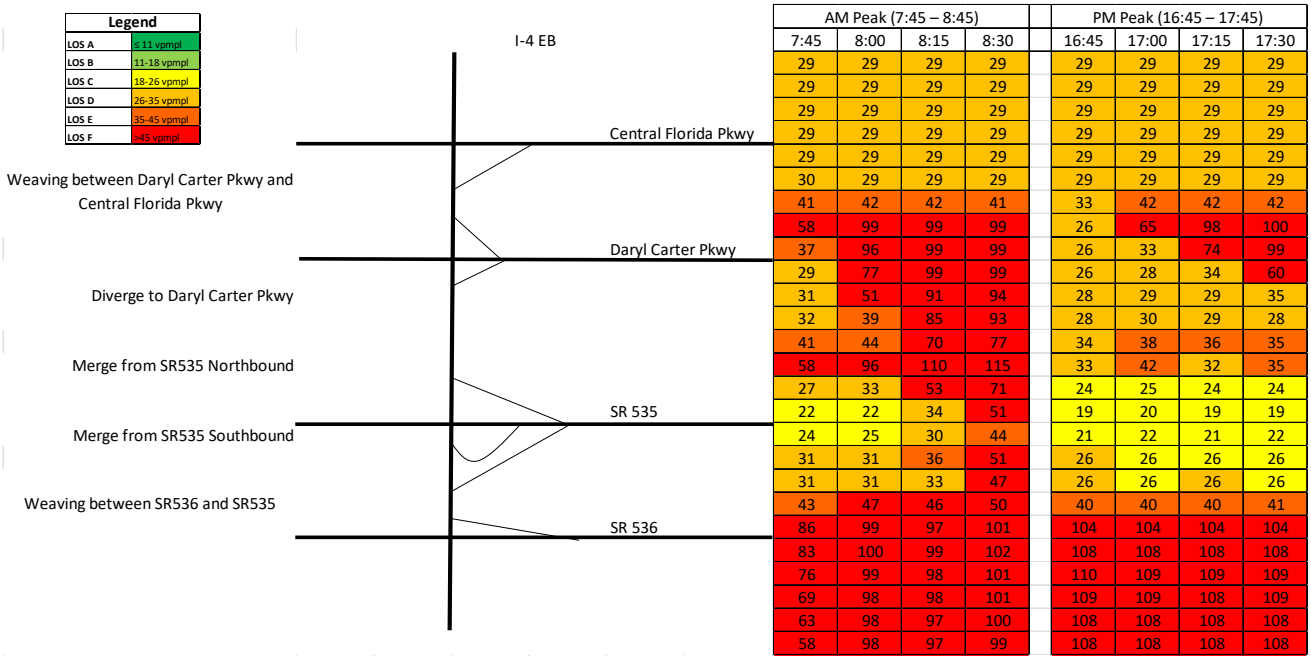
AM Peak (7:45 – 8:45)				PM Peak (16:45 – 17:45)			
7:45	8:00	8:15	8:30	16:45	17:00	17:15	17:30
28	29	29	29	27	29	29	29
29	29	29	29	27	30	29	29
29	29	29	29	27	30	29	29
29	29	29	29	27	30	29	29
29	29	29	29	27	30	29	29
29	29	29	29	28	30	29	29
36	42	41	42	28	37	41	42
46	99	99	99	25	31	34	50
28	88	99	99	25	27	26	26
27	67	100	99	25	26	26	26
29	45	91	93	27	28	28	28
30	35	80	93	27	28	28	28
38	44	65	75	30	34	34	33
41	90	107	115	24	29	28	28
26	30	51	72	23	24	23	23
21	22	30	54	18	19	19	19
23	25	27	47	20	21	21	21
30	31	32	53	25	26	25	25
31	31	31	47	25	26	25	25
40	45	42	47	40	40	40	41
77	94	91	95	103	104	104	103
70	94	92	96	108	108	109	108
59	94	91	95	109	109	110	110
46	94	91	95	98	109	109	109
35	94	92	95	85	108	109	109
31	85	92	94	72	108	108	108

Figure 49: 2035 Build AM and PM I-4 EB Density Contours



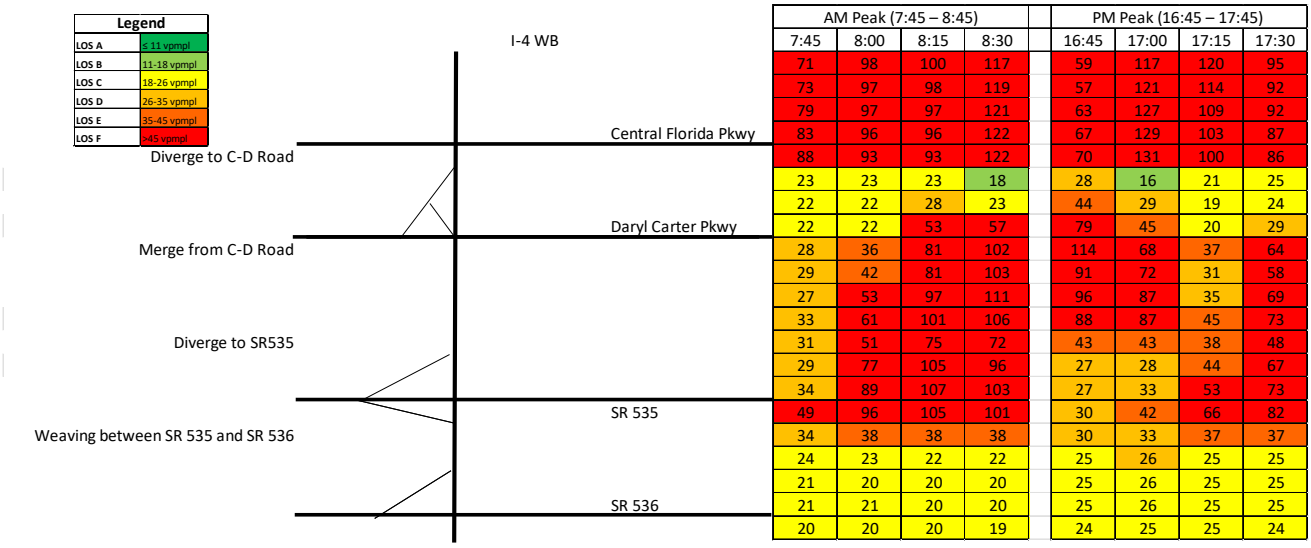
AM Peak (7:45 – 8:45)				PM Peak (16:45 – 17:45)			
7:45	8:00	8:15	8:30	16:45	17:00	17:15	17:30
34	33	33	97	42	49	105	127
33	33	35	109	41	52	114	121
33	34	38	121	47	57	122	116
34	36	48	130	53	61	126	109
39	42	62	133	58	67	127	104
27	27	55	50	28	28	18	20
26	32	112	89	26	54	40	18
26	58	119	102	27	88	58	19
38	96	131	122	51	114	82	29
34	90	107	105	44	92	77	31
45	98	109	109	56	96	88	39
56	91	103	103	67	88	86	49
37	51	66	69	41	44	43	36
28	63	89	102	28	27	33	46
30	76	94	105	28	30	48	60
41	84	98	103	31	52	62	74
30	37	39	38	31	32	35	37
23	23	23	22	26	25	25	24
20	21	20	20	25	25	25	25
20	21	20	20	25	25	25	25
20	21	20	20	24	24	24	25

Figure 50: 2035 Build AM and PM I-4 WB Density Contours



AM Peak (7:45 – 8:45)				PM Peak (16:45 – 17:45)			
7:45	8:00	8:15	8:30	16:45	17:00	17:15	17:30
29	29	29	29	29	29	29	29
29	29	29	29	29	29	29	29
29	29	29	29	29	29	29	29
29	29	29	29	29	29	29	29
29	29	29	29	29	29	29	29
30	29	29	29	29	29	29	29
41	42	42	41	33	42	42	42
58	99	99	99	26	65	98	100
37	96	99	99	26	33	74	99
29	77	99	99	26	28	34	60
31	51	91	94	28	29	29	35
32	39	85	93	28	30	29	28
41	44	70	77	34	38	36	35
58	96	110	115	33	42	32	35
27	33	53	71	24	25	24	24
22	22	34	51	19	20	19	19
24	25	30	44	21	22	21	22
31	31	36	51	26	26	26	26
31	31	33	47	26	26	26	26
43	47	46	50	40	40	40	41
86	99	97	101	104	104	104	104
83	100	99	102	108	108	108	108
76	99	98	101	110	109	109	109
69	98	98	101	109	109	108	109
63	98	97	100	108	108	108	108
58	98	97	99	108	108	108	108

Figure 51: 2045 Build AM and PM I-4 EB Density Contours



AM Peak (7:45 – 8:45)				PM Peak (16:45 – 17:45)			
7:45	8:00	8:15	8:30	16:45	17:00	17:15	17:30
71	98	100	117	59	117	120	95
73	97	98	119	57	121	114	92
79	97	97	121	63	127	109	92
83	96	96	122	67	129	103	87
88	93	93	122	70	131	100	86
23	23	23	18	28	16	21	25
22	22	28	23	44	29	19	24
22	22	53	57	79	45	20	29
28	36	81	102	114	68	37	64
29	42	81	103	91	72	31	58
27	53	97	111	96	87	35	69
33	61	101	106	88	87	45	73
31	51	75	72	43	43	38	48
29	77	105	96	27	28	44	67
34	89	107	103	27	33	53	73
49	96	105	101	30	42	66	82
34	38	38	38	30	33	37	37
24	23	22	22	25	26	25	25
21	20	20	20	25	26	25	25
21	21	20	20	25	26	25	25
20	20	20	19	24	25	25	24

Figure 52: 2045 Build AM and PM I-4 WB Density Contours

Build VISSIM Travel Time Results

Travel time markers were coded into the network to measure the trip travel time along the I-4 mainline, along SR 535, and from SR 535 to the I-4 ramps at the interchange. These travel time routes are consistent with those measured in the No-Build analysis to allow for comparison. The travel time results for the 2025, 2035, and 2045 Build peak hours are summarized in **Table 58**, **Table 59,** and **Table 60**, respectively. The start/end markers of each route are shown in **Appendix U**.

Table 58: VISSIM Corridor Travel Time Results – Opening Year (2025) Build Peak Hours

Travel Time Measurement	Build 2025 AM Peak Hour (min)	Build 2025 PM Peak Hour (min)
I-4 EB	6.2	4.1
I-4 WB	4.5	4.3
SR 535 NB	6.5	7.4
SR 535 SB	3.7	4.7
SR 535 NB to I-4 EB Ramp	3.3	3.3
SR 535 NB to I-4 WB Ramp	4.5	5.0
SR 535 SB to I-4 WB Ramp	1.6	2.2
SR 535 SB to I-4 EB Ramp	2.1	2.8

*Note: The average free flow travel time along the SR 535 corridor (end-to-end within the study limits) is approximately 4.5 min and the average free-flow travel time along the I-4 corridor (end-to-end within the study limits) is approximately 3 min based on HERE data.

Table 59: VISSIM Corridor Travel Time Results – Interim Year (2035) Build Peak Hours

Travel Time Measurement	Build 2035 AM Peak Hour (min)	Build 2035 PM Peak Hour (min)
I-4 EB	6.8	4.4
I-4 WB	9.4	7.6
SR 535 NB	7.1	7.3
SR 535 SB	3.8	4.8
SR 535 NB to I-4 EB Ramp	5.1	3.7
SR 535 NB to I-4 WB Ramp	5.1	5.0
SR 535 SB to I-4 WB Ramp	1.6	2.3
SR 535 SB to I-4 EB Ramp	2.0	2.9

*Note: The average free flow travel time along the SR 535 corridor (end-to-end within the study limits) is approximately 4.5 min and the average free-flow travel time along the I-4 corridor (end-to-end within the study limits) is approximately 3 min based on HERE data.

Table 60: VISSIM Corridor Travel Time Results – Design Year (2045) Build Peak Hours

Travel Time Measurement	Build 2045 AM Peak Hour (min)	Build 2045 PM Peak Hour (min)
I-4 EB	7.0	5.2
I-4 WB	9.2	7.9
SR 535 NB	8.3	8.5
SR 535 SB	3.7	5.0
SR 535 NB to I-4 EB Ramp	7.0	5.7
SR 535 NB to I-4 WB Ramp	6.6	6.3
SR 535 SB to I-4 WB Ramp	1.6	2.5
SR 535 SB to I-4 EB Ramp	2.0	3.0

*Note: The average free flow travel time along the SR 535 corridor (end-to-end within the study limits) is approximately 4.5 min and the average free-flow travel time along the I-4 corridor (end-to-end within the study limits) is approximately 3 min based on HERE data.

As summarized in **Table 60**, the end-to-end travel times along SR 535 were improved with the Build improvements. Under the Build scenario, travel times along SR 535 range between approximately four to eight and a half minutes during the Design Year (2045). The represents an approximately 6 to 20 percent improvement over the No-Build scenario. Each of the specific O-D routes from SR 535 to I-4 are improved when compared to the No-Build scenario during the Design Year (2045) peak hours.

The travel time along westbound I-4 is expected to be reduced with the westbound express lane “Tube” as part of the Build scenario. The I-4 westbound express lane “Tube” is expected to provide travel time benefits ranging between approximately 1 and 31 percent within the AOI during the future year peak hours. It should be noted that as traffic demands increase, this bottleneck at the beginning of the westbound network becomes more severe and reduces the travel time slightly along westbound I-4 as the traffic is metered at the beginning of the network (travel times decrease in 2045 AM when compared to 2035 AM).

Like the No-Build scenario, the eastbound travel times along I-4 in the Build scenario are impacted by the unmet demand at the beginning of the eastbound network and an active bottleneck between SR 536/SR 535 and Daryl Carter Parkway/Central Florida Parkway. Generally, the eastbound travel times are similar (within 12 seconds) between the No-Build and Build scenarios.

Build Intersection Node Performance Results

The 2025, 2035, and 2045 node performance measures at the study intersections along SR 535 are summarized in **Table 61** through **Table 69** including the simulated volume, delay, average queue length, maximum queue length, and estimated LOS of the overall intersection. The tables also include the turn lane lengths for the exclusive turn lanes which were estimated by measuring from the stop bar to the end of the taper. Queue lengths were rounded to the nearest foot. It is important to note that the LOS from simulation is an estimate and is not the same as the LOS derived in the Highway Capacity Manual. The intersection node results for the intersections along Daryl Carter Parkway are included in **Appendix U** for reference. Many of the study intersections are impacted by capacity constraints along I-4 previously described in this section.

As summarized in **Table 61** through **Table 69,** the overall intersection LOS F values summarized in Section 9.2.5 have been mitigated with only the SR 535 and Palm Parkway intersection expected to operate at LOS F during the 2035 AM peak hour and both 2045 peak hours. No capacity improvements at this intersection are funded as part of the interchange and I-4 westbound express lane "Tube" projects. The Phase I improvements at the I-4 westbound at SR 535 ramp terminal intersection show improvements in overall intersection delay and LOS under the Build scenario in each of the future year peak hours. The improvements in Phase II will focus on the I-4 eastbound ramp terminal intersection and will improve the operations at this intersection.

The maximum queue for the I-4 westbound off-ramp to SR 535 was approximately 965 feet and this maximum queue is not expected to encroach into the portion of the off-ramp designated for deceleration. The maximum queue for the I-4 eastbound off-ramp to SR 535 was approximately 1,690 feet and is expected to extend into the length of the off-ramp designated for deceleration, consistent with the No-Build scenario.

- I-4 westbound off-ramp to SR 535
    - Stop bar to gore length – 2,500 feet
        - Portion of ramp designated for deceleration – 615 feet (Table 105 of AASHTO Green Book)
        - Remaining distance for storage – 1,885 feet
- I-4 eastbound off-ramp to SR 535
    - Stop bar to gore length – 2,100 feet
        - Portion of ramp designated for deceleration – 615 feet (Table 105 of AASHTO Green Book)
        - Remaining distance for storage – 1,485 feet

The maximum queues observed along the off-ramps were reported in 2025 as this analysis year is the least impacted by the upstream latent demands and capacity constraints on the I-4 mainline. As demands increase in 2035 and 2045, the maximum queue lengths along the off-ramp shorten versus the 2025 results as volumes are constrained upstream.

Table 61: 2025 Build Peak Hour Node Evaluation Results – SR 535 at Meadow Creek Drive and I-4 EB Off-Ramp/Vineland Avenue

Intersection	Movement	AM Peak Hour				PM Peak Hour				Turn Lane Length (feet)
		Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	
SR 535 @ Meadow Creek Drive	EBR	169	76.7	63	243	336	83.5	127	324	-
	WBR	81	81.8	28	129	59	68.2	17	88	-
	SBT	1,291	4.7	12	250	1,913	1.6	5	336	-
	SBR	65	5.2	1	66	165	3.0	0	48	215
	SBL	11	21.2	2	41	52	26.0	2	91	275
	SBU	32	9.7	2	41	60	9.6	2	91	275
	NBU	29	9.1	0	16	32	18.7	1	69	275
	NBL	27	7.2	0	16	52	16.6	1	69	275
	NBR	9	16.8	86	658	51	12.3	50	443	-
	NBT	1,999	10.5	86	658	1,813	10.8	50	443	-
	Intersection	**3,715**	**12.9**	**LOS B***		**4,531**	**13.1**	**LOS B***		**-**
SR 535 @ I-4 EB Off-Ramp/ Vineland Avenue	EBL	303	82.8	92	324	537	122.6	861	1,688	375
	EBT	66	69.9	21	112	358	105.2	117	607	-
	EBR	81	2.9	1	63	182	17.4	20	402	900
	WBR	359	36.6	52	273	534	75.8	183	699	-
	WBL	88	82.8	33	122	296	89.2	94	321	-
	NBT	1,925	32.7	287	789	1,669	45.1	248	762	-
	NBR	95	22.6	1	119	246	19.0	4	145	350
	SBL	161	104.8	61	178	408	80.0	105	344	750
	SBT	1,165	4.8	13	192	1,629	19.7	69	486	-
	Intersection	**4,244**	**32.5**	**LOS C***		**5,859**	**54.3**	**LOS D***		**-**

***Note:** Estimated LOS from VISSIM.
Distance to the I-4 EB gore point from the stop bar is approximately 2,500 feet.

Table 62: 2025 Build Peak Hour Node Evaluation Results – SR 535 at I-4 WB Ramps and Hotel Plaza Boulevard

Intersection	Movement	AM Peak Hour				PM Peak Hour				Turn Lane Length (feet)
		Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	
SR 535@ I-4 WB Ramps	WBL	596	60.6	182	670	867	65.5	256	962	-
	WBR	698	62.4	177	632	729	62.2	233	925	-
	NBT	1,571	14.2	52	329	1,926	20.0	89	422	-
	SBR	759	0.9	4	232	662	0.8	12	369	550
	SBT	1,698	12.9	46	470	2,077	19.1	76	607	-
	Intersection	**5,322**	**23.4**	**LOS C***		**6,262**	**28.9**	**LOS C***		**-**
SR 535 @ Hotel Plaza Boulevard	NBT	1,349	14.7	45	402	1,690	40.3	175	872	-
	NBL	522	81.2	143	465	532	82.6	141	475	550
	NBR	292	1.4	1	111	355	2.9	5	230	-
	EBR	438	43.7	66	271	1,125	39.4	185	1,529	-
	EBL	174	168.7	115	289	620	89.3	227	1,141	-
	SBT	2,027	24.5	159	819	1,636	59.7	302	1,086	-
	SBR	258	19.2	8	157	295	33.2	18	318	350
	Intersection	**5,060**	**32.8**	**LOS C***		**6,254**	**51.3**	**LOS D***		**-**

***Note:** Estimated LOS from VISSIM.
Distance to the I-4 WB gore point from the stop bar is approximately 2,500 feet.

Table 63: 2025 Build Peak Hour Node Evaluation Results – SR 535 at Palm Parkway

Intersection	Movement	AM Peak Hour				PM Peak Hour				Turn Lane Length (feet)
		Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	
SR 535 @ Palm Pkwy	WBL	274	104.7	116	411	285	120.2	136	583	330
	WBT	223	63.5	59	238	560	91.6	237	838	-
	WBR	34	47.9	75	263	45	83.7	260	863	-
	EBR	997	43.5	377	1,351	732	6.5	5	261	-
	EBT	472	98.6	590	1,413	361	73.8	199	886	-
	EBL	468	92.4	207	1,026	463	119.0	256	907	-
	SBT	949	63.2	241	895	850	78.5	347	1,524	-
	SBL	36	77.9	12	193	46	190.2	115	1,066	170
	SBR	328	8.2	0	55	538	14.1	1	163	460
	NBU	43	85.6	154	502	46	83.0	158	545	1,150
	NBR	220	2.7	0	61	364	4.5	0	75	1,350
	NBL	550	78.7	154	502	609	73.7	158	545	1,150
	NBT	720	41.5	98	495	1,312	42.9	215	1,071	-
	Intersection	**5,315**	**60.3**	**LOS E***		**6,212**	**58.9**	**LOS E***		**-**

***Note:** Estimated LOS from VISSIM.

Table 64: 2035 Build Peak Hour Node Evaluation Results – SR 535 at Meadow Creek Drive and I-4 EB Off-Ramp/Vineland Avenue

Intersection	Movement	AM Peak Hour				PM Peak Hour				Turn Lane Length (feet)
		Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	
SR 535 @ Meadow Creek Drive	EBR	174	77.6	65	243	354	93.6	146	360	-
	WBR	72	136.0	55	237	64	78.3	21	95	-
	SBT	1,284	8.9	20	253	1,907	2.1	6	236	-
	SBR	62	5.7	1	46	154	3.2	1	41	215
	SBL	11	49.9	8	103	50	48.4	16	148	275
	SBU	30	44.5	8	103	62	59.6	16	148	275
	NBU	26	23.4	0	30	33	18.2	1	78	275
	NBL	24	12.0	0	30	52	19.2	1	78	275
	NBR	9	27.2	290	749	52	16.3	76	474	-
	NBT	1,966	33.1	290	749	2,022	13.2	76	474	-
	Intersection	**3,658**	**28.2**	**LOS C***		**4,749**	**16.4**	**LOS B***		**-**
SR 535 @ I-4 EB Off-Ramp/ Vineland Avenue	EBL	298	84.9	92	313	514	106.4	464	1,624	375
	EBT	66	73.2	23	100	356	92.8	106	469	-
	EBR	87	3.0	1	63	192	11.5	9	173	900
	WBR	374	87.4	181	1,028	635	23.4	55	225	-
	WBL	89	90.7	33	124	348	86.2	109	374	-
	NBT	1,874	54.5	434	823	1,843	49.1	331	800	-
	NBR	84	37.1	0	114	270	27.3	3	144	350
	SBL	170	93.5	58	163	431	81.3	114	366	750
	SBT	1,153	6.5	18	239	1,550	17.6	55	426	-
	Intersection	**4,194**	**47.5**	**LOS D***		**6,139**	**48.0**	**LOS D***		**-**

***Note:** Estimated LOS from VISSIM.
Distance to the I-4 EB gore point from the stop bar is approximately 2,500 feet.

Table 65: 2035 Build Peak Hour Node Evaluation Results – SR 535 at I-4 WB Ramps and Hotel Plaza Boulevard

Intersection	Movement	AM Peak Hour				PM Peak Hour				Turn Lane Length (feet)
		Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	
SR 535@ I-4 WB Ramps	WBL	559	61.5	166	648	792	65.5	225	855	-
	WBR	651	61.7	161	611	672	63.7	204	818	-
	NBT	1,545	12.2	44	345	2,026	19.9	94	457	-
	SBR	848	1.0	3	176	723	0.9	13	355	550
	SBT	1,791	12.2	45	413	2,234	17.4	76	594	-
	Intersection	**5,394**	**21.5**	**LOS C***		**6,448**	**27.1**	**LOS C***		**-**
SR 535 @ Hotel Plaza Boulevard	NBT	1,293	15.0	45	377	1,673	36.4	154	877	-
	NBL	507	80.0	132	452	533	75.3	130	542	550
	NBR	315	1.4	1	128	422	2.3	3	260	-
	EBR	522	50.6	92	386	1,276	48.6	558	1,678	-
	EBL	184	200.6	148	352	695	210.7	900	1,676	-
	SBT	2,127	25.0	182	865	1,699	63.4	362	1,240	-
	SBR	275	19.4	9	165	361	37.7	31	493	350
	Intersection	**5,224**	**35.0**	**LOS C***		**6,659**	**64.8**	**LOS E***		**-**

***Note:** Estimated LOS from VISSIM.
Distance to the I-4 WB gore point from the stop bar is approximately 2,500 feet.

Table 66: 2035 Build Peak Hour Node Evaluation Results – SR 535 at Palm Parkway

Intersection	Movement	AM Peak Hour				PM Peak Hour				Turn Lane Length (feet)
		Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	
SR 535 @ Palm Pkwy	WBL	312	185.3	270	792	276	159.7	211	976	330
	WBT	262	62.5	69	287	623	137.9	593	1,411	-
	WBR	47	50.8	86	312	54	135.0	617	1,435	-
	EBR	994	60.9	1,257	1,697	824	12.3	47	532	-
	EBT	519	139.0	1,336	1,694	418	93.5	391	1,266	-
	EBL	498	140.7	1,273	1,694	485	199.5	673	1,325	-
	SBT	1,029	119.1	1,053	1,679	902	90.6	571	1,678	-
	SBL	59	123.6	542	1,248	54	216.1	262	1,498	170
	SBR	347	40.6	0	63	570	22.2	7	359	460
	NBU	45	89.9	162	499	46	85.7	206	671	1,150
	NBR	209	2.5	0	51	350	3.9	0	72	1,350
	NBL	546	83.2	162	499	677	86.4	206	671	1,150
	NBT	706	38.4	91	504	1,299	40.6	196	918	-
	Intersection	**5,572**	**89.8**	**LOS F***		**6,579**	**77.0**	**LOS E***		**-**

***Note:** Estimated LOS from VISSIM.

Table 67: 2045 Build Peak Hour Node Evaluation Results – SR 535 at Meadow Creek Drive and I-4 EB Off-Ramp/Vineland Avenue

Intersection	Movement	AM Peak Hour				PM Peak Hour				Turn Lane Length (feet)
		Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	
SR 535 @ Meadow Creek Drive	EBR	184	78.3	68	247	371	101.0	162	388	-
	WBR	77	147.0	52	222	67	93.8	23	108	-
	SBT	1,225	4.3	10	163	1,849	2.6	8	210	-
	SBR	58	3.4	1	49	136	3.9	1	58	215
	SBL	8	88.2	14	135	48	76.6	33	191	275
	SBU	31	119.4	14	135	64	99.2	33	191	275
	NBU	29	34.9	0	35	33	25.3	1	53	275
	NBL	21	16.8	0	35	54	24.1	1	53	275
	NBR	6	45.3	415	756	48	47.0	324	752	-
	NBT	1,916	53.8	415	756	2,133	42.5	324	752	-
	Intersection	**3,556**	**39.4**	**LOS D***		**4,802**	**32.1**	**LOS C***		**-**
SR 535 @ I-4 EB Off-Ramp/ Vineland Avenue	EBL	250	91.1	80	291	432	90.5	173	964	375
	EBT	65	72.1	22	110	357	83.6	106	483	-
	EBR	88	2.5	1	51	197	12.5	9	186	900
	WBR	325	230.5	600	1,667	717	30.5	78	369	-
	WBL	82	169.0	31	139	392	87.2	126	436	-
	NBT	1,829	65.4	493	816	1,920	66.9	465	821	-
	NBR	83	39.8	0	114	268	47.4	3	160	350
	SBL	170	76.9	50	169	435	69.2	98	367	750
	SBT	1,094	8.6	21	278	1,421	28.7	86	551	-
	Intersection	**3,985**	**65.6**	**LOS E***		**6,138**	**55.3**	**LOS E***		**-**

***Note:** Estimated LOS from VISSIM.
Distance to the I-4 EB gore point from the stop bar is approximately 2,500 feet.

Table 68: 2045 Build Peak Hour Node Evaluation Results – SR 535 at I-4 WB Ramps and Hotel Plaza Boulevard

Intersection	Movement	AM Peak Hour				PM Peak Hour				Turn Lane Length (feet)
		Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	
SR 535@ I-4 WB Ramps	WBL	505	63.2	147	576	746	69.0	211	769	-
	WBR	564	64.2	146	539	604	64.6	188	732	-
	NBT	1,412	9.3	31	312	2,009	19.5	115	619	-
	SBR	886	1.0	4	247	717	0.9	12	325	550
	SBT	1,792	11.3	43	486	2,208	17.0	73	560	-
	Intersection	**5,160**	**19.8**	**LOS B***		**6,285**	**26.7**	**LOS C***		**-**
SR 535 @ Hotel Plaza Boulevard	NBT	1,208	14.6	42	403	1,668	36.0	150	901	-
	NBL	470	82.1	125	430	546	75.5	136	572	550
	NBR	320	1.1	0	74	460	2.3	5	299	-
	EBR	609	53.5	114	468	1,238	56.2	780	1,696	-
	EBL	191	243.3	190	434	695	243.9	1,178	1,699	-
	SBT	2,079	25.2	180	875	1,709	68.0	475	1,368	-
	SBR	272	19.3	7	143	426	45.1	102	929	350
	Intersection	**5,149**	**37.6**	**LOS D***		**6,741**	**70.7**	**LOS E***		**-**

***Note:** Estimated LOS from VISSIM.
Distance to the I-4 WB gore point from the stop bar is approximately 2,500 feet.

Table 69: 2045 Build Peak Hour Node Evaluation Results – SR 535 at Palm Parkway

Intersection	Movement	AM Peak Hour				PM Peak Hour				Turn Lane Length (feet)
		Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	Simulated Vol	Delay (s)	Ave Queue (feet)	Max Queue (feet)	
SR 535 @ Palm Pkwy	WBL	311	282.4	668	1,482	249	158.9	271	724	330
	WBT	280	104.1	203	1,062	642	156.7	1,065	1,674	-
	WBR	58	97.6	221	1,084	56	154.1	1,077	1,671	-
	EBR	949	57.2	1,384	1,701	843	36.8	727	1,667	-
	EBT	534	151.9	1,444	1,700	447	142.0	1,059	1,682	-
	EBL	500	152.2	1,401	1,700	489	242.7	1,188	1,683	-
	SBT	1,038	125.6	1,272	1,692	945	106.4	814	1,677	-
	SBL	70	128.9	985	1,684	52	221.8	376	1,250	170
	SBR	334	47.0	0	78	577	31.8	33	358	460
	NBU	36	79.2	138	478	35	88.4	220	647	1,150
	NBR	209	2.5	0	53	336	3.7	0	60	1,350
	NBL	510	77.2	138	478	707	87.8	220	647	1,150
	NBT	673	35.3	79	453	1,277	41.9	203	933	-
	Intersection	**5,502**	**101.0**	**LOS F***		**6,656**	**92.0**	**LOS F***		**-**

***Note:** Estimated LOS from VISSIM.

10.3. Future Build Operational Summary

Based on the operational analyses conducted for the future year Build AM and PM peak hours, the VISSIM analyses show improvements along westbound I-4 and SR 535. The eastbound congestion along I-4 is expected to be similar to the No-Build results. The following summarizes the key findings from the future year simulation analyses.

- Consistent with the No-Build simulation analysis, the Build simulation resulted in severe latent demand and capacity constraints on the I-4 mainline and SR 535 arterial impacting:
    - Westbound C-D system from Central Florida Parkway and Daryl Carter Parkway
    - Eastbound on-ramp from northbound SR 535
    - Eastbound on-ramp from Daryl Carter Parkway
    - Intersection of SR 535 and Palm Parkway
- The travel time along westbound I-4 is expected to be reduced with the westbound express lane "Tube" as part of the Build scenario. The I-4 westbound express lane "Tube" is expected to provide travel time benefits ranging between approximately 1 and 31 percent within the AOI in the future years evaluated. The travel time benefits are expected to be approximately 4 to 6 percent during the design year (2045).
- Due to the removal of the northbound left-turn movement, an overall intersection LOS C or better was observed at the SR 535 at I-4 westbound ramp terminal intersection during each of the future year peak hours.
- Queues along the westbound off-ramp to SR 535 are not expected to impact the I-4 westbound mainline in any of the future peak hours analyzed.
    - The VISSIM analysis shows a max queue of approximately 965 feet along the westbound off-ramp.
    - The distance to the gore point from the stop bar is approximately 2,500 feet with 615 feet of that length designated for deceleration (based on Table 10-5 of the AASHTO Green Book). This leaves approximately 1,885 feet for storage.
- The queues along the eastbound off-ramp at SR 535 are expected to encroach into the portion of the off-ramp designated for deceleration.
    - The maximum queue observed in VISSIM was approximately 1,690 feet. The distance to the gore point from the stop bar is approximately 2,100 feet with 615 feet of that length designated for deceleration (based on Table 10-5 of the AASHTO Green Book). This leaves approximately 1,485 feet for storage.
    - I-4 eastbound was capacity constrained upstream and it is expected that had the constraint not existed upstream, the queues from SR 535 would have impacted the I-4 eastbound mainline.
    - Additional improvements will be considered and evaluated as part of Phase II of interchange improvements at SR 535. At this time, it is not known when additional funding will become available to construct the Phase II interchange improvements. FDOT will

coordinate with the appropriate agencies and will conduct the appropriate documentation for the Phase II improvements when funding is made available.

- Travel times along SR 535 (full corridor) are expected to range between four and seven and a half minutes depending on the travel time route (northbound or southbound). With the Build improvements in place, drivers would experience travel time benefits of between approximately 6 to 20 percent in the Design Year (2045) peak hours.

11. NO-BUILD AND BUILD MICROSIMULATION COMPARATIVE SUMMARY

The future year VISSIM microsimulation results for the No-Build and Build scenarios are summarized and directly compared in this section. The comparisons include intersection node, travel time, and network wide performance metrics.

11.1. **Intersection Node Comparison**

Table 70 through **Table 72** provide a direct comparison of the No-Build and Build overall intersection delay and LOS for the study intersections along SR 535 in each of the future year AM and PM peak hours based on the VISSIM analysis conducted. The Phase I improvements at the I-4 westbound at SR 535 ramp terminal intersection show improvements in overall intersection delay and LOS under the Build scenario in each of the future year peak hours. Each of the study intersections along SR 535 show equal or better overall intersection LOS in each of the future year peak hours.

Table 70: 2025 AM and PM VISSIM Intersection Node Results Comparison (No-Build and Build)

Intersection	2025 AM				2025PM			
	No-Build		Build		No-Build		Build	
	Delay (s)	LOS*	Delay (s)	LOS*	Delay (s)	LOS*	Delay (s)	LOS*
SR 535 & Meadow Creek Drive	12.8	B	12.9	B	17.3	B	13.1	B
SR 535 & I-4 EB Off Ramp/Vineland Ave	33.8	C	32.5	C	54.2	D	54.3	D
SR 535 & I-4 WB Ramps	29.6	C	23.4	C	35.3	D	28.9	C
SR 535 & Hotel Plaza Blvd	40.0	D	32.8	C	58.1	E	51.3	D
SR 535 & Palm Parkway	59.5	E	60.3	E	60.8	E	58.9	E

*Note: Estimated LOS from VISSIM.

Table 71: 2035 AM and PM VISSIM Intersection Node Results Comparison (No-Build and Build)

Intersection	2035 AM				2035PM			
	No-Build		Build		No-Build		Build	
	Delay (s)	LOS*	Delay (s)	LOS*	Delay (s)	LOS*	Delay (s)	LOS*
SR 535 & Meadow Creek Drive	29.2	C	28.2	C	16.9	B	16.4	B
SR 535 & I-4 EB Off Ramp/Vineland Ave	51.9	D	47.5	D	51.1	D	48.0	D
SR 535 & I-4 WB Ramps	30.1	C	21.5	C	38.3	D	27.1	C
SR 535 & Hotel Plaza Blvd	47.0	D	35.0	C	80.0	F	64.8	E
SR 535 & Palm Parkway	93.9	F	89.8	F	80.7	F	77.0	E

*Note: Estimated LOS from VISSIM.

Table 72: 2045 AM and PM VISSIM Intersection Node Results Comparison (No-Build and Build)

Intersection	2045 AM				2045PM			
	No-Build		Build		No-Build		Build	
	Delay (s)	LOS*	Delay (s)	LOS*	Delay (s)	LOS*	Delay (s)	LOS*
SR 535 & Meadow Creek Drive	44.5	D	39.4	D	39.9	D	32.1	C
SR 535 & I-4 EB Off Ramp/Vineland Ave	69.8	E	65.6	E	64.8	E	55.3	E
SR 535 & I-4 WB Ramps	31.8	C	19.8	B	37.8	D	26.7	C
SR 535 & Hotel Plaza Blvd	50.3	D	37.6	D	84.0	F	70.7	E
SR 535 & Palm Parkway	104.2	F	101.0	F	98.3	F	92.0	F

*Note: Estimated LOS from VISSIM.

11.2. **Travel Time Comparison**

As summarized in **Table 73** through **Table 75**, travel times along SR 535 decreased under the Build condition during both Design Year (2045) peak hours. The westbound express lane "Tube" is expected to provided travel time benefits ranging between 1 and 31 percent along westbound I-4 within the AOI.

Like the No-Build scenario, the eastbound travel times along I-4 in the Build scenario are impacted by the unmet demand at the beginning of the eastbound network and an active bottleneck between SR 536/SR 535 and Daryl Carter Parkway/Central Florida Parkway. Generally, the eastbound travel times are similar (within 12 seconds) between the No-Build and Build scenarios and these differences can be attributed to the stochastic nature of the simulation model and the active bottlenecks/latent demand along I-4 eastbound.

Table 73: Travel Time Comparison (2025 No-Build and Build)

Time Period	Travel Time Measurement	Travel Time No-Build (min)	Travel Time Build (min)	Difference (Build vs. No-Build)
AM	I-4 EB	6.2	6.2	0%
	I-4 WB	6.4	4.5	**-31%**
	SR 535 NB	6.3	6.5	3%
	SR 535 SB	3.8	3.7	**-2%**
	SR 535 NB to I-4 EB Ramp	3.1	3.3	5%
	SR 535 NB to I-4 WB Ramp	4.2	4.5	6%
	SR 535 SB to I-4 WB Ramp	2.1	1.6	**-26%**
	SR 535 SB to I-4 EB Ramp	2.0	2.1	0%
PM	I-4 EB	4.1	4.1	0%
	I-4 WB	6.3	4.3	**-31%**
	SR 535 NB	7.5	7.4	**-2%**
	SR 535 SB	5.7	4.7	**-18%**
	SR 535 NB to I-4 EB Ramp	3.4	3.3	**-3%**
	SR 535 NB to I-4 WB Ramp	4.9	5.0	2%
	SR 535 SB to I-4 WB Ramp	2.9	2.2	**-26%**
	SR 535 SB to I-4 EB Ramp	2.8	2.8	0%

Table 74: Travel Time Comparison (2035 No-Build and Build)

Time Period	Travel Time Measurement	Travel Time No-Build (min)	Travel Time Build (min)	Difference (Build vs. No-Build)
AM	I-4 EB	6.7	6.8	2%
	I-4 WB	9.5	9.4	**-1%**
	SR 535 NB	7.5	7.1	**-6%**
	SR 535 SB	4.3	3.8	**-11%**
	SR 535 NB to I-4 EB Ramp	5.5	5.1	**-8%**
	SR 535 NB to I-4 WB Ramp	4.6	5.1	10%
	SR 535 SB to I-4 WB Ramp	2.4	1.6	**-34%**
	SR 535 SB to I-4 EB Ramp	2.2	2.0	**-8%**
PM	I-4 EB	4.3	4.4	1%
	I-4 WB	8.1	7.6	**-7%**
	SR 535 NB	7.9	7.3	**-8%**
	SR 535 SB	5.9	4.8	**-17%**
	SR 535 NB to I-4 EB Ramp	3.9	3.7	**-6%**
	SR 535 NB to I-4 WB Ramp	4.9	5.0	1%
	SR 535 SB to I-4 WB Ramp	3.8	2.3	**-38%**
	SR 535 SB to I-4 EB Ramp	3.5	2.9	**-17%**

Table 75: Travel Time Comparison (2045 No-Build and Build)

Time Period	Travel Time Measurement	Travel Time No-Build (min)	Travel Time Build (min)	Difference (Build vs. No-Build)
AM	I-4 EB	7.0	7.0	0%
	I-4 WB	9.6	9.2	**-4%**
	SR 535 NB	8.8	8.3	**-6%**
	SR 535 SB	4.1	3.7	**-9%**
	SR 535 NB to I-4 EB Ramp	7.6	7.0	**-8%**
	SR 535 NB to I-4 WB Ramp	6.6	6.6	**-1%**
	SR 535 SB to I-4 WB Ramp	2.2	1.6	**-27%**
	SR 535 SB to I-4 EB Ramp	2.5	2.0	**-21%**
PM	I-4 EB	5.0	5.2	4%
	I-4 WB	8.5	7.9	**-6%**
	SR 535 NB	9.5	8.5	**-11%**
	SR 535 SB	6.3	5.0	**-20%**
	SR 535 NB to I-4 EB Ramp	7.1	5.7	**-19%**
	SR 535 NB to I-4 WB Ramp	7.6	6.3	**-17%**
	SR 535 SB to I-4 WB Ramp	3.6	2.5	**-30%**
	SR 535 SB to I-4 EB Ramp	3.6	3.0	**-16%**

The northbound SR 535 to I-4 westbound travel time is longer in the Build than the No-Build during the 2025 and 2035 peak hours. This is due to a longer travel distance (use of the new loop ramp versus the existing signalized northbound left-turn movement). Safety was a consideration and is expected to provide safety benefits by removing the 3 crossing conflicts, resulting in less severe crashes under the Build condition. It is important to note that as the SR 535 corridor becomes more congested in the Design Year (2045), the proposed Build configuration provides both operational benefits (travel time is improved in the Build versus the No Build) and safety benefits.

With the Build interchange improvements in place, drivers would experience travel time benefits of between 6 to 9 percent during the 2045 AM peak hour and between 11 to 20 percent during the 2045 PM peak hour along SR 535. Southbound travel times along SR 535 are improved due to the removal of the northbound left-turn phase at the I-4 westbound ramps intersection. There are instances where the northbound SR 535 to I-4 westbound ramp travel time is longer (no more than 30 seconds) in the Build than in the No-Build (2025 and 2035) and this is due to the longer distance traveled to/through the loop ramp as part of the proposed improvements.

11.3. Network Performance Comparison

As shown in **Table 76** through **Table 78**, the Build scenario provides better network performance when compared to the No-Build scenario in each of the future year peak hours. Each of the performance metrics such as average delay, average speed, total delay, latent demand, latent delay, and vehicles arrived are better in the Build when compared to the No-Build (values bolded in green in the following tables). The

percent difference between the Build and No-Build are also presented in the tables. The reduction of latent demand and latent delay is due to the operational improvements at the I-4 at SR 535 interchange and the westbound express lane "Tube".

Table 76: Network Performance Comparison (2025 No-Build and Build)

Time Period	Scenario	Average Delay (seconds)	Average Speed (mph)	Total Delay (hr)	Latent Demand (veh)	Latent Delay (hr)	Vehicles Arrived
AM	No-Build	171.4	32.3	1,277	405	124	22,689
	Build	**137.4**	**35.0**	**1,022**	**397**	**124**	**23,261**
	Difference	**-20%**	**8%**	**-20%**	**-2%**	**-1%**	**3%**
PM	No-Build	174.9	30.1	1,481	684	200	26,309
	Build	**134.4**	**33.4**	**1,138**	**681**	**191**	**26,996**
	Difference	**-23%**	**11%**	**-23%**	**0%**	**-4%**	**3%**

Table 77: Network Performance Comparison (2035 No-Build and Build)

Time Period	Scenario	Average Delay (seconds)	Average Speed (mph)	Total Delay (hr)	Latent Demand (veh)	Latent Delay (hr)	Vehicles Arrived
AM	No-Build	337.1	22.0	2,735	3,003	764	23,256
	Build	**310.7**	**22.8**	**2,584**	**2,228**	**615**	**23,695**
	Difference	**-8%**	**4%**	**-6%**	**-26%**	**-20%**	**2%**
PM	No-Build	268.3	23.9	2,377	4,700	1,774	27,170
	Build	**248.1**	**24.8**	**2,239**	**3,999**	**1,375**	**27,857**
	Difference	**-8%**	**4%**	**-6%**	**-15%**	**-23%**	**3%**

Table 78: Network Performance Comparison (2045 No-Build and Build)

Time Period	Scenario	Average Delay (seconds)	Average Speed (mph)	Total Delay (hr)	Latent Demand (veh)	Latent Delay (hr)	Vehicles Arrived
AM	No-Build	404.9	19.2	3,361	7,403	2,722	23,429
	Build	**370.9**	**20.1**	**3,125**	**6,842**	**2,617**	**23,850**
	Difference	**-8%**	**5%**	**-7%**	**-8%**	**-4%**	**2%**
PM	No-Build	335.0	20.6	3,077	9,269	4,206	27,168
	Build	**310.6**	**21.5**	**2,905**	**8,544**	**3,809**	**27,909**
	Difference	**-7%**	**4%**	**-6%**	**-8%**	**-9%**	**3%**

12. QUALITATIVE SAFETY ANALYSIS

The purpose of the qualitative safety analysis was to determine the potential safety impacts of reconfiguring the I-4 at SR 535 interchange for the following improvements:

- Freeway –
  - Addition of I-4 westbound express lane "Tube".
- Ramps –
  - Lengthen the I-4 westbound off-ramp to SR 535; and
  - Add a new I-4 westbound loop on-ramp from northbound SR 535.
- Ramp Terminal Interchange
  - Remove the northbound left-turn movement from SR 535 to the I-4 westbound on-ramp. This improvement will also remove the merge area for the I-4 westbound on-ramp immediately upstream from the SR 535 ramp terminal intersection.

Limitations exist with the current Highway Safety Manual (HSM) methodologies and tools when it comes to quantitatively analyzing the improvements noted above. The Enhanced Interchange Safety Analysis Tool (ISATe) Build 06.10 – Modified to Include Present Worth Analysis was reviewed for applicability to analyze the proposed interchange modifications. It was determined that ISATe could not evaluate each of the interchange modifications, thus a quantitative analysis would not be able to provide a full picture of the potential safety impacts. The Crash Modification Factor (CMF) Clearinghouse was also reviewed but no potentially applicable CMFs were found for the specific improvements proposed. Per Section 1.6.3 of the November 2020 FDOT IARUG Safety Analysis Guidance, a qualitative assessment was performed in lieu of a quantitative safety analysis.

12.1. **Freeway, Ramp, and Interchange Analysis**

12.1.1. Freeway Mainline Analysis

The I-4 westbound express lane "Tube" concept is planned to traverse the interchange study area. The safety analysis of the I-4 westbound express lane "Tube" was documented under separate cover and approved by FHWA in December 2021 as part of the I-4 at Sand Lake Road IMR. Limitations exist with the current Highway Safety Manual (HSM) methodologies and tools when it comes to quantitatively analyzing safety performance of freeways with buffer separated express lanes. Chapter 1 of the Enhanced Interchange Safety Analysis Tool (ISATe): User Manual notes that the "predictive method for freeways does not account for the influence of…freeways with limited access managed lanes that are buffer-separated from the general purpose lanes".

The "Tube" express lane will reduce traffic volume along the I-4 westbound mainline in this area, which should lead to a reduction in merging conflicts between I-4 mainline vehicles and SR 535 vehicles. The reduction in merging conflicts is anticipated to improve safety and reduce potential sideswipe crashes for

the Phase I improvements along the I-4 westbound mainline. As discussed in **Section 11.2**, westbound mainline travel times are expected to be improved by approximately 1 to 31 percent in future analysis years with the Phase I improvements and the express lane "Tube" concept. This should lead to a reduction in congestion related rear end crashes.

No changes are proposed for I-4 eastbound as part of the Phase 1 improvements, thus no qualitative safety analysis was performed for the I-4 eastbound freeway mainline.

12.1.2. Ramp Analysis

As noted previously, ramp improvements are proposed for the I-4 at SR 535 interchange. The following bullets discuss the qualitative safety analysis for these ramp improvements:

- Lengthening the I-4 westbound off-ramp to SR 535 by approximately 0.25 miles, and introducing two curves in the ramp, will likely lead to a crash increase. Even though crashes may increase, the lengthening of the off-ramp will provide more queue storage thus reducing the potential for congestion/queueing on the westbound I-4 mainline. Reducing the congestion/queueing should reduce the potential for high speed/severity rear end crashes on the I-4 mainline.
- For the I-4 westbound on-ramp from SR 535 southbound, a merge point is being removed with the removal of the northbound left-turn from SR 535, but a new merge point is being added where this ramp connects to the westbound loop ramp. Crashes are not anticipated to increase on this ramp based on these improvements.

12.1.3. Interchange Analysis

The westbound freeway ramp terminal at I-4 and SR 535 was not analyzed in ISATe due to the unique Build configuration. The improvements generally configure the interchange ramp terminal into a four-leg ramp terminal at four quadrant parclo A, as shown in Figure 1c of the 2012 ISATe User Manual. However, in the Build configuration, the northbound SR 535 to westbound I-4 parclo ramp is moved further to the north outside of the westbound freeway ramp terminal area. The following bullets outline the qualitative safety assessment:

- The Phase I configuration is removing the northbound left-turn movement from SR 535 to I-4 westbound from the ramp terminal intersection. With this configuration, conflict points will be reduced:
    - The existing ramp terminal has 9 total conflict points: 3 merging, 2 diverging, and 4 crossing.
    - The proposed configuration has 5 total conflict points: 2 merging, 2 diverging, and 1 crossing.
    - Crossing conflict points are typically locations where higher severity crashes are more likely to happen (i.e., left-turn crashes). Because the northbound left-turn movement is

being removed, there are 3 less crossing conflicts which should lead to less severe crashes for the proposed configuration.

- The removal of the northbound left-turn movement also mitigates the potential of rear-end/sideswipe crashes caused by queue spillback out of the turn lane for this movement (northbound left-turn queue summarized in **Section 9.2.5**).

12.2. **Qualitative Safety Analysis Summary**

The following bullets summarize the qualitative safety analysis for the I-4 at SR 535 Phase I improvements:

- The "Tube" express lane will reduce traffic volume along the I-4 westbound mainline in the study area, which should improve safety and reduce potential sideswipe crashes. The reduced traffic should lead to a reduction in congestion, and thus a reduction in congestion related rear end crashes.
- Because the northbound left-turn movement is being removed at the westbound ramp terminal, there are 3 less crossing conflicts which should lead to less severe crashes for the proposed configuration.
- The removal of the northbound left-turn movement also mitigates the potential of rear-end/sideswipe crashes caused by queue spillback out of the turn lane for this movement (congestion observed in the microsimulation analysis).
- Lengthening the I-4 westbound off-ramp to SR 535 by approximately 0.25 miles, and introducing two curves in the ramp, will likely lead to a crash increase. Even though crashes may increase, the lengthening of the off-ramp will provide more queue storage thus reducing the potential for congestion/queueing on the westbound I-4 mainline. Reducing the congestion/queueing should reduce the potential for high speed/severity rear end crashes on the I-4 mainline.

13. OTHER CONSIDERATIONS

13.1. **Conceptual Signing Plan**

The conceptual signing plan for this project is included in **Appendix V**.

13.2. **Access Management Coordination**

The access management plan within the area of influence will not be changed by the proposed improvements to the interchange.

13.3. **Environmental Considerations**

The approved I-4 BtU PD&E Study covering the South Section that received approval on 8/24/2017 will be re-evaluated to support the proposed alternative. It is expected that the proposed alternative will have

the same or fewer environmental impacts as the 2017 Approved Build alternative due to the reduced project limits.

13.4. **Design Exceptions/Variations**

There are design variations anticipated as part of this project:

- Design Variation for Vertical Alignment – exiting I-4 sag curves approaching SR 535 and the crest curve over SR 535
- Design Variation for Border Width

These design variations are currently being coordinated with FDOT for the appropriate reviews.

14. FEDERAL HIGHWAY ADMINISTRATION (FHWA) POLICY POINTS

The Federal Highway Administration (FHWA) regulates the addition and modification of access points along the interstate system. On May 22, 2017 FHWA issued an updated Policy on Access to the Interstate, which now includes two policy points that must be addressed before a new interchange or modification of access points to the interstate is approved. The following summarizes how the I-4 at SR 535 Phase I improvements fulfills each requirement.

14.1. **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 microsimulation (VISSIM) analysis shows that the Build scenario provides improved operations to the No-Build scenario along I-4 during each of the future year AM and PM peak hours. The travel time along westbound I-4 is expected to be reduced with the westbound express lane “Tube” as part of the Build scenario. The I-4 westbound express lane “Tube” is expected to provide travel time benefits ranging between approximately 1 and 31 percent within the AOI during the future year peak hours.

The microsimulation analysis shows the queues along the westbound off-ramp at SR 535 are expected to encroach into the portion of the off-ramp designated for deceleration under the No-Build scenario. In addition, the maximum queue for the northbound left-turn movement from SR 535 to I-4 westbound spills out of the turn lane during each of the future year peak hours. As a result, travel times along SR 535 (e.g., northbound SR 535) are expected to be more than double the average free-flow travel time along the corridor with the average travel time range between approximately 9 and 10 minutes during the 2045 peak hours.

The Build scenario is not expected to create spillback onto the mainline I-4 westbound lanes or encroach into the section of the off-ramp designated for deceleration during either Design Year (2045) peak hour. The Build scenario VISSIM results show improvements over the No-Build scenario at each of the study

intersections along SR 535 including the interchange area and the adjacent intersections during the Design Year (2045) peak hours. These improvements mitigate queue spillback between the signalized intersections along SR 535, improving travel time along SR 535 by 6 to 20 percent, and reducing the maximum queue length along the I-4 westbound off-ramp.

The Build condition is anticipated to improve safety along the I-4 westbound mainline when compared to the No-Build condition from a qualitative perspective. The "Tube" express lane will reduce traffic volume along the I-4 westbound mainline in the study area, which should improve safety and reduce potential sideswipe crashes. The reduced traffic should lead to a reduction in congestion, and thus a reduction in congestion related rear end crashes. Because the northbound left-turn movement is being removed at the westbound ramp terminal, there are 3 less crossing conflicts which should lead to less severe crashes for the proposed Phase I configuration. The removal of the northbound left-turn movement also mitigates the potential of rear end/sideswipe crashes caused by queue spillback out of the turn lane for this movement (congestion observed in the microsimulation analysis). In addition, the lengthening of the I-4 westbound off-ramp to SR 535 will provide more queue storage thus reducing the potential for congestion/queueing on the I-4 westbound mainline. Reducing the congestion/queueing should reduce the potential for high speed/severity rear end crashes on the I-4 mainline.

The safety and operational analyses conducted as part of this IMR have concluded that the proposed interchange improvements and express lane "Tube" improvements do not have a significant adverse impact on the safety and operations of I-4 through the study area. As described above in the Future Traffic Operations and Future Safety Performance sections, the proposed action of building the I-4/SR 535 interchange and the express lane "Tube" safely and efficiently collects, distributes, and accommodates the traffic anticipated to use the improvements.

As noted in the Future Operational Analysis sections, the analyses confirmed that capacity improvements, such as those identified in the I-4 BtU South Section SAMR and PD&E Study, are needed along I-4 to address mainline bottlenecks within the AOI and will be evaluated as funding becomes available. At this time, the FDOT is using a phased approach to implement improvement projects as construction funding is identified.

14.2. **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.

The existing interchange is a partial cloverleaf interchange providing full access to all traffic movements on the connecting crossroad (SR 535). The proposed improvement will maintain full access to all traffic movements.

15. CONCLUSIONS

The FDOT District Five has prepared an IMR for the proposed Phase I interchange improvements at the I-4 and SR 535 interchange, other arterial improvements, and a portion of the westbound express lane "Tube" (approximately 3 miles). The Phase I interchange improvements and westbound express Lane "Tube" are funded for construction in fiscal year 2023 (FM #448914-1 and G/W FM #449771-1). An ultimate interchange configuration for I-4 at SR 535 was identified as part of an evaluation; however, due to funding limitations and an increase in construction costs/materials, FDOT will be phasing the construction of the interchange improvements into two phases: Phase I and Phase II. At this time, it is not known when additional funding will become available to construct the Phase II interchange improvements; however, this is a top priority in the District. FDOT will coordinate with the appropriate agencies and will conduct the appropriate documentation for the Phase II improvements and plans to program Phase II within the next 10 years pending available funds. These improvements will be compatible with the overall improvements to I-4 as part of the I-4 BtU South project which was granted SO&E acceptability in May 2017 by FHWA.

At this time, it is not known when additional funding will become available to expand the southern limits of the I-4 BtU project. The FDOT District 5 has initiated the evaluation of additional opportunities that maintain the purpose and need from the previously approved I-4 BtU PD&E Study as well as consider operational needs, construction costs, and constructability. Future projects in the I-4 BtU South Section will be evaluated as construction funding is identified.

The purpose of this IMR is to document the potential safety and operational impacts of the proposed interchange, typical section, and arterial modifications being proposed as part of the I-4 and SR 535 Phase I improvements. The findings of the operational and safety analysis and the FHWA Policy Point discussion are summarized as follows:

Future Traffic Operations

- The microsimulation (VISSIM) analysis shows that the Build scenario provides improved operations to the No-Build scenario along I-4 during each of the future year AM and PM peak hours. The analysis confirmed that capacity improvements, such as those identified in the I-4 BtU South Section SAMR and PD&E Study, are needed along I-4 and will be evaluated as funding becomes available.
- The travel time along westbound I-4 is expected to be reduced with the westbound express lane "Tube" as part of the Build scenario. The I-4 westbound express lane "Tube" is expected to provide travel time benefits ranging between approximately 1 and 31 percent within the AOI during the future year peak hours.
- The Build scenario is not expected to create spillback from the SR 535 at I-4 westbound ramp terminal intersection onto the mainline I-4 westbound lanes or encroach into the section of the off-ramp designated for deceleration during either Design Year (2045) peak hour.
- The Build scenario VISSIM results show improvements over the No-Build scenario at each of the study intersections along SR 535 including the interchange area and the adjacent intersections

during the Design Year (2045) peak hours. These improvements mitigate queue spillback between the signalized intersections along SR 535, improve travel time along SR 535 by 6 to 20 percent, and reduce the maximum queue length along the I-4 westbound off-ramp.

- Performance metrics such as average delay, average speed, total delay, latent demand, latent delay, and vehicles arrived are better in the Build when compared to the No-Build for each analysis year analyzed.

Future Safety Performance

- The Build condition is anticipated to improve safety along the I-4 westbound mainline when compared to the No-Build condition from a qualitative perspective. The "Tube" express lane will reduce traffic volume along the I-4 westbound mainline in the study area, which should improve safety and reduce potential sideswipe crashes. The reduced traffic should lead to a reduction in congestion, and thus a reduction in congestion related rear end crashes.
- Because the northbound left-turn movement from SR 535 to I-4 westbound is being removed at the westbound ramp terminal, there are 3 less crossing conflicts which should lead to less severe crashes for the proposed Phase I configuration.
- The removal of the northbound left-turn movement from SR 535 to I-4 westbound also mitigates the potential of rear end/sideswipe crashes caused by queue spillback out of the turn lane for this movement (congestion observed in the microsimulation analysis).
- The lengthening of the I-4 westbound off-ramp to SR 535 will provide more queue storage thus reducing the potential for congestion/queueing on the I-4 westbound mainline. Reducing the congestion/queueing should reduce the potential for high speed/severity rear end crashes on the I-4 mainline.

FHWA Policy Points

The proposed improvements satisfy FHWA's Two Policy Point Requirements included in the May 22, 2017 update to "Policy on Access to the Interstate System".

- Policy Point 1: The safety and operational analyses conducted as part of this IMR have concluded that the proposed interchange improvements and express lane "Tube" improvements do not have a significant adverse impact on the safety and operations of I-4 through the study area.
    - The proposed improvements improve the operations along SR 535 and the Phase I improvements are not expected to create spillback onto the mainline I-4 westbound lanes or encroach into the section of the off-ramp designated for deceleration during either peak hour in the future analysis years based on the microsimulation analysis conducted.
    - The proposed improvements improve the operations along I-4 with the travel time along westbound I-4 expected to be reduced with the westbound express lane "Tube" as part of the Build scenario.
    - The proposed improvements are predicted to result in fewer crashes along the I-4 mainline and reduce the potential for high speed/severity rear end crashes on the I-4 mainline due to the lengthening of the I-4 westbound off-ramp.

- As described in the Future Traffic Operations and Future Safety Performance sections, the proposed improvements improve the ability of I-4, the I-4 westbound off-ramp to SR 535, the I-4 westbound ramp terminal intersection with SR 535, and key local facilities to safely and efficiently collect, distribute, and accommodate traffic.
- As noted in the Future Traffic Operations section, "The analysis confirmed that capacity improvements, such as those identified in the I-4 BtU South Section SAMR and PD&E Study, are needed along I-4 and will be evaluated as funding becomes available." At this time, the FDOT is using a phased approach to implement improvement projects as construction funding is identified.
- Policy Point 2: The proposed improvements will maintain full access between I-4 and SR 535. All traffic movements are being provided.

The interchange improvements evaluated as part of the Build scenario fulfill the project's purpose and need and satisfy the FHWA Policy Points.

Appendix A – MLOU

Appendix B – Raw Count Data

Turning Movement Counts

Volume Counts

Appendix C – Signal Timing Data

Appendix D – Straight Line Diagrams

Appendix E – Seasonal Factor and Axle Correction Factors

Appendix F – VISSIM Vehicle Input Demand Profiles

Appendix G – VISSIM Calibration Results

Appendix H – Crash Data Tables and Graphs

Appendix I – Crash Rate Analysis

Appendix J – Subarea Model Validation Memo

Appendix K – Design Traffic Factors

Appendix L – FDOT Historical AADT Reports and Trends Analyses

Historical AADT Reports

Trends Analyses

Appendix M – BEBR Population Study

Appendix N – CFRPM v7 Model Plots

Appendix O – NCHRP 765 Inputs and Outputs

Appendix P – I-4 at Sand Lake Road IMR Express Lane "Tube" Volume Excerpts

Appendix Q – No-Build Design Plans/Concepts

Appendix R – No-Build Signal Timings

Appendix S – No-Build VISSIM

Appendix T – Phase I Interchange Improvement Concept

Appendix U – Build VISSIM

Appendix V – Conceptual Signing Plan