



Final Report

North of S.R. 536 to I-4

FM 437175-1



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FINAL REPORT

State Road (S.R.) 535 Concept Development Study

From North of S.R. 536/World Center Drive to Interstate 4 (I-4)/Vineland
Avenue
FM 437175-1-12

Orange County, Florida

Prepared For:
Florida Department of Transportation, District Five
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Report Purpose

This document serves as the final report for the State Road (S.R.) 535 Concept Development Study. This report provides an overview of the study, analyzes existing conditions, and reviews the future alternative development and analysis. This final report will provide a recommended alternative concept plan for future phases of project development.

Corridor Planning Study Review

In 2017, the Florida Department of Transportation (FDOT) District Five completed a Corridor Planning Study to evaluate the future needs of S.R. 535 between U.S. 192 and Interstate 4 (I-4)/Vineland Avenue in northwest Osceola County/southwest Orange County. The S.R. 535 study limits in the Corridor Planning Study is displayed in **Figure 1**. The Corridor Planning Study identified and evaluated multi-modal alternatives to be carried forward into future phases of project development. The purpose and need statement from the Corridor Planning Study is summarized below.

PURPOSE

The purpose of the S.R. 535 Corridor Planning Study was to develop and evaluate alternatives to accommodate future traffic demand and improve bicycle, pedestrian, and transit connectivity.

NEED

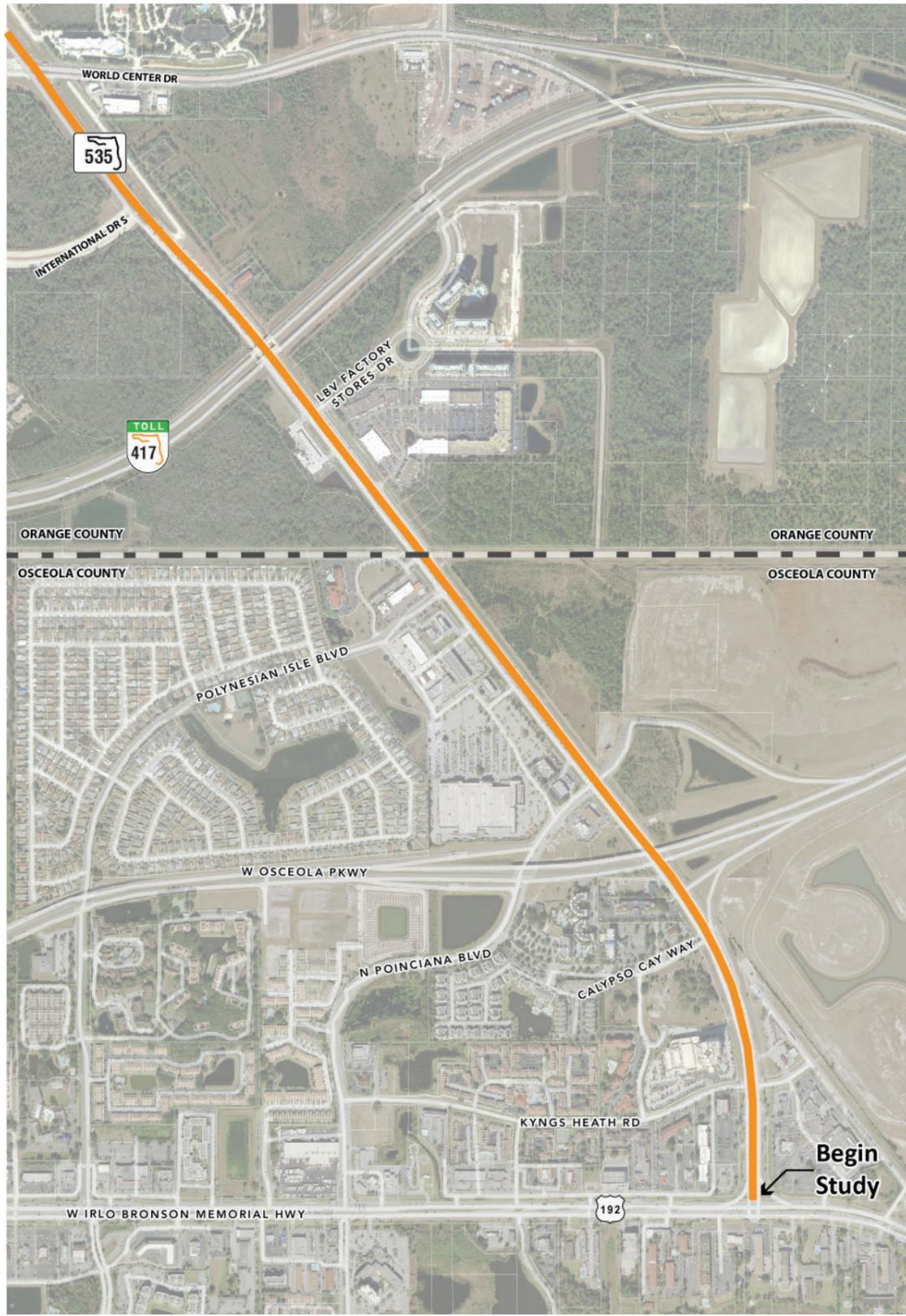
The need for the project was based on three primary factors: transportation demand, modal interrelationships, and safety:

Transportation Demand

Six of the eight segments along S.R. 535 are operating at level of service (LOS) E or F during the weekday peak hours, based on the 2016 existing conditions analysis and field review observations. The Annual Average Daily Traffic (AADT) volumes in 2016 range from a low of 26,900 vehicles per day (vpd) in the four lane segment to a high of 49,700 in the six lane segment of S.R. 535. The projected future year 2040 AADT are anticipated to range from 42,000 vpd in the four lane segment to 70,000 vpd in the six lane segment of S.R. 535. 2040 demand is projected to be approximately 10,000 to 25,000 vpd higher than the roadway capacities.

Modal Interrelationships

Pedestrian facilities are missing on both the east and west sides of S.R. 535 between Kyngs Heath Road and Vistana Drive. There are no bicycle facilities present along the entire length of S.R. 535 within the study limits. Large areas of vacant land separate the two developed areas of the study corridor. As vacant land continues to develop, the need for pedestrian, bicycle, and transit facilities along the S.R. 535 corridor from Kyngs Heath Road to just south of Vistana Drive to accommodate all modes of transportation will increase.



Aerial Image Fly Date: March 2016

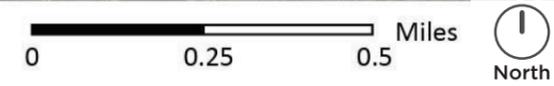


Figure No. 1
**S.R. 535 Corridor
 Planning Study Limits**

- Study Corridor
- - - County Line

Safety

There were a total of 1,142 reported crashes between 2012 and 2016, 521 of which (46 percent) resulted in at least one injury and seven of which resulted in at least one fatality. The highest crash type observed was rear end, comprising 61 percent of the total crashes, indicating congestion. Angle (11 percent) and sideswipe (8 percent) were the second and third highest crash types. Crashes during non-daylight conditions accounted for 42 percent of the overall crashes.

Of the 1,142 reported crashed between 2012 and 2016, there were 13 pedestrian crashes and five bicycle crashes during the analysis period and of the seven total fatal crashes, four involved a pedestrian or bicycle. Six of the 18 pedestrian/bicycle crashes occurred when pedestrians/bicyclists were walking on the paved shoulder in areas where no sidewalks are present, with two of those crashes resulting in a fatality. Four pedestrian crashes occurred within marked crosswalks at Meadow Creek Drive, one of which resulted in a fatality. Analysis of the crash data indicates a need for enhanced pedestrian/bicycle facilities along the study corridor.

IDENTIFIED ISSUES AND OPPORTUNITIES

Throughout stakeholder interviews and the existing roadway, operational, and safety conditions analysis, the Study Team identified opportunities for improvement along the S.R. 535 study corridor. The issues and opportunities summarized below helped define the purpose and need:

- There is a desire and need for enhanced/continuous pedestrian and bicycle facilities along the corridor.
 - Sidewalks/bicycle facilities are missing from Kyngs Heath Road to just north of S.R. 536/World Center Drive. Nine of the 18 pedestrian/bicycle crashes occurred along this section with three resulting in a fatality.
 - Of the nine pedestrian/bicycle crashes, five occurred with the pedestrian/bicyclist walking on the shoulder. Three of the nine crashes occurred when pedestrians attempted to cross S.R. 535 near intersections without marked crosswalks.
- Operational issues existed in both the AM and PM peak hours, with queuing extending $\frac{1}{4}$ to over 1.5 miles in certain areas.
 - During the AM peak hour, S.R. 535 from south of Poinciana Boulevard to LBV Factory Stores Drive experienced 1-mile queues in the northbound direction.
 - Eastbound queuing during the AM peak hour at the Poinciana Boulevard intersection extended approximately 850 feet west of S.R. 535.
 - Southbound queuing in the PM peak hour extended from LBV Factory Stores Drive through S.R. 536/World Center Drive to Meadow Creek Drive, a distance of approximately 1.65 miles.
 - Due to southbound queue spillback, the westbound left and eastbound right turn movements were not fully served leading to vehicles blocking the S.R. 536/World Center Drive intersection.
 - Northbound queuing in the PM peak hour extended from LBV Factory Stores Drive to Polynesian Isle Boulevard, a distance of approximately 0.30 miles. Northbound queuing

also extended from I-4/Vineland Avenue to approximately 0.50 miles south of the Meadow Creek Drive intersection, a total distance of approximately 0.75 miles.

- Due to southbound queue spillback, eastbound queuing along Meadow Creek Drive extended approximately 600 feet, with a majority of these vehicles turning left to go north onto S.R. 535.
- Safety is a concern with a total of 1,142 reported crashes from 2010 to 2014, of which 521 (46 percent) resulted in at least one injury and seven of which resulted in at least one fatality.
 - Crashes at the nine signalized intersections accounted for 909 of the 1,142 crashes (80 percent) along the S.R. 535 corridor. An additional 77 crashes (7 percent) occurred at the unsignalized intersection of S.R. 535 and International Drive.
 - S.R. 536/World Center Drive is the location with the highest number of crashes, accounting for 212 of the 1,142 crashes (19 percent). Polynesian Isle Boulevard (133 crashes), I-4/Vineland Avenue (123 crashes), and LBV Factory Stores Drive (101 crashes) were the next highest crash frequency locations.
 - The highest crash type observed was rear end, comprising 61 percent of the total crashes. Angle (11 percent) and sideswipe (8 percent) were the second and third highest crash types.
 - There were 13 pedestrian and 5 bicycle crashes over the five years resulting in five of the seven fatal crashes.
- With no transit routes/stops provided south of S.R. 536/World Center Drive, local commuter trips between the south and north sides of the S.R. 535 corridor must be made by vehicle.
 - From stakeholder interviews, there is a desire to extend the current transit service south to U.S. 192 and possibly connect with a future bus rapid transit system that would operate between Kissimmee and Disney World.

RECOMMENDATIONS/NEXT STEPS

The improvements recommended from the Corridor Planning Study will move forward in the following two segments:

- U.S. 192 to North of S.R. 536/World Center Drive; and
- North of S.R. 536/World Center Drive to I-4/Vineland Avenue.

U.S. 192 to North of S.R. 536/World Center Drive

The following improvements were recommended for this segment of the study corridor:

- Six-lane widening from U.S. 192 to International Drive; and
- Displaced Left Turn (DLT) innovative intersection treatment at the intersection of S.R. 536/World Center Drive.

The recommended improvements will be further evaluated in the S.R. 535 PD&E Study, which is scheduled in MetroPlan Orlando's Transportation Improvement Program (TIP) for fiscal year 2019/20.

North of S.R. 536/World Center Drive to I-4/Vineland Avenue

The following improvements were recommended for this segment of the study corridor:

- Restricted Crossing U-Turn (RCUT) innovative intersection treatments from Vistana Drive to I-4/Vineland Avenue.

The recommended improvements were further evaluated in this Concept Development Study.

Concept Development Study

PROJECT DESCRIPTION

The S.R. 535 Concept Development Study was conducted to recommend an innovative intersection concept plan along S.R. 535 from North of S.R. 536/World Center Drive to I-4/Vineland Avenue. Additional goals of this study included:

- Provide bicycle and pedestrian facilities to increase safety;
- Provide vehicle operational improvements along the study corridor; and
- Identify potential Transportation System Management and Operations (TSM&O) improvements.

STUDY AREA DESCRIPTION

S.R. 535 from North of S.R. 536/World Center Drive to I-4/Vineland Avenue is classified as an urban minor arterial oriented southeast to northwest in unincorporated Orange County. The study corridor is characterized by hotels, resorts, multi-family vacation rental apartment complexes, and retail development. The S.R. 535 study corridor is displayed in **Figure 2**.



LEGEND

Study Corridor



FIGURE 2: Study Corridor

Existing Conditions

The purpose of the existing conditions analysis is to gain an understanding of the corridor and evaluate any changes or new information obtained since the completion of the Corridor Planning Study. Data was collected, a field review was performed, and the safety assessment along the corridor was revised.

DATA COLLECTION

Data collected during the Corridor Planning Study was reviewed and analyzed to understand the existing conditions along S.R. 535. Updates to outdated data and additional data were collected as part of the Concept Development Study. The following list identifies the new, or updated, data obtained.

- Crash Data (discussed in **Safety Assessment**)
- As-Built Design Plans (discussed in **Concept Development Timeline**)
- LiDAR data from the South Florida Water Management District (discussed in **Drainage Analysis**)
- Latest year aerial photography (discussed in **Concept Development Timeline**)
- Parcel data (discussed in **Concept Development Timeline**)
- Right of Way (ROW) maps (discussed in **Concept Development Timeline**)

The data collection matrix in **Appendix A** lists the data used for the existing conditions, including the source and date it was obtained.

FIELD REVIEW

A field review along the study corridor was conducted on July 19, 2018. The objective of the field review was to identify the locations of utilities and drainage features along the corridor. The review team walked the length of the corridor along the east and west sides of the roadway and noted the locations of the following features:

- Overhead power lines
- Drainage inlets
- Signal poles, signal cabinets, and pedestrian detector pedestals
- Additional utilities such as water valves, fire hydrants, and electrical boxes

Utility poles along the east side of S.R. 535 are shown in **Figure 3**.



Figure 3: Existing Utility Poles on the East Side of S.R. 535 (Facing North)

A detailed field review summary is provided in **Appendix B**.

SAFETY ASSESSMENT

Crash records were obtained for S.R. 535 within the study limits for the most recent five year period on record (2012 through 2016) from FDOT's Crash Analysis Reporting System (CARS). This section summarizes the corridor wide crash statistics and reviews crash data for the high crash intersections along the study corridor. A detailed pedestrian/bicycle safety review is also discussed in this section.

Corridor Wide Crash Statistics

Figure 4 displays a summary of crash frequency by year along with their respective severity from 2012 to 2016. There was a total of 487 reported crashes during this period, 199 of which (41 percent) resulted in at least one injury and three of which resulted in at least one fatality. As displayed in **Figure 4**, the crashes per year along the corridor has increased from 82 in 2012 to 109 in 2016.

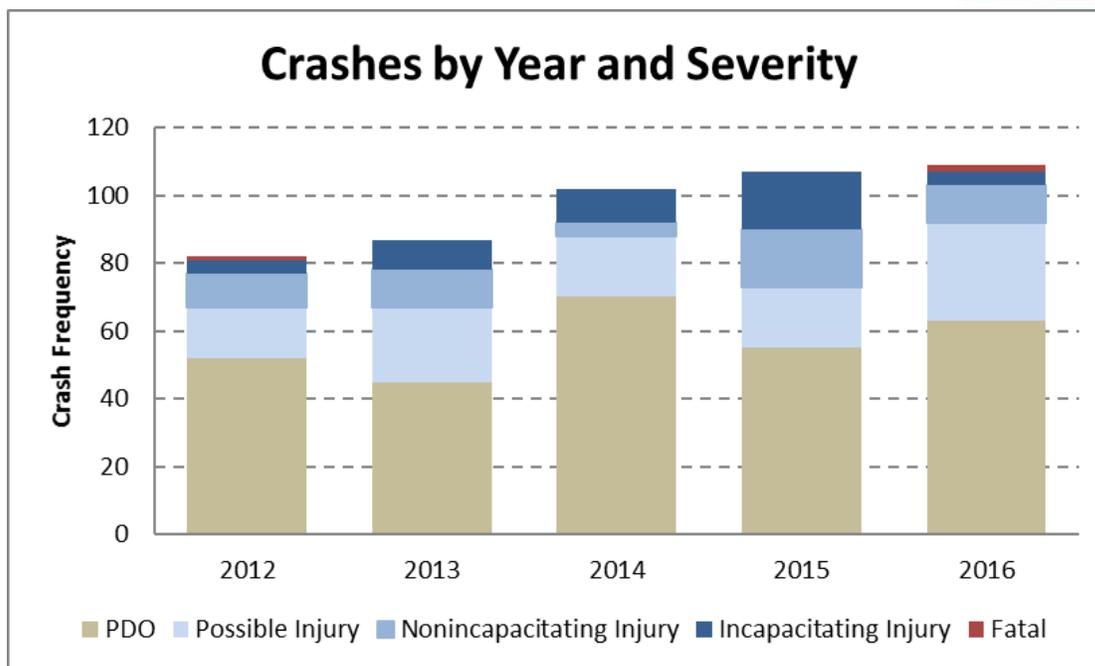


Figure 4: Crashes per Year and Severity (Corridor Wide)

Figure 5 displays the crashes along the corridor by type and severity for the five year study period. The highest crash type observed was rear end, comprising 59 percent of the total crashes. Sideswipe (11 percent) and angle (9 percent) were the second and third highest crash types. There were seven pedestrian and two bicycle crashes over the five years resulting in two of the three fatal crashes. A rear end crash accounted for the remaining fatal crash.

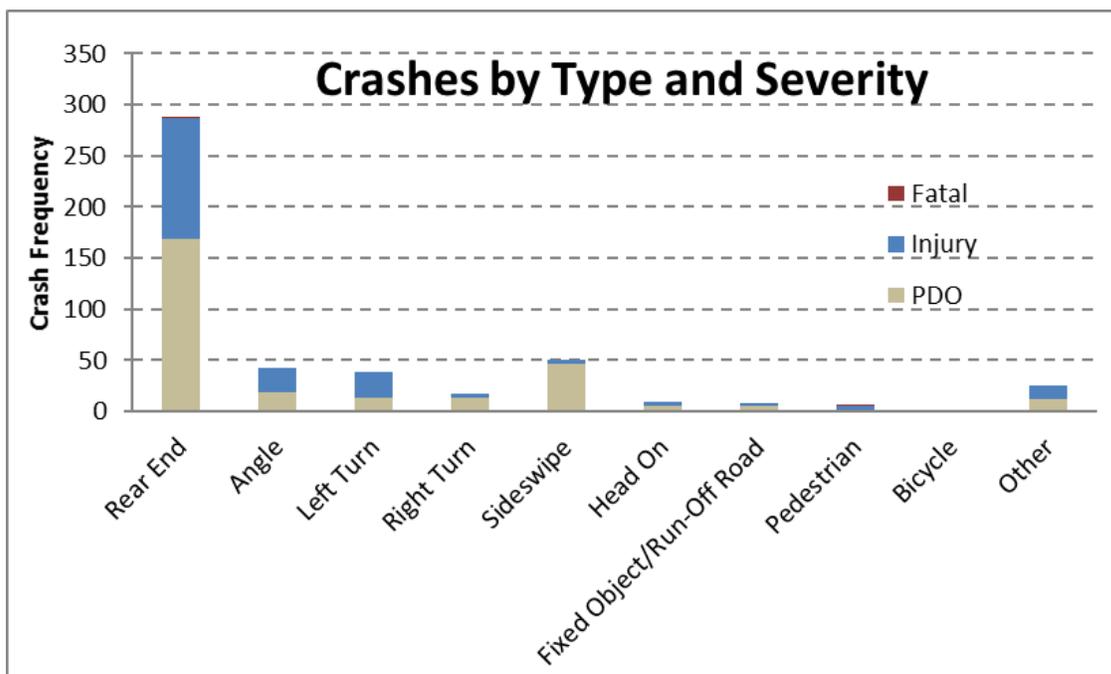


Figure 5: Crashes by Type and Severity (Corridor Wide)

Other crash statistics to note include the following:

- Crashes occurring in non-daylight conditions accounted for 39 percent of the crashes.
- Crashes occurring in wet roadway surfaces conditions accounted for 18 percent of the crashes.
- A spike in crashes was observed during the summer months of June through August, which combined accounted for 35 percent of the total crashes.
- Thirty-six percent of the crashes were observed between 3 p.m. and 8 p.m.
- Thirty-seven percent of the drivers at fault were aged between 16 and 29.

The number of crashes by location is shown in **Figure 6**. The segment of North of S.R. 536 to Vistana Drive is the location with the highest number of crashes, accounting for 138 of the 487 crashes (28 percent) over the five years. Meadow Creek Drive (132 crashes) was the next highest crash frequency location. **Figure 7** displays the crash locations along the S.R. 535 study corridor from North of S.R. 536/World Center Drive to I-4/Vineland Avenue.

The raw crash data obtained from CARS can be found in **Appendix C**. A more detailed summary of the 2012 to 2016 corridor wide crash data set in tabular and graphical format is also provided in **Appendix C**.

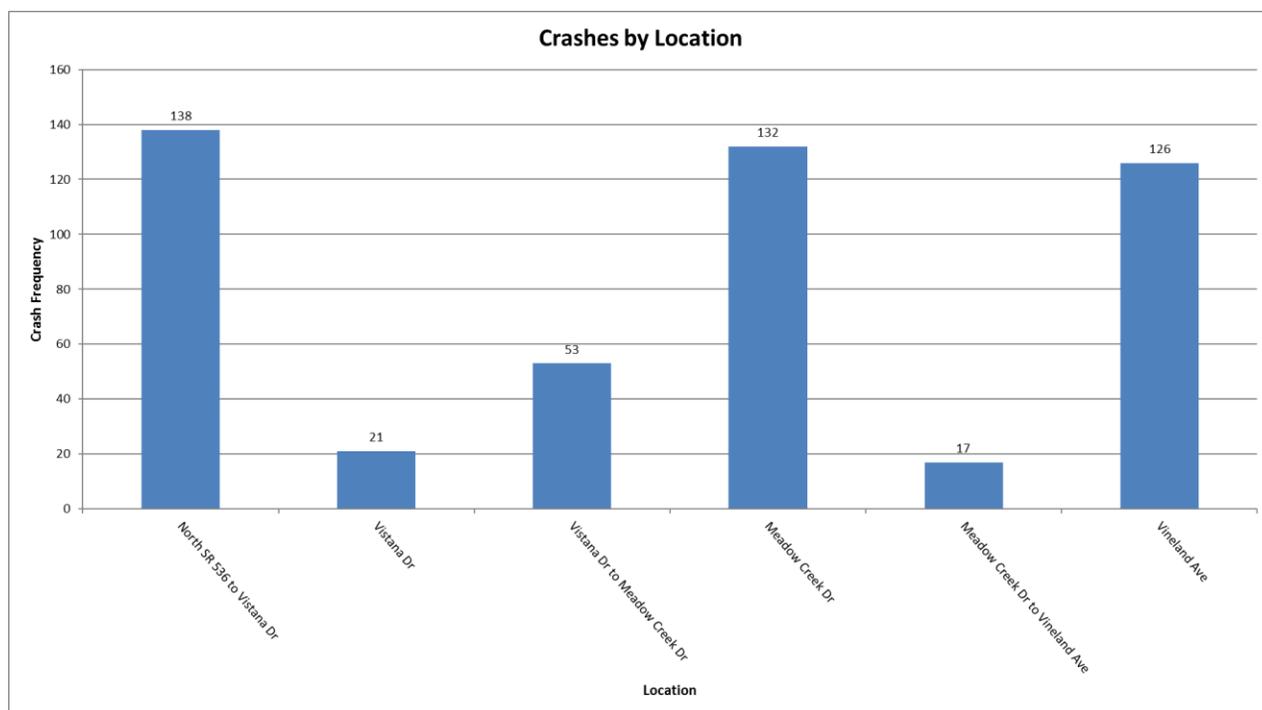


Figure 6: Crashes by Location (Corridor Wide)

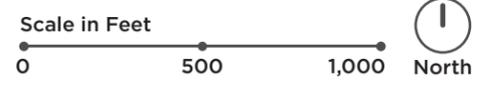


FIGURE 7: 2012-2016 Crash Frequency

High Crash Intersections

Crashes at the Meadow Creek Drive and I-4/Vineland Avenue signalized intersections accounted for 258 of the 487 crashes (53 percent) along the S.R. 535 corridor.

S.R. 535 AND MEADOW CREEK DRIVE (132 CRASHES)

The signalized intersection of S.R. 535 with Meadow Creek Drive accounted for 132 of the crashes (27 percent) along the study corridor. **Figure 8** displays the crashes by type and severity at the intersection. The highest crash type observed was rear end, comprising 69 percent of the total crashes. Sideswipe (8 percent) and angle (5 percent) were the second and third highest crash types. There were five pedestrian crashes at this intersection, two of which resulted in a fatality. A more detailed summary of the 2012 to 2016 S.R. 535/Meadow Creek Drive crash data set in tabular and graphical format is provided in **Appendix C**.

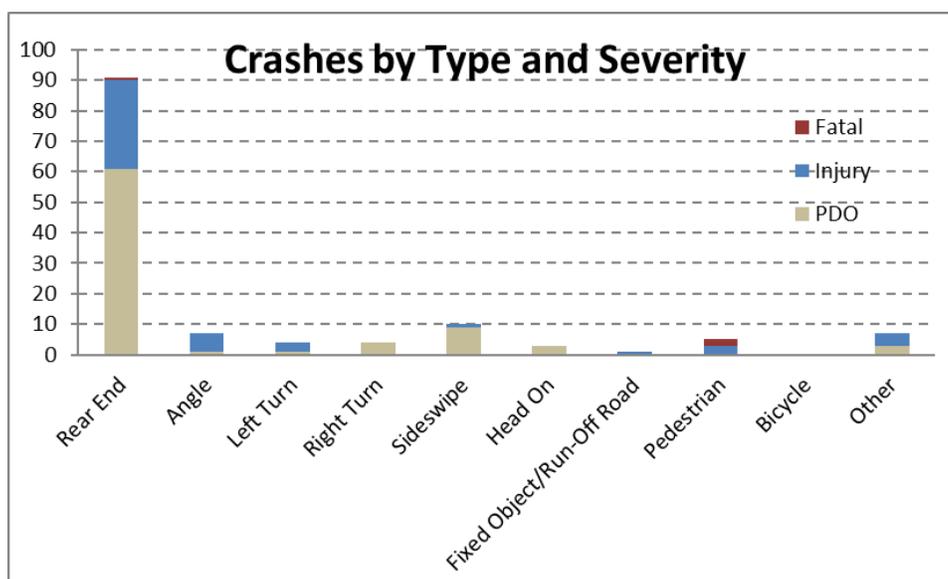


Figure 8: Crashes by Type and Severity (S.R. 535/Meadow Creek Drive)

S.R. 535 AND I-4/VINELAND AVENUE (126 CRASHES)

The signalized intersection of S.R. 535 with I-4/Vineland Avenue accounted for 126 of the crashes (26 percent) along the study corridor. **Figure 9** displays the crashes by type and severity at the intersection. The highest crash type observed was rear end, comprising 56 percent of the total crashes. Sideswipe (11 percent) and angle (10 percent) were the second and third highest crash types. There was one pedestrian crash at this intersection that resulted in an injury. A more detailed summary of the 2012 to 2016 S.R. 535 and I-4/Vineland Avenue crash data set in tabular and graphical format is provided in **Appendix C**.

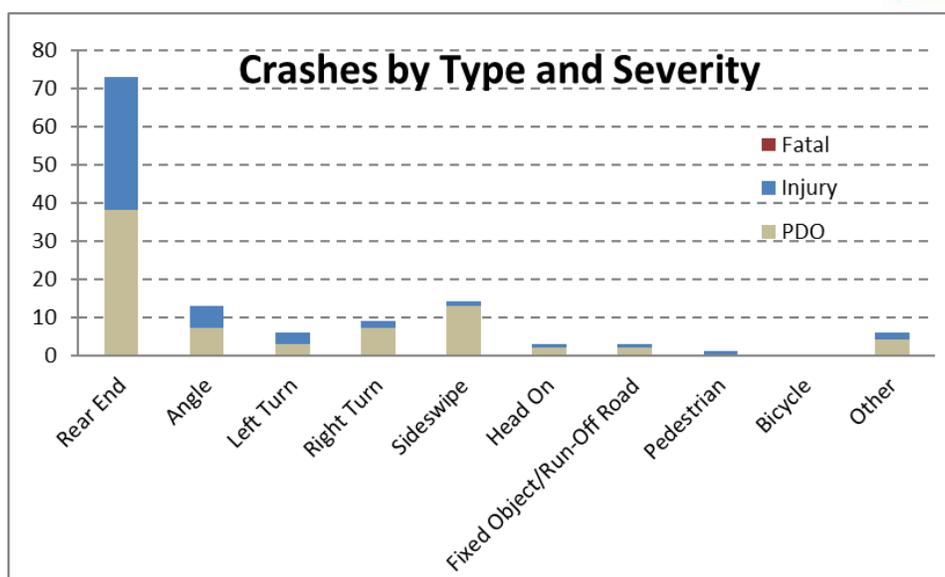


Figure 9: Crashes by Type and Severity (S.R. 535 and I-4/Vineland Avenue)

Pedestrian and Bicycle Crash Review

There were seven pedestrian crashes and two bicycle crashes during the analysis period. General pedestrian and bicycle statistics are summarized below:

- Of the seven pedestrian crashes, two were fatal and five were injury.
- Of the two bicycle crashes, none were fatal, but both resulted in injury.
- Four of the nine pedestrian/bicycle related crashes (44 percent) occurred in non-daylight conditions.
- Alcohol and/or drugs was involved in one of the nine crashes (11 percent).

A more detailed summary of the 2012 to 2016 S.R. 535 pedestrian/bicycle crash data set in tabular and graphical format is provided in **Appendix C**.

Pedestrian and bicycle crashes by location are displayed in **Figure 10**. Crashes by location are summarized below:

- One bicycle crash occurred while riding on the shoulder on S.R. 535 at Lake Bryan Beach Boulevard, which resulted in an injury.
- One pedestrian crash occurred while the pedestrian was on the sidewalk at Vistana Center Drive, which resulted in an injury.
- Five pedestrian crashes occurred within the marked crosswalks at Meadow Creek Drive. Two of the five pedestrian crashes resulted in a fatality. In both fatalities, the crashes occurred at night and involved a vehicle traveling southbound on S.R. 535 (through the Meadow Creek Drive intersection) colliding with a pedestrian crossing the intersection.
- One pedestrian crash occurred within marked crosswalks at I-4/Vineland Avenue, which resulted in an injury.



FIGURE 10: 2012-2016 Pedestrian and Bicycle Crashes

Transportation Systems Management and Operations (TSM&O) Improvements

One of the goals of the S.R. 535 Concept Development Study was to further explore potential improvements along the corridor and develop short and long term TSM&O strategies in coordination with FDOT. A coordination meeting with FDOT was held on August 30, 2018. A summary of the meeting is provided in **Appendix D**.

During discussions with FDOT, TSM&O strategies that are already in place or are being considered were discussed. Such strategies include the following.

- **Adaptive Signal Control** – Adaptive signal control in the form of InSync is already in place in Orange County.
- **Innovative Intersection Treatments** – The S.R. 535 Corridor Planning study analyzed potential innovative intersection treatments. As part of the S.R. 535 Concept Development Study, Restricted Crossing U-Turns (RCUTs) from Vistana Drive to Meadow Creek Drive were evaluated and conceptually developed. The **Preferred Concept Layout** section provides detailed discussion and analysis for these potential improvements.
- **Bicycle Facilities** – The addition of bicycle lanes along S.R. 535 is currently planned for implementation as part of the upcoming resurfacing project scheduled for the corridor.

The sections below review the short and long term TSM&O strategies discussed with FDOT. The estimated capital and annual operation and maintenance (O&M) costs are described in **Table 1** for short term improvements and **Table 2** for long term improvements.

SHORT TERM TSM&O STRATEGIES

- **Signal Performance Metrics** – To continuously monitor the performance of a traffic signal, equipment can be added to the signal controller to enable reporting of loop detector and phasing data. Additionally, a stop bar detection upgrade and advance detection need to be implemented. In addition to providing performance monitoring, this improvement can be relayed to connected vehicles as well.
- **LED Corridor Lighting** – Roadway lighting benefits motorists by improving their ability to see roadway geometry and other vehicles at extended distances ahead. To implement lighting along the corridor, coordination with Orange County and FDOT is needed to verify the lighting upgrade schedule.
- **Bus Stop Relocation and Access** – For the transit service along the S.R. 535 corridor, increased headways would be beneficial to tourists staying in the resorts/hotels found on the corridor. Through coordination with LYNX and private transit providers, optimal locations for existing stops can be identified to increase headways.

Table 1: Short Term TSM&O Strategies

Improvement	Estimated Capital Cost	Estimated Annual O&M Cost
Signal Performance Metrics	\$120/intersection	<\$1,000/intersection*
Stop Bar Detection Upgrade	\$10,000/intersection	<\$1,000/intersection*
Advance Detection	\$10,000/intersection	<\$1,000/intersection*
LED Lighting	\$50,000	<\$1,000
Bus Stop Relocation	<\$10,000	<\$1,000

*These costs are the responsibility of the local maintaining agencies

LONG TERM TSM&O STRATEGIES

- PedSafe** – PedSafe is an innovative pedestrian and bicycle collision avoidance system currently being designed by FDOT. PedSafe will connect advanced signal controller capability, use of Connected Vehicle (CV) technologies, and existing communication capabilities to reduce the occurrence of pedestrian and bicycle crashes. As a region and a state that annually tops the Dangerous by Design list of most dangerous areas for walking, development and implementation of PedSafe is an immediate priority with multiple benefits. Once PedSafe is ready for deployment, coordination with FDOT and Orange County will be needed to implement along S.R. 535.
- Transit Kiosks** – As part of LYNX’s Route Optimization Study, improved transit station amenities will be a focus on new routes, such as one currently planned from Kissimmee to the Walt Disney World Resort area. As new stops are being implemented and existing stops are being relocated, coordination with LYNX and private transit providers can begin to research and install transit kiosks at transit stops along the S.R. 535 corridor.
- Transit Signal Priority** – Deploying transit signal priority can reduce delay and runtime variability along a transit line and could benefit LYNX and private transit providers. Once the new LYNX route(s) is in place, equipment allowing for transit signal priority needs to be installed to traffic signals along the corridor and buses.

Table 2: Long Term TSM&O Strategies

Improvement	Estimated Capital Cost	Estimated Annual O&M Cost
PedSafe	\$10,000/intersection	<\$2,000/intersection
Transit Kiosks	\$35,000/site	\$3,500/site
Transit Signal Priority	\$30,000	<\$1,000*

*These costs are the responsibility of the local maintaining agencies

Evaluation of Typical Section and Innovative Intersection Alternatives

Following the existing conditions analysis and the development of TSM&O strategies, the study entered the concept development phase. The beginning of this phase included an evaluation of typical section alternatives and innovative intersection treatments along S.R. 535. During this evaluation, discussions were held which resulted in additional analysis and refinement to the alternatives. Detailed meeting summaries for meetings held throughout the study are provided in **Appendix D**. The following sections summarize the discussions held, decisions made, and the resulting analysis and revisions made before selecting a preferred typical section and innovative intersection alternative.

TYPICAL SECTION ALTERNATIVES

The recommended typical section alternatives proposed at the end of the Corridor Planning Study were reviewed as part of the Concept Development Study. The existing typical section as well as the refined typical section alternatives developed for this study are discussed below.

As discussed in the **Recommendations/Next Steps** section on page 8, the recommended RCUT improvements span from Vistana Drive to I-4/Vineland Avenue. Based on these limits, typical section alternatives were evaluated within the curb and gutter section of S.R. 535 from 350 feet South of Vistana Drive to I-4/Vineland Avenue.

Figure 11 displays the existing 6-lane typical section from 350 feet South of Vistana Drive to I-4/Vineland Avenue. The existing roadway has six travel lanes with three lanes in each direction. The travel lane width varies as the two outside lanes are 14 feet wide and the remaining four lanes are 12 feet wide. Curb and gutter is present both in the median and on the roadside. A five-foot sidewalk is located approximately three feet from the back of curb on both sides of the roadway. Approximately 130 feet of ROW is available throughout the corridor.

Alternative 1, as displayed in **Figure 12**, has the following typical section elements:

- Narrow lane widths to 11 feet;
- Rebuild curb and gutter on outside shoulder; and
- Widen existing sidewalk to be a 12-foot shared-use path.

This option would maintain the urban typical section with curb and gutter on both the median and roadside. The design speed for this typical section would be 45 MPH, consistent with the existing posted speed limit.

Alternative 2, as displayed in **Figure 13**, has the following typical section elements:

- Narrow lane widths to 11 feet;
- Provide seven-foot buffered bicycle lanes outside of travel lanes;
- Rebuild curb and gutter on outside shoulder; and
- Widen sidewalk to be a 10-foot shared-use path.

This option would maintain the urban typical section with curb and gutter on both the median and roadside. The design speed for this typical section would be 45 MPH, consistent with the existing posted speed limit.

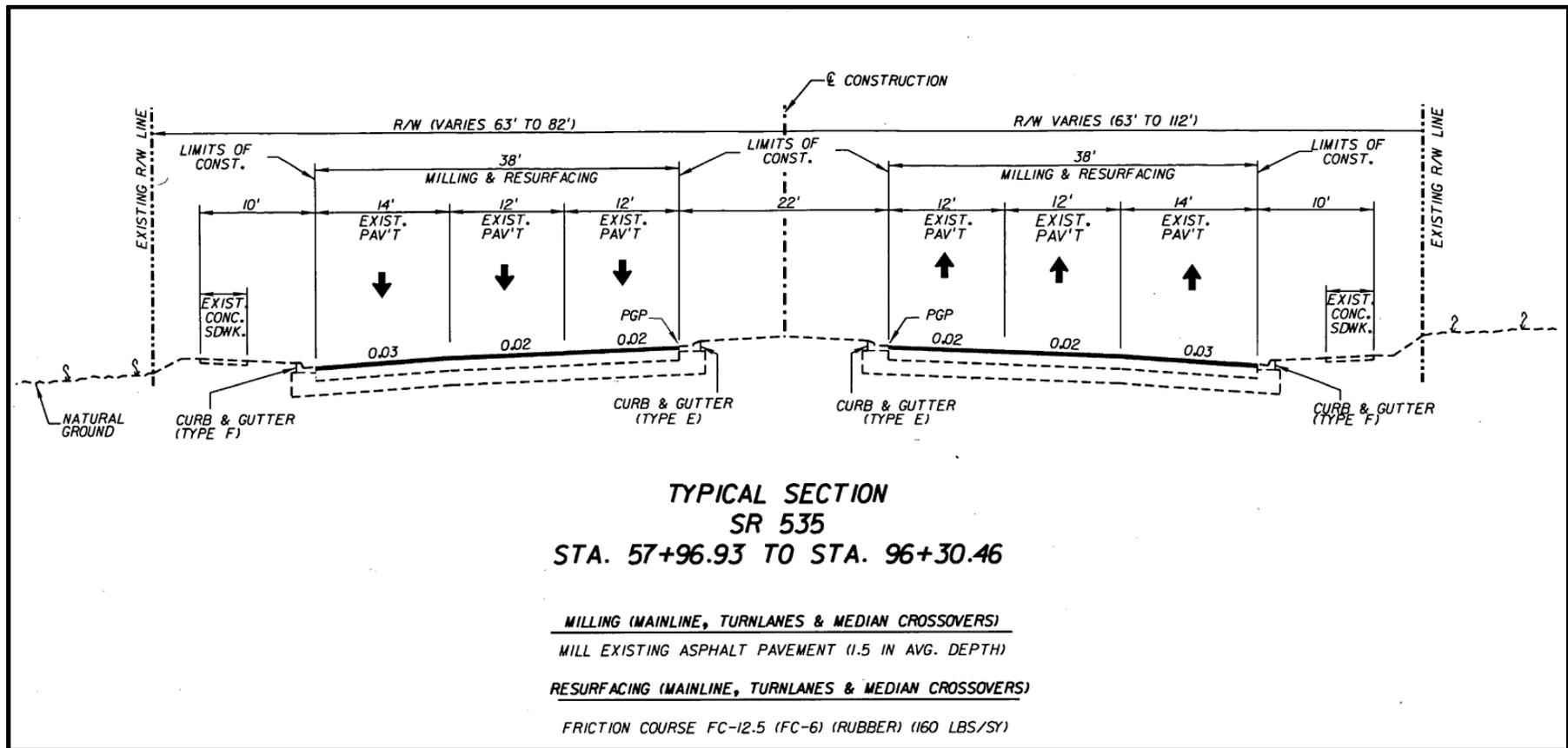
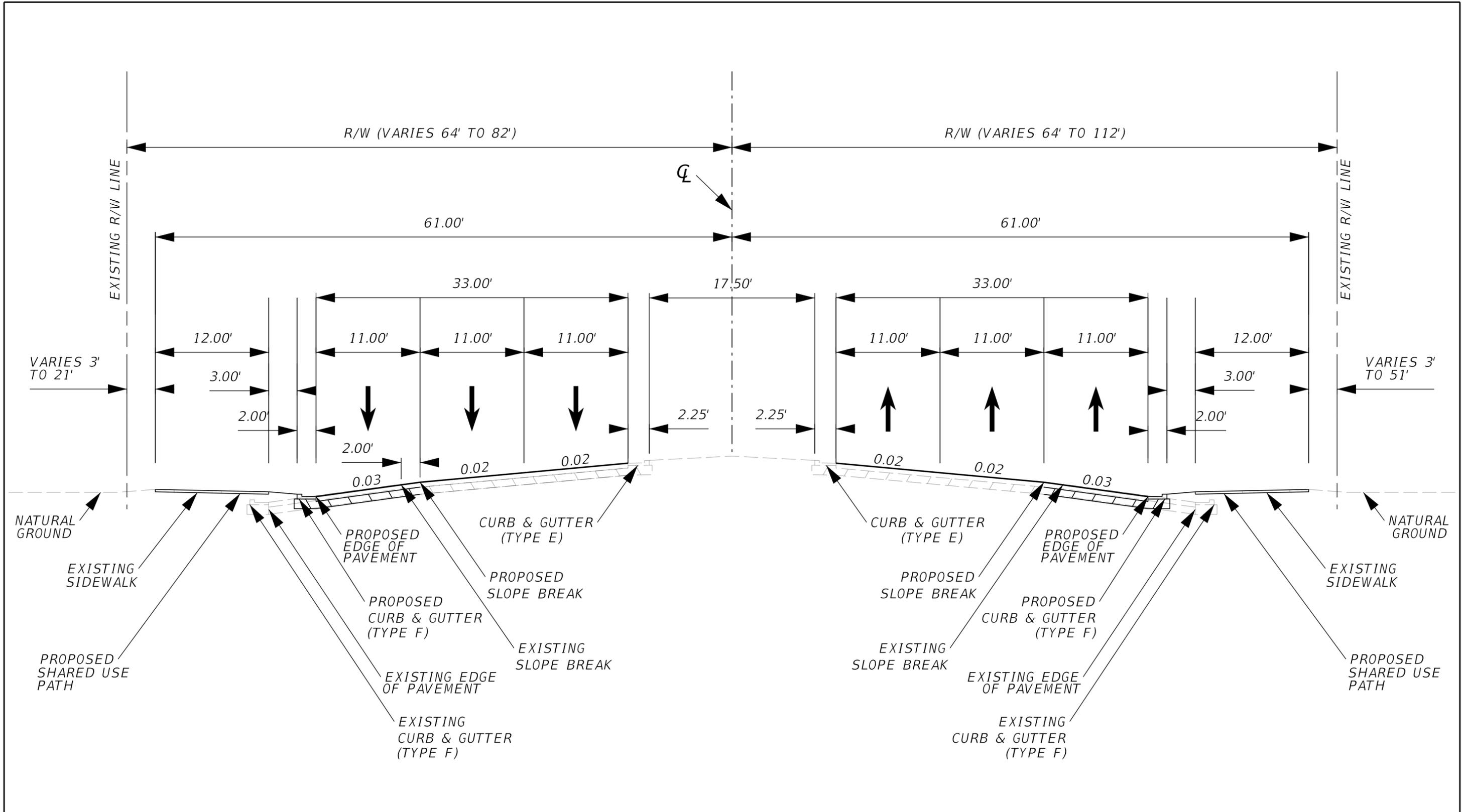
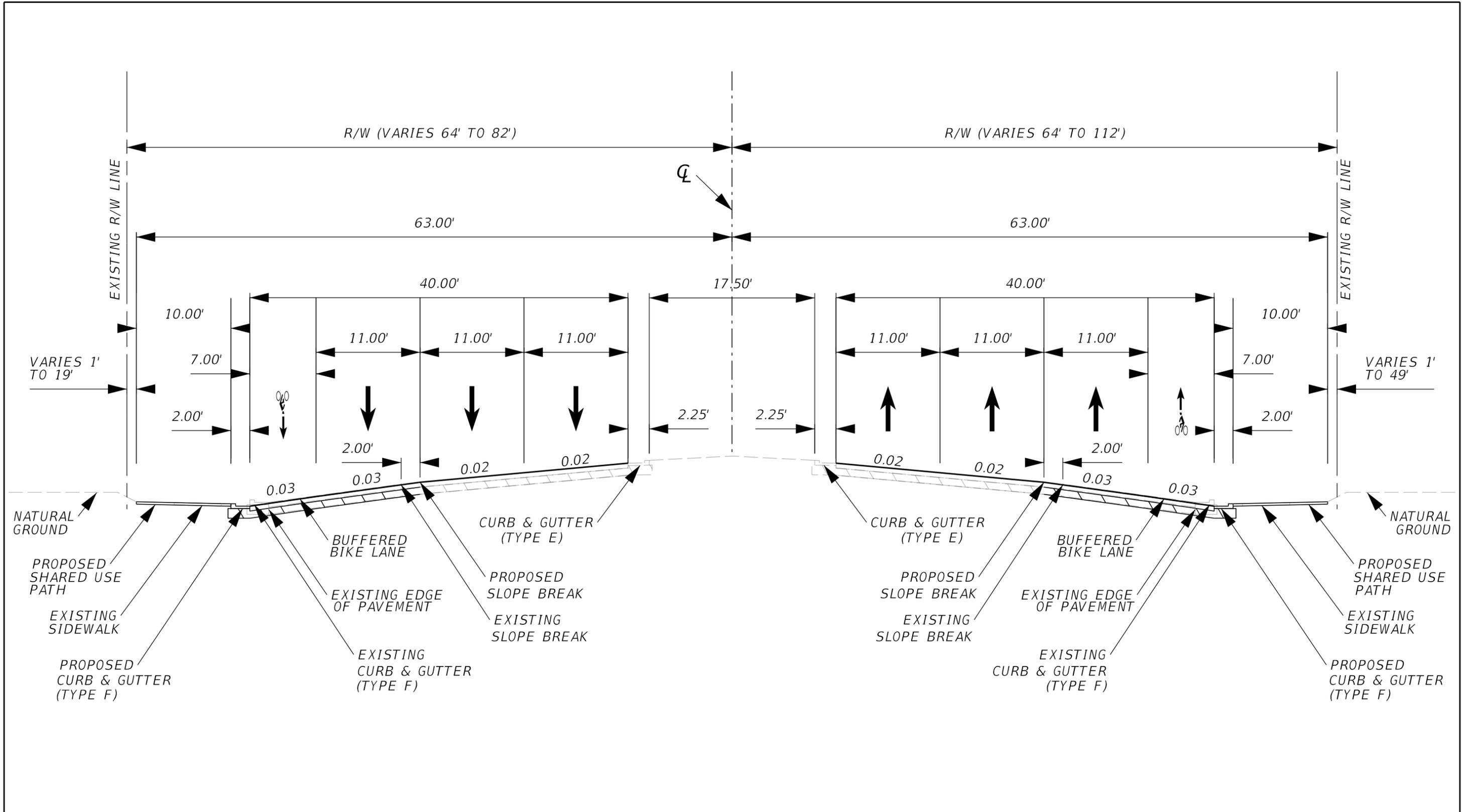


Figure 11: Existing Typical Section



ALTERNATIVE 1 - 12' SHARED USE PATH

REVISIONS				STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION			TYPICAL SECTION ALTERNATIVES	FIGURE NO. 12
DATE	DESCRIPTION	DATE	DESCRIPTION	ROAD NO.	COUNTY	FINANCIAL PROJECT ID		
				SR 535	ORANGE	437175-1-12		



ALTERNATIVE 2 - 7' BUFFERED BIKE LANE & 10' SHARED USE PATH

REVISIONS				STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION	TYPICAL SECTION ALTERNATIVES	FIGURE NO.
DATE	DESCRIPTION	DATE	DESCRIPTION			
						ROAD NO. SR 535
						13

TYPICAL SECTION ALTERNATIVES COMPARISON MATRIX

The alternative typical sections for S.R. 535 from Vistana Drive to I-4/Vineland Avenue are compared in **Table 3**. A bullet list of the high, moderate, and low ratings for each option is provided after the table.

Table 3: Typical Section MOE – 350' South of Vistana Drive to I-4/Vineland Avenue

Measure of Effectiveness*	Alternative 1	Alternative 2
Improve Pedestrian Mobility/Safety	High	High
Improve Bicycle Mobility/Safety	Moderate	High
Improve Vehicular Mobility	Same/Negligible Difference	
Improve Vehicular Safety	Same/Negligible Difference	Moderate
Support Efforts to Increase Transit	Same/Negligible Difference	
ROW Impacts	Low	Low
Drainage Impacts	Moderate	Moderate
Utility Impacts	Moderate	Moderate
Construction Cost Comparison ¹	\$2.5 million	\$2.7 million

*As compared to the existing condition.

¹Based on a cost per mile model.

- **Improve Pedestrian Mobility/Safety** – Each of the alternatives provides wider sidewalks along the corridor, thus the high rating for each alternative.
- **Improve Bicycle Mobility/Safety** – Each of the typical section alternatives are providing some type of bicycle facility where it is not currently present today, either in the form of a shared-use path or buffered bicycle lane. Alternative 1 only provides a shared-use path but no on-street bicycle facility thus the reason for the moderate instead of high rating.
- **Improve Vehicular Mobility** – Each of the alternatives will be reducing the overall lane width but this should not impact overall mobility of vehicles along the corridor.
- **Improve Vehicular Safety** – Alternative 1 will be narrowing the lane widths but this should not impact overall safety along the corridor. Alternatives 2 will be adding a buffered bicycle lane, increasing the buffer to the curb and gutter where there isn't one today. This can potentially reduce fixed-object crashes related to the curb and gutter.
- **Support Efforts to Increase Transit** – Each of the alternatives provide the same opportunity to increase transit along the corridor.
- **ROW Impacts** – Each of the alternatives would possibly require minor ROW acquisition at various intersections.
- **Drainage Impacts** – It is not anticipated that pond sites will be needed because no new travel lanes are being added. The buffered bicycle lanes and wider sidewalk should be exempt from

water treatment. Both alternatives have a moderate rating because the outside curb and gutter would need to be reconstructed.

- **Utility Impacts** – Power lines are located near the ROW line and underground fiber optic cable, water, and sewer lines are present along the corridor. The power lines may potentially be impacted by the widening of the sidewalk. The next phase of study will need to evaluate the impacts to the underground utilities along the corridor.
- **Cost Comparison** – Alternative 1 would cost approximately \$2.5 million, as widening sidewalk and rebuilding outside curb and gutter would be the primary construction costs. Alternative 2 would cost approximately \$2.7 million because of the extra pavement addition for the buffered bicycle lane, while also widening the sidewalk and rebuilding outside curb and gutter. Note that construction cost estimates for the typical section alternatives are based on FDOT cost per mile models.

IMPLEMENTATION OPPORTUNITIES

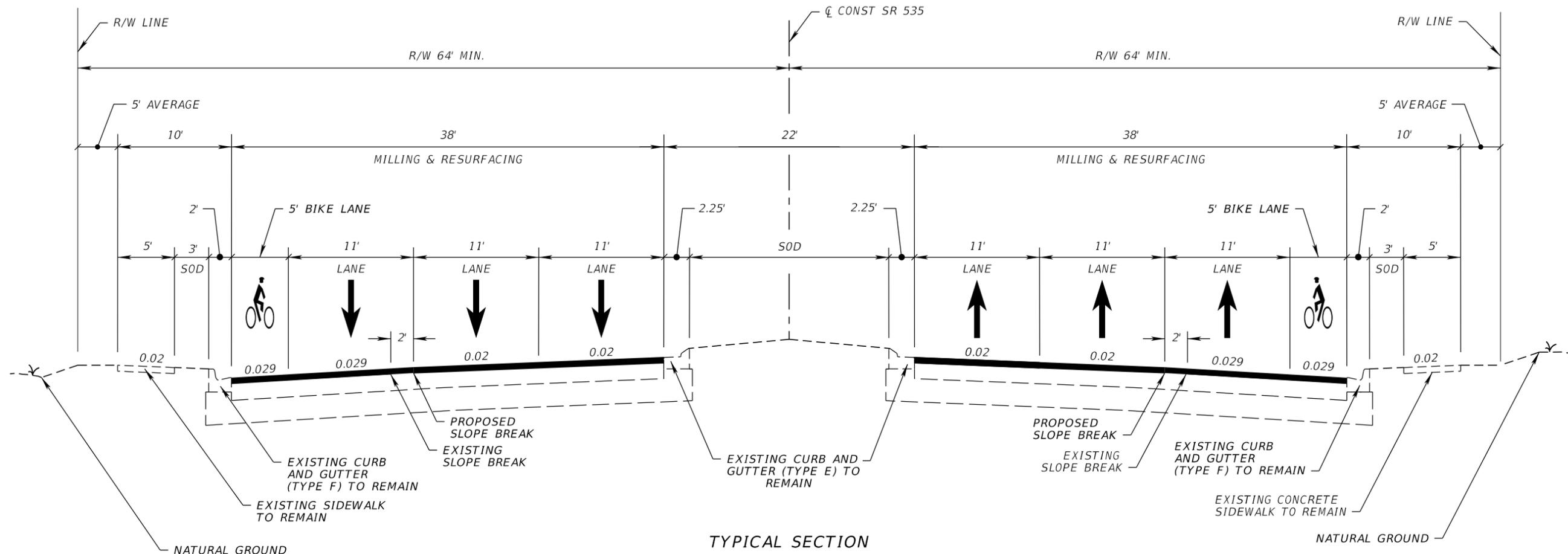
During the typical section alternatives analysis, the Study Team met with the FDOT Team leading the upcoming Resurfacing, Restoration and Rehabilitation (3R) project scheduled for S.R. 535. The meeting was held on August 30, 2018 and a summary of the meeting is provided in **Appendix D**. The 3R (FM #439237-1) is scoped within the S.R. 535 Concept Development study limits and at the time of the meeting was in the final design stage with 60% Final Design Plans submitted. The Study Team, in coordination with the 3R Team, determined that further feasibility analysis on the innovative intersection concepts at Vistana Drive and Meadow Creek Drive should be completed. If concepts prove to be feasible, the Study Team and 3R Team decided that the innovative intersection concepts should be included in the 3R scope of work.

SELECTION OF TYPICAL SECTION ALTERNATIVE

The Study Team met for an internal discussion on October 18, 2018 to review the analysis completed and agree on a typical section alternative that can be incorporated into the 3R scope. A summary of this meeting is provided in **Appendix D**.

During the October 18, 2018 meeting, the Study Team determined that bike lanes and the widening of sidewalk should be included to facilitate multi-modal activity along the corridor. The proposed typical section of the 3R (as shown in **Figure 14**) was reviewed to identify differences with the Concept Development Study typical section alternatives. The following differences were identified:

- In the 3R typical section, the bike lane addition is a five-foot lane (without buffer) within the existing curb lines. Alternative 1 proposes moving the outside curb to the inside without a bike lane while Alternative 2 proposes moving the outside curb to the outside to accommodate a seven-foot buffered bike lane.
- The 3R typical section maintains the existing sidewalk width throughout the corridor, while both Alternatives 1 and 2 propose a wider sidewalk/path along S.R. 535.



**TYPICAL SECTION
SR 535
STA. 122+15.00 TO STA. 162+60.00**

MILLING
MILL EXISTING ASPHALT
PAVEMENT (4.00" DEPTH)

RESURFACING

TYPE SP STRUCTURAL COURSE (TRAFFIC C) (2.50") (PG 76-22)
FRICTION COURSE FC-12.5 (TRAFFIC C) (1.50") (PG 76-22)

STA. + . TO STA. + .

MILLING

MILL EXISTING ASPHALT
PAVEMENT (12.00" DEPTH)

RESURFACING

OPTIONAL BASE GROUP 13 (TYPE 12.5) (8.00")
TYPE SP STRUCTURAL COURSE (TRAFFIC C) (2.50") (PG 76-22)
FRICTION COURSE FC-12.5 (TRAFFIC C) (1.50") (PG 76-22)

STA. 152+57.60 TO STA. 153+60.00

WIDENING*

OPTIONAL BASE GROUP 15 (TYPE B-12.5) (9.00") WITH
TYPE SP STRUCTURAL COURSE (TRAFFIC C) (2.50") (PG 76-22)
AND FRICTION COURSE FC-12.5 (TRAFFIC C) (1.50") (PG 76-22)

* ACTUAL WIDTH OF BASE
WIDENING MAY VARY DUE TO
ACTUAL EXISTING PAVEMENT
WIDTH. CONTRACTOR MAY ELECT
TO PLACE UNIFORM WIDTH BASE
WIDENING STRIP AT NO
ADDITIONAL COST TO THE
DEPARTMENT.

TRAFFIC DATA

CURRENT YEAR = 2018 AADT = 53,000
ESTIMATED OPENING YEAR = 2020 AADT = 55,000
ESTIMATED DESIGN YEAR = 2040 AADT = 78,000
K = 9.0 %
D = 53.6 %
T = 5.5 % (24 HOUR)
DESIGN HOUR T = 2.75%
DESIGN SPEED = 45 MPH
POSTED SPEED = 45 MPH (FROM MP 1.304 TO MP 2.020) AND
40 MPH (FROM MP 2.020 TO MP 2.135)

REVISIONS				MAJHARUL ALAM, PE P.E. LICENSE NUMBER 61600 PROPEL ENGINEERING, INC. 6685 FOREST HILL BLVD., SUITE 205 GREENACRES, FL 33413 CERTIFICATE OF AUTHORIZATION 00031050	STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION			FIGURE NO. 14
DATE	DESCRIPTION	DATE	ROAD NO.		COUNTY	FINANCIAL PROJECT ID		
			SR 535		ORANGE	439237-1-52-01		

TYPICAL SECTION

THE OFFICIAL RECORD OF THIS SHEET IS THE ELECTRONIC FILE DIGITALLY SIGNED AND SEALED UNDER RULE 61G15-23.004, F.A.C.

The 2019 FDOT Design Manual (FDM) standard specifies bicycle lanes should be included on state facilities and shared use paths cannot act as a substitute. Adhering to FDM standards would eliminate Alternative 1 from consideration.

The only differences between Alternative 2 and the 3R typical section are the buffered bike lanes and the wider (10-foot) sidewalk. To advance implementation, an alternative was evaluated where the pavement from the 3R is maintained (thus removing the two-foot bike lane buffer in Alternative 2) and the existing sidewalk is widened. Widening the sidewalk to 10-feet wide, as proposed in Alternative 2, results in either ROW and/or utility impacts. To determine a recommended sidewalk widening, the maximum available sidewalk width was evaluated on both sides of the corridor. The lowest maximum width observed along the corridor was eight feet. In order to maintain a consistent sidewalk width throughout the corridor, the Study Team recommended widening the sidewalk to eight feet. This sidewalk widening was incorporated into the initial round of draft RCUT concepts as discussed in the **Concept Development Timeline** section.

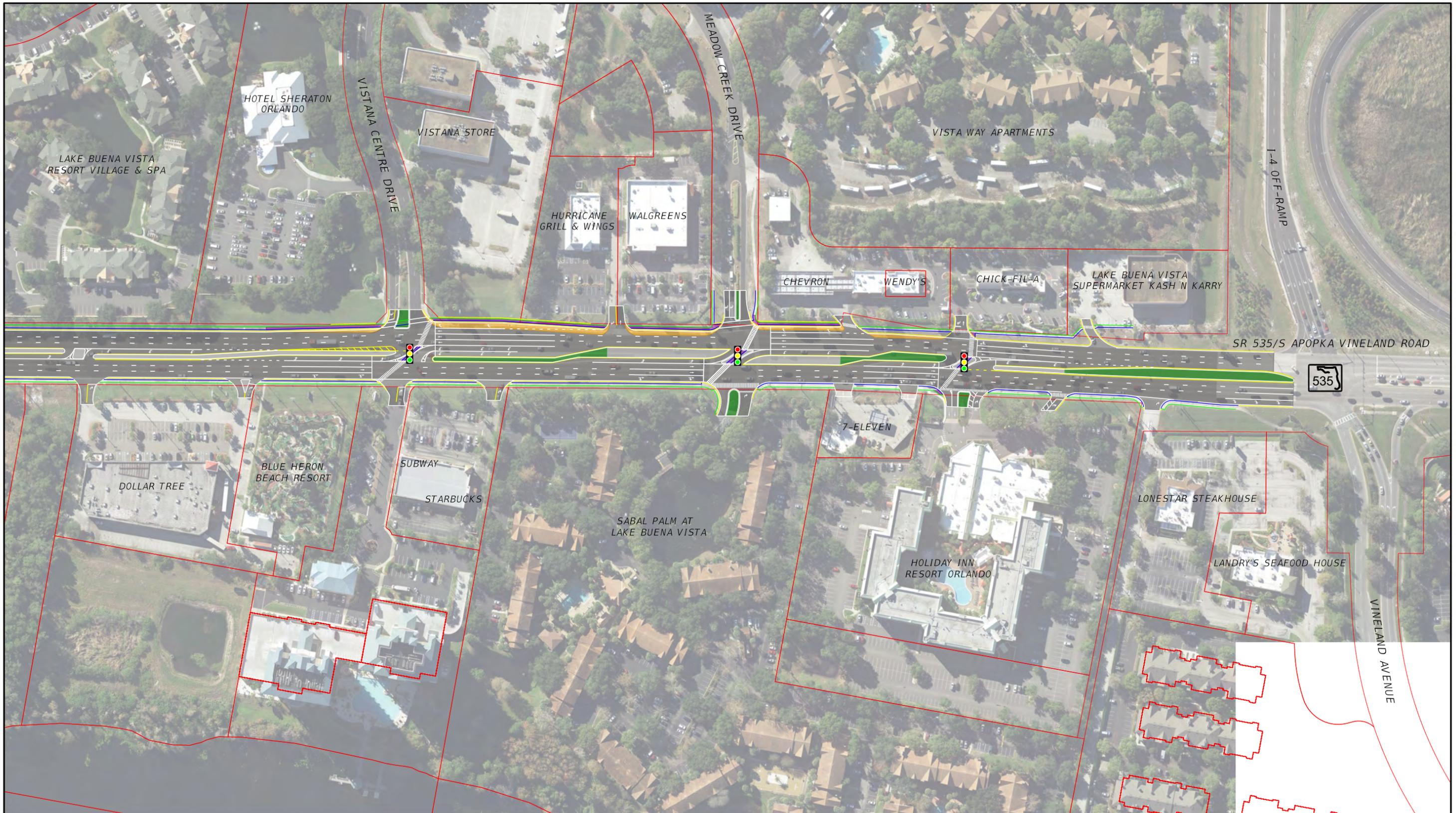
As discussed in the **RCUT Draft Concept – January 21, 2019** section, the 3R Team informed the Study Team that a wider sidewalk would not be incorporated into the 3R project. Thus, the Study Team utilized the 3R typical section to develop draft RCUT concepts beyond January 21, 2019.

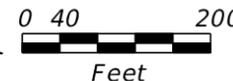
INNOVATIVE INTERSECTION ALTERNATIVES

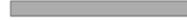
The innovative intersection alternatives under consideration for the S.R. 535 corridor were the Restricted Crossing U-Turn (RCUT) and the Partial Median U-Turn (PMUT). Both innovative intersection alternatives were considered for the Meadow Creek Drive intersection, while just the RCUT alternative was considered at the Vistana Drive intersection. Details on the considerations and selection of innovative intersection alternatives at these two intersections are discussed in the **Intersection Control Evaluation (ICE)** section.

Conceptually, an RCUT intersection differs from a conventional intersection by rerouting left-turn and through movements from minor street approaches to U-Turn locations upstream/downstream of the main intersection. **Figure 15** shows a preliminary RCUT concept created for the intersection of S.R. 535 and Meadow Creek Drive. In the concept, left-turn and through movements from the eastbound and westbound approaches at Meadow Creek Drive are restricted by a new directional median located at the center of the intersection. These movements would instead turn right onto S.R. 535 to then perform a U-Turn at new signals located at Vistana Center Drive and the Chick-fil-A Driveway (both existing directional median openings).

A PMUT intersection is similar to the RCUT intersection, as movements are rerouted to signalized U-Turn locations upstream/downstream of the main intersection. While the RCUT reroutes minor street left-turn and through movements, the PMUT reroutes major street left-turn movements only. **Figure 16** shows a preliminary PMUT concept created for the intersection of S.R. 535 and Meadow Creek Drive. In the concept, northbound and southbound left-turn lanes are eliminated as these movements instead continue through the intersection to then perform U-Turns at the new signals located at Vistana Center Drive and the Chick-fil-A Driveway (both existing directional median openings).



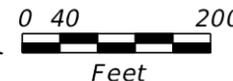



 PROPOSED ROW	 SIDEWALK FRONT	 RESURFACED PAVEMENT	 NEW SIDEWALK
 PARCEL LINE	 SIDEWALK BACK	 NEW PAVEMENT	 BACK OF CURB

FOR ILLUSTRATIVE PURPOSES ONLY
AERIAL PHOTO ACQUIRED 2016

REVISIONS				STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION			SR 535 AT MEADOW CREEK DRIVE RCUT ALTERNATIVE	FIGURE NO. 15
DATE	DESCRIPTION	DATE	DESCRIPTION	ROAD NO.	COUNTY	FINANCIAL PROJECT ID		
				SR 535	ORANGE	18956		



 PROPOSED ROW	 SIDEWALK FRONT	 RESURFACED PAVEMENT	 NEW SIDEWALK
 PARCEL LINE	 SIDEWALK BACK	 NEW PAVEMENT	 BACK OF CURB

FOR ILLUSTRATIVE PURPOSES ONLY
AERIAL PHOTO ACQUIRED 2016

REVISIONS				STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION			SR 535 AT MEADOW CREEK DRIVE PMUT ALTERNATIVE	FIGURE NO. 16
DATE	DESCRIPTION	DATE	DESCRIPTION	ROAD NO.	COUNTY	FINANCIAL PROJECT ID		
				SR 535	ORANGE	18956		

AUTOTURN ANALYSIS

The August 30, 2018 meeting determined that incorporating innovative intersections in the 3R scope is possible, but may be limited by potential ROW impacts. The Study Team was tasked with performing a U-Turn analysis, using AutoTURN software, for different design vehicles within the current 3R design to evaluate the potential ROW impacts anticipated with the inclusion of either RCUT or PMUT alternatives.

The AutoTURN analysis was performed to determine the ROW needed to facilitate U-Turn movements along the S.R. 535 study corridor. The following U-Turn locations were evaluated:

- Proposed U-Turn location 450 feet South of Vistana Drive;
- Vistana Drive;
- Existing Directional Median 1,050 feet North of Vistana Drive;
- Vistana Center Drive; and
- Existing Chick-fil-A Directional Median 500 feet North of Meadow Creek Drive.

AutoTURN U-Turn movements along S.R. 535 were evaluated for the following design vehicles:

- Passenger Car (AASHTO 2011 P);
- Box Truck (AASHTO 2011 SU-30); and
- Transport Truck (FL IDG 2007 WB-62FL).

Detail plan sheets of AutoTURN movements along the corridor for each vehicle type is provided in **Appendix E**. The following results were observed for each vehicle type:

- Passenger Car
 - For every location along S.R. 535, passenger cars were able to complete U-Turns within the roadway pavement area.
 - No additional ROW is required.
- Box Truck and Transport Truck
 - Paved bulb-outs need to be constructed along the corridor to accommodate U-Turn movements.
 - There are no ROW impacts for the proposed U-Turn location south of Vistana Drive.
 - North of Vistana Drive, ROW impacts are anticipated along the corridor at the following locations:
 - Existing Directional Median 1,050 feet North of Vistana Drive on both sides of the road;
 - Vistana Center Drive on both sides of the road; and
 - Existing Chick-fil-A Directional Median 500 feet North of Meadow Creek Drive on the west side of the road.

These results were discussed with the FDOT Design staff in a meeting held on September 19, 2018. A summary of this meeting is provided in **Appendix D**. Following a discussion on the results, the group

decided to continue evaluating the RCUT and PMUT alternatives by performing an Intersection Control Evaluation (ICE).

INTERSECTION CONTROL EVALUATION (ICE)

The following section details the ICE analysis performed at Meadow Creek Drive and Vistana Drive. Detailed and signed ICE forms are provided in **Appendix F**. The full ICE submittal packages for both intersections can be found in the project files.

S.R. 535/Meadow Creek Drive Intersection

STAGE 1 ICE

The Stage 1 ICE included an assessment of anticipated volume-to-capacity ratio (V/C), multimodal score, and safety analysis for various intersection control types. The recommendation from the Stage 1 ICE at the S.R. 535/Meadow Creek Drive intersection included the existing signal control, the signalized RCUT, and the PMUT. The signal control moved forward into Stage 2 because it is the base condition. The RCUT was recommended for Stage 2 because of the anticipated operational benefits and safety improvements. The PMUT, which would restrict northbound/southbound left turns onto Meadow Creek Drive but allow eastbound/westbound left turns from Meadow Creek Drive, was also selected because it had comparable operational and safety benefits as the RCUT. The Median U-Turn (MUT), which would restrict all left turn movements at the intersection, was not recommended to move forward as the eastbound left turn is the highest left turning movement at the intersection and if it is restricted, may cause U-Turn issues at other currently unsignalized locations.

Other alternative intersections were analyzed as part of the Stage 1 Analysis and justification for why they did not move forward is provided in the S.R. 535/Meadow Creek Drive Stage 1 ICE Forms.

STAGE 2 ICE

The Stage 2 ICE included a detailed operational analysis utilizing Synchro and a refined safety analysis based on site specific characteristics. The results from the operational and safety analyses for the RCUT and PMUT were compared against the existing signal control to determine the benefit of either improvement. The existing signal control performed at a lower level-of-service (LOS) with higher delay than the RCUT and the PMUT. The RCUT performed approximately two to eight seconds of delay better than the PMUT in the operational analysis. The RCUT and PMUT both operate better than the existing signal, with the PMUT anticipated to experience less fatal and injury crashes than the RCUT.

Planning level construction cost estimates were generated for the RCUT and PMUT concepts. The construction costs of these improvements were taken into consideration to calculate a benefit-cost (B/C) ratio and a net present value (NPV) for the RCUT and the PMUT alternatives. **Table 4** displays the costs and benefits found in the S.R. 535/Meadow Creek Drive Stage 2 ICE Forms.

Table 4: Cost and Benefit Summary

Control Strategy	ROW Costs (\$)	Construction Costs (\$)	Delay B/C	Safety B/C	Overall B/C	Net Present Value
Signalized Control	\$0	\$0	-	-	-	-
RCUT (Signalized)	\$0	\$1,730,000	11.51	3.87	15.38	\$26,890,687
Partial MUT	\$0	\$1,540,000	10.47	5.79	16.27	\$25,650,085

As shown in **Table 4**, the construction cost for the RCUT will be approximately \$200K higher than the PMUT. The RCUT has a higher delay B/C but a lower safety B/C when compared to the PMUT. The RCUT has a higher NPV than the PMUT, even though it has an overall lower B/C ratio.

OTHER CONSIDERATIONS

Other considerations were taken into account when selecting either the RCUT or PMUT intersection control type, with the first being pedestrian crossing safety at the Meadow Creek Drive intersection. Crash history and field observations have shown a conflict between eastbound/westbound left turns and pedestrians crossing the north/south legs of the intersection. The PMUT would still allow the left turns from Meadow Creek Drive, thus this conflict would remain. The RCUT would restrict the left turns from the minor street thus eliminating the conflict between left turning vehicles and pedestrians.

Another consideration relates to the potential design of the PMUT. The PMUT should be designed to discourage the northbound/southbound left turn movements at the intersection. But even with this type of design, there is still the possibility a driver can make an illegal northbound/southbound left turn. With the tourist activity in the area, this may be more likely to occur even with appropriate PMUT design. The RCUT intersection is more intuitive for drivers and is more consistent with the types of access management practices currently being implemented by FDOT.

The last consideration is accommodation of U-Turns at adjacent intersections. With the PMUT intersection, the restricted northbound left turns would have to U-Turn at the directional median opening for the Chick-fil-A approximately 475 feet north of Meadow Creek Drive. Based on the turning movement counts, six total heavy vehicles were making the northbound U-Turn during the peak hours. The U-Turns being made by the heavy vehicles would need to be accommodated with a loon area at the directional median opening. The U-Turn path for a WB-62FL is displayed in **Figure 17**. As shown in the figure, the U-Turn area would potentially encroach on parking stalls for the Chevron. There is also a grade difference between the existing edge of pavement and where the parking stalls are located. If the RCUT is implemented, this would allow for the heavy vehicles to make the northbound left turn. Thus, the only vehicles making the U-Turn at the Chick-fil-A would be the re-routed westbound left turns and through movements from the Sabal Palm Apartments. There were no recorded heavy

vehicles making these movements from the apartments so a loop to accommodate heavy vehicle U-Turns would not be necessary. This would make the RCUT a more favorable option as it would eliminate the need for ROW and potential parking impacts at the Chick-fil-A directional median opening.

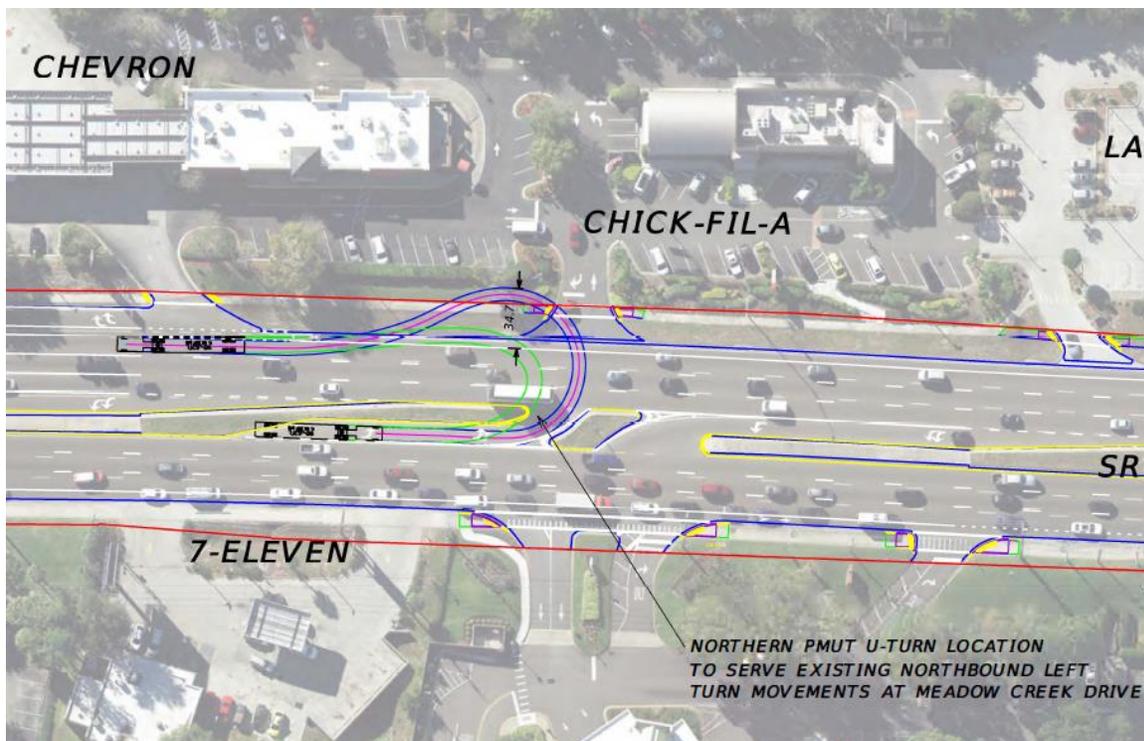


Figure 17: U-Turn Area for WB-62FL

S.R. 535/Vistana Drive**STAGE 1 ICE**

The Stage 1 ICE for the S.R. 535/Vistana Drive intersection followed the same procedure used for the S.R. 535/Meadow Creek Drive intersection. The following summarizes the control types analyzed as part of the Stage 1 evaluation and provides the recommendations for which types should be assessed further:

- Two-Way Stop-Controlled (TWSC): Do Not Advance – The TWSC alternative has the highest volume to capacity (v/c) ratio of any alternative in the existing condition.
- **RCUT (Signalized): Advance** – The signalized RCUT is acceptable based on operational/safety results and the pedestrian safety context of the corridor.
- RCUT (Unsignalized): Do Not Advance – The v/c ratio in this alternative is greater than 1.0 in the PM peak hour.
- Median U-Turn: Do Not Advance – Limited operational benefits due to the intersection only having three legs with low minor street left turn volumes.
- Roundabout: Do Not Advance – The S.R. 535 corridor is currently a 6-lane roadway.
- Signalized Control: Do Not Advance – This alternative results in a higher v/c and safety ranking than the signalized RCUT.

At the conclusion of the Stage 1 analysis, the signalized RCUT emerged as the only alternative recommended for advancement. The Study Team recommended the signalized RCUT alternative for the S.R. 535 and Vistana Drive intersection. The Stage 1 ICE Forms are provided in **Appendix F**.

FDOT PLANNED MEDIAN MODIFICATIONS AT VISTANA DRIVE

FDOT Traffic Operations is converting the existing full median openings at the intersections at Lake Bryan Beach Boulevard and Vistana Drive to directional medians to improve safety along the corridor, as illustrated in **Figure 18**.



Figure 18: FDOT Planned Median Improvements

In a meeting with FDOT Traffic Operations, held on October 2, 2018, converting the proposed improvement at Vistana Drive to a signalized RCUT was discussed. The proposed directional median at Vistana Drive can be converted to a signalized RCUT configuration with the addition of signalization elements (stop bars, traffic signals, crosswalks). As the intersection at Vistana Drive is a three-legged intersection, the eastbound left-turns would be rerouted to a southbound U-Turn location south of Vistana Drive. There is approximately 1,000 feet between Vistana Drive and Lake Bryan Beach Boulevard, which would allow for the placement of another directional median opening.

ICE Recommendations

Both the RCUT and PMUT are projected to have favorable B/C ratios with positive NPVs. Because the B/C ratios and NPVs are relatively close to each other, the considerations noted in the previous section was the deciding factor in choosing the RCUT configuration over the PMUT configuration for the S.R. 535/Meadow Creek Drive intersection. A preliminary RCUT plan was presented to the public during the Corridor Planning Study on November 2, 2017 with positive feedback. The RCUT recommendation was also supported by members of the FDOT TSM&O, Traffic Operations, and Design Departments in various meetings held between August 30th and October 2nd, 2018. Detailed summaries of these meetings are provided in **Appendix D**.

During the meeting with FDOT Traffic Operations on October 2, 2018, it was agreed that the signalized RCUT alternative at the S.R. 535/Vistana Drive intersection was acceptable to move forward based on the Stage 1 results and the context of the corridor discussed above.

The Study Team met for an internal discussion on October 18, 2018 to review the analysis completed and the implementation opportunities available for the innovative intersection concepts. An objective of the meeting was to agree on an innovative intersection alternative to be incorporated into the 3R scope. Based on the ICE analysis performed at both the intersections at Meadow Creek Drive and Vistana Drive, the RCUT alternative was recommended for both intersections.

Concept Development Timeline

Following the selection of the typical section and RCUT alternatives, the development of the RCUT concept began. This section will detail the discussions held, decisions made, and the resulting analysis and revisions throughout the concept development phase. The following versions of the RCUT Draft Concept are discussed and are provided in **Appendix G**.

- **RCUT Draft Concept – December 4, 2018**
- **RCUT Draft Concept – January 21, 2019**
- **RCUT Draft Concept – February 11, 2019**
- **RCUT Draft Concept – March 6, 2019**
- **RCUT Draft Concept – March 12, 2019**
- **RCUT Draft Concept – March 18, 2019**

DESIGN STANDARDS

The RCUT concept and typical section alternatives were developed using MicroStation V8i (SELECTseries 4) software and the U-Turn analysis was completed using AutoTURN for MicroStation. The typical section alternatives and RCUT concept were developed following the guidelines and standards:

- FDOT Design Manual (FDM 2018, 2019)
- Manual on Uniform Traffic Control Devices (MUTCD)
- Minimum Standards for Design, Construction, and Maintenance Streets and Highways (Florida Greenbook)
- FDOT CADD Manual

RCUT DRAFT CONCEPT – DECEMBER 4, 2018

The first draft of the RCUT concept for the S.R. 535 study corridor was completed in December 2018. The selected typical section added bike lanes, and sidewalks were widened to eight feet wide. Curb ramps were reconstructed along driveways to include detectable warnings.

Following discussions with FDOT Traffic Operations, a new intersection was added 600 feet north of Lake Bryan Beach Boulevard to provide northbound/southbound U-Turns. The features added to the other RCUT locations, such as median islands, crosswalks, stop bars, and traffic signals were added to this location. Additionally, new pavement for the turn lanes and bulb-outs associated with the northbound and southbound U-Turn movements was included.

The intersections of Vistana Drive, Vistana Center Drive, Meadow Creek Drive, and the Chick-fil-A Driveway were converted to signalized RCUTs and include the following features:

- New pavement added at Vistana Drive and Vistana Center Drive for southbound U-Turn bulb-outs

- New or widened center median islands to restrict eastbound/westbound left-turns and allow for pedestrian crossings
- New east/west pedestrian crosswalks added
- New stop bars and traffic signals added
- Pavement removal on the east leg of the Meadow Creek Drive intersection to reduce pedestrian crossing

The RCUT Draft Concept dated December 4, 2018 is provided in **Appendix G**.

RCUT DRAFT CONCEPT – JANUARY 21, 2019

Following the submittal of the initial RCUT concept, the Study Team learned that the proposed sidewalk widening would not be included in a revised design scope for the 3R final design. To maintain consistency with 3R design, the RCUT concept was revised to reflect no sidewalk widening.

The RCUT Draft Concept dated January 21, 2019 is provided in **Appendix G**.

RCUT DRAFT CONCEPT – FEBRUARY 11, 2019

Following a review by FDOT, the following changes were requested to the Vistana Center Drive intersection. The previous RCUT concept included a free flowing southbound right turn lane at the intersection. The RCUT concept was revised to remove the free flow movement by the following features:

- A stop bar was placed in the southbound right turn lane
- An additional signal head was placed on the mast arm in the southwest corner of Vistana Center Drive
- An additional pedestal with a signal head was placed in the channelized island

Additionally, the Study Team met with the FDOT ROW Office on January 30, 2019 to discuss the ROW impacts in the RCUT concept. A summary of this meeting is provided in **Appendix D**. During the meeting, the proposed corner clip on the northwest corner of the Meadow Creek Drive intersection was discussed. At that location, the ROW impact from the RCUT concept is within the ROW take area proposed by the I-4 Beyond the Ultimate (BtU) project. The corner clip in the RCUT concept is to provide space to install a mast arm serving the northbound left-turn movement. To avoid ROW impacts at the Meadow Creek Drive intersection, the concept was revised with the mast arm in the northwest corner moved to the median on the west leg.

The RCUT Draft Concept dated February 11, 2019 is provided in **Appendix G**.

RCUT DRAFT CONCEPT – MARCH 6, 2019

The RCUT concept was reviewed by members of FDOT Roadway Design and revisions were recommended. The RCUT was revised to reflect recommendations from FDOT Roadway Design.

The path of the proposed sidewalk located east of S.R. 535 at the U-Turn location North of Lake Bryan Beach Boulevard was revised. The previous proposed sidewalk path went around the existing swale. The revised path connects the proposed crossing at the intersection directly to the existing sidewalk across the swale. Drainage considerations were evaluated and determined that crossing the sidewalk over the swale was feasible.

The Study Team was informed that prolonged time of the ROW acquisition phase may result in the RCUT concept not being incorporated into the 3R design scope. To reduce the ROW take area for the project, the bulb-out to accommodate U-Turn movements on the east side of S.R. 535 at the Vistana Drive intersection was removed.

Along the S.R. 535 corridor, the proposed northbound and southbound left-turn stop bars were relocated and through movement stop bars were extended to include the northbound and southbound left-turn lanes. The following left-turn movements along the corridor relocated the stop bars, but did not align with the through movement stop bars:

- The southbound left turn lane at Vistana Drive was relocated towards the south to allow more storage area.
- The northbound left turn lane at the Chick-fil-A Driveway was relocated towards the north to allow more storage area.
- The southbound left turn at the Chick-fil-A Driveway is set back further from the southbound approach stop bar, because aligning the left turn stop bar with the through movement stop bar would put the stop bar in the turning area.

The proposed mast arms serving the northbound and southbound left-turn movements at each intersection were removed. Instead of the mast arms, additional signal heads serving the left turn movements were proposed on the same mast arms serving the northbound and southbound through movements at each intersection.

The proposed mast arms placed in medians to facilitate minor street movements were removed and placed at the corners of the intersections listed below. The new mast arm placement was evaluated based on MUTCD guidelines.

- U-Turn location North of Lake Bryan Beach Boulevard
- Vistana Drive
- Vistana Center Drive
- Meadow Creek Drive
- Chick-fil-A Driveway

The location of the existing strain pole at the northeast corner of the Meadow Creek Drive intersection was identified and included on the concept. The existing strain pole is located in the sidewalk, thus the proposed mast arm on the northeast corner remained in the same location as in the previous RCUT concept draft.

Following the completion of the initial drainage analysis, the existing and proposed drainage structures were revised. Detailed results of the drainage analysis are discussed with the final RCUT concept.

The RCUT Draft Concept dated March 6, 2019 is provided in **Appendix G**.

RCUT DRAFT CONCEPT – MARCH 12, 2019

A meeting with FDOT Traffic Operations was held on March 7, 2019 to discuss the RCUT concept. A summary of this meeting is provided in **Appendix D**. During this meeting, a question was raised if the new U-Turn location between Lake Bryan Beach Boulevard and Vistana Drive was required for the RCUT at Vistana Drive to operate at an acceptable LOS. To answer this question, an AM and PM peak hour operational analysis was completed for removing the U-Turn location and allowing U-Turns at the Vistana Drive intersection.

This revised operational analysis took into consideration the added northbound U-Turns from Lake Bryan Beach Boulevard and converted the signal at the Vistana Drive RCUT from two phases to three phases. The results of this operational analysis showed that these changes do not negatively impact the operations of the RCUT configuration at Vistana Drive. The future condition operates at LOS B or better in both the AM and PM peak hours.

Another point of discussion was the need for the bulb-out serving the southbound U-Turn movement at Vistana Center Drive. Traffic Operations noted it would be acceptable to remove the bulb-out as heavy vehicles on the corridor have alternative routes available to reach I-4 (i.e., south on S.R. 535 to S.R. 536/World Center Drive, then west to I-4).

Based on the discussion with Traffic Operations and the subsequent analysis, the following revisions were made to the RCUT concept:

- The U-Turn location between Lake Bryan Beach Boulevard and Vistana Drive was removed
- The bulb-out serving the southbound U-Turn movement at Vistana Center Drive was removed
- The shading in the concept plans was revised to show only the improvements being proposed by the RCUT concept
 - This included the removal of improvements along the corridor proposed by the S.R. 3R project such as sidewalk additions and a new pedestrian crossing at I-4/Vineland Avenue

The RCUT Draft Concept dated March 12, 2019 is provided in **Appendix G**.

RCUT DRAFT CONCEPT – MARCH 18, 2019

A meeting with FDOT Program Management was held on March 14, 2019 to discuss the RCUT concept. A summary of this meeting is provided in **Appendix D**.

In previous drafts of the RCUT concept, the ROW lines shown were estimated by a combination of the ROW lines shown in the 3R design files and the As-Built plans obtained for the corridor. The ROW boundary on the west leg of the Meadow Creek Drive intersection needed to be reviewed and following the meeting, it was confirmed the west leg of the intersection of S.R. 535 and Meadow Creek Drive was owned by the Reedy Creek Improvement District (RCID). The 3R design team noted that an agreement was reached with RCID to allow curb ramp reconstruction planned within their ROW.

Previous drafts of the RCUT concept also showed a removal of pavement on the east leg of the intersection at Meadow Creek Drive (Lake Vining Drive), which was included to reduce the pedestrian crossing distance at the intersection. A question was asked if the proposed pavement removal outside of the ROW line at the location is required as part of the RCUT configuration. While not required for the RCUT, the removal of pavement was included in the RCUT concept as an ideal improvement, if an agreement with the property owner on Lake Vining Drive can be reached.

Finally, a question was asked during the meeting if the existing span wire at the Meadow Creek Drive intersection can be utilized in the RCUT configuration in lieu of the proposed mast arms. Following the meeting, FDOT Traffic Operations confirmed that a strain pole may be considered at all intersections throughout the corridor as S.R. 535 is not within the mast arm support boundary.

Following the meeting, the Study Team reached out to Orange County and confirmed their desire to install mast arms along the corridor. A Local Partnership Agreement (LPA) will need to be reached between FDOT and Orange County which will require Orange County to pay for the cost difference between a strain pole installation and a signal pole installation.

Following the discussion with FDOT Program Management, the following revisions were made to the RCUT concept:

- The ROW line across Meadow Creek Drive was revised to match the 3R design plans
- A note was added indicating that the curb ramp reconstruction at Meadow Creek Drive is being performed as part of the 3R project outside of the ROW
- The work related to removing excess pavement on the east leg of the Meadow Creek Drive intersection (Lake Vining Drive) was removed and RCUT features tie-in to the existing condition
- A note was added for all the mast arms on the concept that strain poles may be considered as a cost saving measure

The RCUT Draft Concept dated March 18, 2019 is provided in **Appendix G**.

Preferred Concept Layout

The final preferred concept layout was completed on May 20, 2019, following the revision timeline discussed above. The previous draft of the RCUT concept was submitted to FDOT Program Management for review to be implemented in a revised 3R design scope. Comments were provided, available in **Appendix G** and the following revisions were completed to finalize the RCUT concept:

- Elements from the 3R such as sidewalk additions and the new pedestrian crossing at I-4/Vineland Avenue were added back into the concept with a red shading
- The mast arms on the southeast corner of Vistana Center Drive and the Chick-fil-A Driveway were moved further south
- The southeast corner curb return at Vistana Center Drive was redrawn to match the existing condition
- The mast arm on the northwest corner of Meadow Creek Drive was moved to the southwest corner of the intersection, out of RCID ROW, and will be 78-feet long

This section will discuss the final improvements recommended in the preferred concept with plans to be incorporated in the 3R project. Additionally, the final analysis for drainage, ROW estimate, and cost estimate will be discussed.

RCUT CONCEPT FEATURES

As discussed previously, the preferred concept features two main signalized RCUT locations at Vistana Drive and Meadow Creek Drive. The preferred concept layout is illustrated in **Figure 19** to **Figure 22**. Following the preferred concept are the detailed improvements proposed along the S.R. 535 corridor.



SR 535 / KISSIMMEE VINELAND ROAD

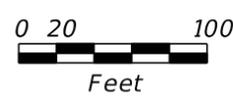
LAKE BRYAN BEACH BOULEVARD

VISTANA PALMS

ROYAL PALMS

BRYAN'S SPANISH COVE

MATCHLINE 1



- EXISTING RIGHT-OF-WAY
- SIDEWALK FRONT
- BACK OF CURB
- NEW SOD
- EXISTING DRAINAGE
- IMPROVEMENT PROPOSED IN SR 535 RESURFACING
- PROPERTY LINE
- SIDEWALK BACK
- NEW OR MODIFIED SIDEWALK/CURB RAMP
- NEW PAVEMENT
- NEW CONCRETE

FOR ILLUSTRATIVE PURPOSES ONLY
 AERIAL PHOTO ACQUIRED 2017
 RIGHT-OF-WAY INFORMATION OBTAINED FROM FM: 439237-1

REVISIONS				STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION			SR 535 CONCEPT DEVELOPMENT RCUT ALTERNATIVE	FIGURE NO. 19
DATE	DESCRIPTION	DATE	DESCRIPTION	ROAD NO.	COUNTY	FINANCIAL PROJECT ID		
01-21-19	REMOVAL OF SIDEWALK WIDENING	03-19-19	REVISIONS FOLLOWING DISCUSSION WITH FDOT PROGRAM MANAGEMENT	SR 535	ORANGE	437175-1-12		
02-11-19	REVISIONS FOLLOWING DISCUSSION WITH FDOT ROW OFFICE	05-20-19	REVISIONS TO ADDRESS COMMENTS FROM FDOT PROGRAM MANAGEMENT					
03-06-19	REVISIONS TO ADDRESS COMMENTS FROM FDOT DESIGN							
03-12-19	REVISIONS FOLLOWING DISCUSSION WITH FDOT TRAFFIC OPERATIONS							

MATCHLINE 1

VISTANA DRIVE

VISTANA SPRINGS

VISTANA CASCADES

STRAIN POLES MAY BE CONSIDERED IN LIEU OF MAST ARMS AS A COST SAVING MEASURE

SR 535 / KISSIMMEE VINELAND ROAD

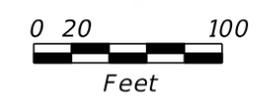
STRAIN POLES MAY BE CONSIDERED IN LIEU OF MAST ARMS AS A COST SAVING MEASURE

BRYAN'S SPANISH COVE

SHELL

DOLLAR TREE

MATCHLINE 2



- EXISTING RIGHT-OF-WAY
- SIDEWALK FRONT
- BACK OF CURB
- NEW SOD
- EXISTING DRAINAGE
- IMPROVEMENT PROPOSED IN SR 535 RESURFACING
- PROPERTY LINE
- SIDEWALK BACK
- NEW OR MODIFIED SIDEWALK/CURB RAMP
- NEW PAVEMENT
- NEW CONCRETE

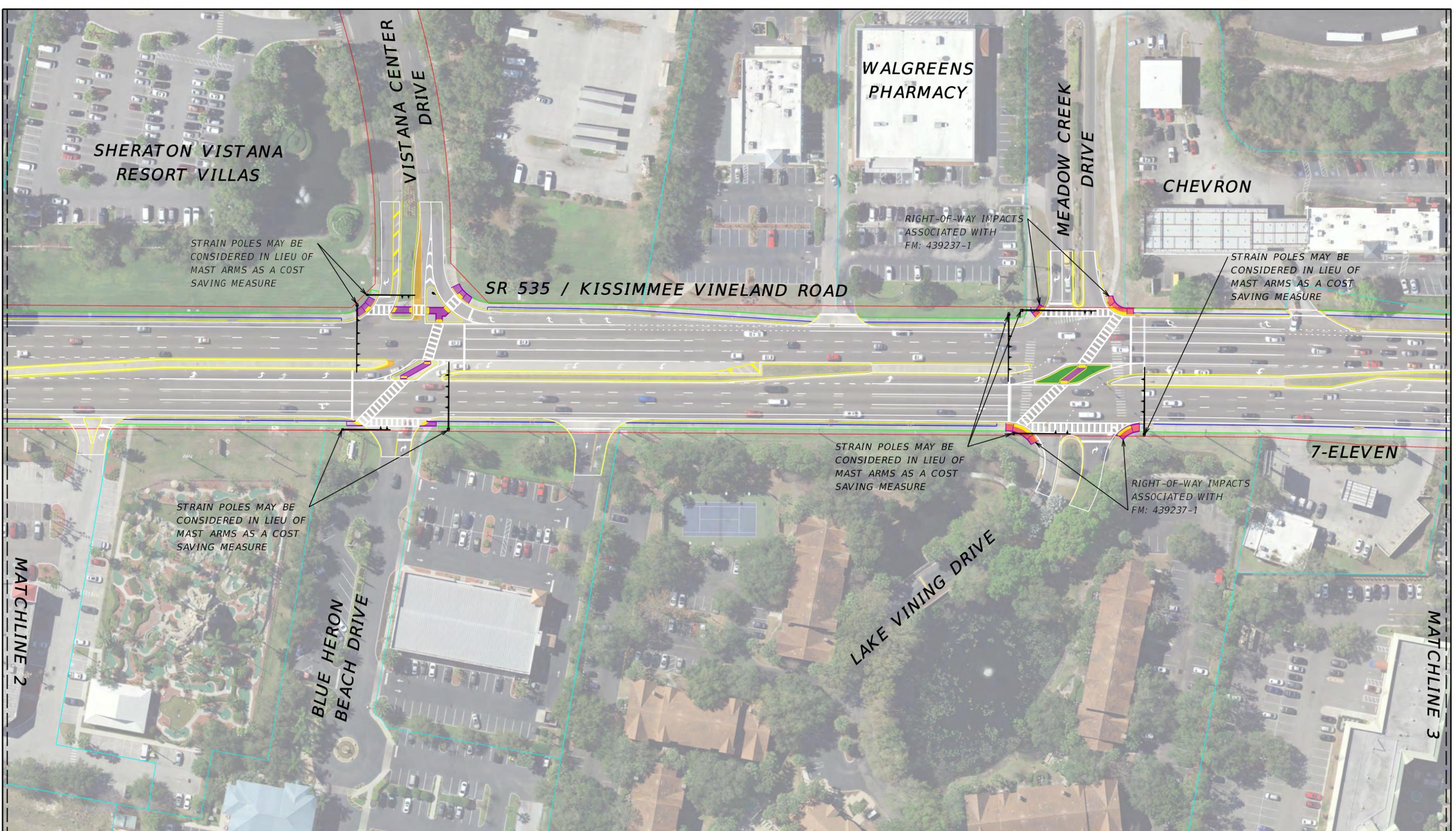
FOR ILLUSTRATIVE PURPOSES ONLY
 AERIAL PHOTO ACQUIRED 2017
 RIGHT-OF-WAY INFORMATION OBTAINED FROM FM: 439237-1

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION
01-21-19	REMOVAL OF SIDEWALK WIDENING	03-19-19	REVISIONS FOLLOWING DISCUSSION WITH FDOT PROGRAM MANAGEMENT
02-11-19	REVISIONS FOLLOWING DISCUSSION WITH FDOT ROW OFFICE	05-20-19	REVISIONS TO ADDRESS COMMENTS FROM FDOT PROGRAM MANAGEMENT
03-06-19	REVISIONS TO ADDRESS COMMENTS FROM FDOT DESIGN		
03-12-19	REVISIONS FOLLOWING DISCUSSION WITH FDOT TRAFFIC OPERATIONS		

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION		
ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 535	ORANGE	437175-1-12

SR 535 CONCEPT DEVELOPMENT
RCUT ALTERNATIVE

FIGURE NO.
20



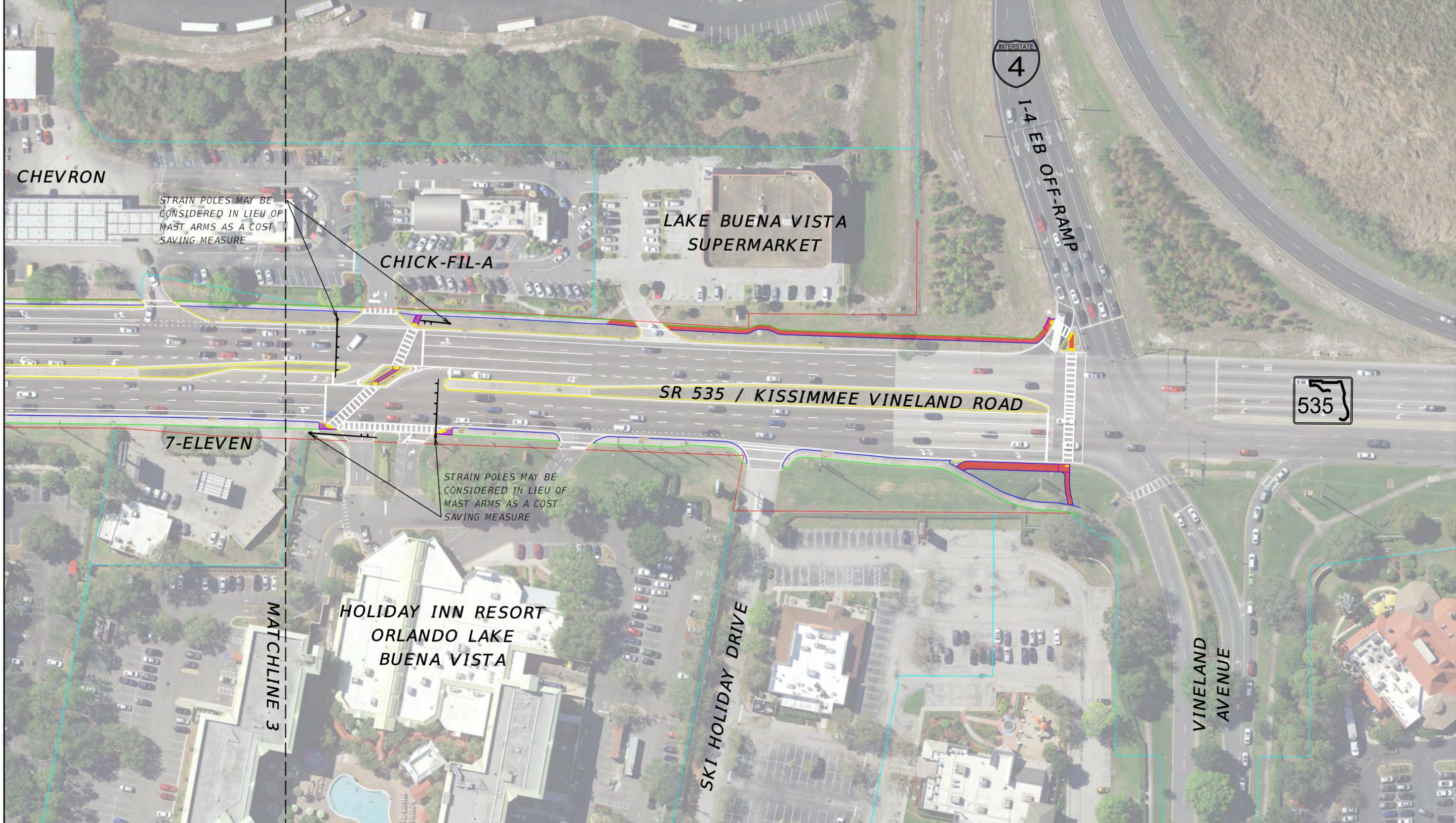
0 20 100
Feet

— EXISTING RIGHT-OF-WAY — SIDEWALK FRONT — BACK OF CURB ■ NEW SOD ■ EXISTING DRAINAGE ■ IMPROVEMENT PROPOSED IN SR 535 RESURFACING

— PROPERTY LINE — SIDEWALK BACK ■ NEW OR MODIFIED SIDEWALK/CURB RAMP ■ NEW PAVEMENT ■ NEW CONCRETE

FOR ILLUSTRATIVE PURPOSES ONLY
AERIAL PHOTO ACQUIRED 2017
RIGHT-OF-WAY INFORMATION OBTAINED FROM FM: 439237-1

REVISIONS				STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION			SR 535 CONCEPT DEVELOPMENT RCUT ALTERNATIVE	FIGURE NO. 21
DATE	DESCRIPTION	DATE	DESCRIPTION	ROAD NO.	COUNTY	FINANCIAL PROJECT ID		
01-21-19	REMOVAL OF SIDEWALK WIDENING	03-19-19	REVISIONS FOLLOWING DISCUSSION WITH FDOT PROGRAM MANAGEMENT	SR 535	ORANGE	437175-1-12		
02-11-19	REVISIONS FOLLOWING DISCUSSION WITH FDOT ROW OFFICE	05-20-19	REVISIONS TO ADDRESS COMMENTS FROM FDOT PROGRAM MANAGEMENT					
03-06-19	REVISIONS TO ADDRESS COMMENTS FROM FDOT DESIGN							
03-12-19	REVISIONS FOLLOWING DISCUSSION WITH FDOT TRAFFIC OPERATIONS							





0 20 100
Feet

— EXISTING RIGHT-OF-WAY — SIDEWALK FRONT — BACK OF CURB ■ NEW SOD ■ EXISTING DRAINAGE ■ IMPROVEMENT PROPOSED IN SR 535 RESURFACING

— PROPERTY LINE — SIDEWALK BACK ■ NEW OR MODIFIED SIDEWALK/CURB RAMP ■ NEW PAVEMENT ■ NEW CONCRETE

FOR ILLUSTRATIVE PURPOSES ONLY

AERIAL PHOTO ACQUIRED 2017

RIGHT-OF-WAY INFORMATION OBTAINED FROM FM: 439237-1

REVISIONS				STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION			SR 535 Concept Development RCUT ALTERNATIVE	FIGURE NO.
DATE	DESCRIPTION	DATE	DESCRIPTION	ROAD NO.	COUNTY	FINANCIAL PROJECT ID		22
01-21-19	REMOVAL OF SIDEWALK WIDENING	03-19-19	REVISIONS FOLLOWING DISCUSSION WITH FDOT PROGRAM MANAGEMENT	SR 535	ORANGE	437175-1-12		
02-11-19	REVISIONS FOLLOWING DISCUSSION WITH FDOT ROW OFFICE	05-20-19	REVISIONS TO ADDRESS COMMENTS FROM FDOT PROGRAM MANAGEMENT					
03-06-19	REVISIONS TO ADDRESS COMMENTS FROM FDOT DESIGN							
03-12-19	REVISIONS FOLLOWING DISCUSSION WITH FDOT TRAFFIC OPERATIONS							

South of Vistana Drive

- New sidewalk on the west side of S.R. 535, as proposed in the 3R, was incorporated.

Vistana Drive

- Median modifications:
 - New concrete directional median to be added at the center of the intersection.
 - South leg median nose extended to restrict northbound U-turns.
- New east-west pedestrian crossing with median pedestrian refuges to be added.
- Curb ramp modifications in the northwest and southwest corners of the intersection. New curb ramp to be added on the east side of S.R. 535.
- Three signal poles are to be added in the southeast, southwest, and northeast corners of the intersection.

Vistana Center Drive

- Pavement modifications:
 - West Leg – New pavement added for the westbound receiving lane.
 - South Leg – New pavement added for the northbound left-turn lane.
- Median modifications:
 - Existing concrete directional median in the middle of the intersection to be extended north/south to accommodate new sidewalk.
 - South leg median nose reduced.
 - New concrete southbound right-turn channelized island to be added in the NW corner of the intersection.
- New east-west pedestrian crossing with median pedestrian refuges to be added.
- Curb ramp modifications on the four corners of the intersection.
- Five signal poles are to be added in the southeast, southwest (two poles), northwest, and northeast corners of the intersection.

Meadow Creek Drive

- Pavement modifications:
 - West Leg – Lane configuration will change from a single left-turn lane and a single right-turn lane to dual right-turns. Pavement markings will need to be updated.
 - East Leg – Lane configuration will change from a single left-turn lane and a single shared thru/right-turn lane to just a single right-turn lane.
- Median modifications:
 - New grass directional median to be added at the center of the intersection.
 - North and south leg median noses extended to restrict northbound/southbound U-turns.
- New east-west pedestrian crossing with median pedestrian refuges to be added.

- Curb ramp modifications on the southeast, southwest, northwest, and northeast corners of the intersection, proposed in the 3R, will be incorporated.
- Four signal poles are to be added on the southeast, southwest, northwest, and northeast corners of the intersection.

Chick-fil-A/Holiday Inn Intersection

- New east-west pedestrian crossing with median pedestrian refuges to be added.
- New sidewalk connecting to the east-west crossing will be added on the northwest corner of the intersection.
- Curb ramp modifications on the northwest, southeast, and northeast corners of the intersection.
- Four signal poles are to be added on the southeast, southwest, northwest, and northeast corners of the intersection.

I-4/Vineland Avenue

The following were incorporated from the proposed 3R design.

- New sidewalk on the both sides of S.R. 535;
 - On the west side of the road from the end of the existing sidewalk (approximately 225 feet north of the Chick-fil-A/Holiday Inn intersection) to the southwest corner of the I-4/Vineland Avenue intersection;
 - In the southeast corner of the I-4/Vineland Avenue intersection; and
- New east-west pedestrian crossing on the south leg of the intersection.

DRAINAGE ANALYSIS

A drainage analysis was conducted to determine if existing drainage structures along the corridor have sufficient capacity to support the impervious area added by the proposed RCUT improvements. Associated structures and pipe sizes were obtained through the 3R drainage design files, existing drainage calculation reports and As-Built plans. This information was used to conduct the drainage analysis.

Existing structures and their associated basins were analyzed for capacity sufficiency using the rational method and Manning's Equation. The coefficient of runoff (C) was recalculated for each basin to include the increased impervious areas.

The subsequent drainage calculations indicated that the accumulated flow within S.R. 535 drainage basins will be supported by the existing drainage structures and further structures or pipes do not need to be added or increased in size.

A detailed summary of the drainage calculations as well as the basis/drainage structures in the As-Built plans are provided in **Appendix H**.

ROW ESTIMATES

To advance implementation by incorporating into the 3R design scope, ROW impacts were avoided by maintaining existing features along the corridor (i.e. medians, pavement, sidewalk) as much as possible. As a result, no ROW impacts are anticipated as part of the preferred concept layout.

COST ESTIMATES

As part of the coordination to implement the preferred concept elements into the 3R design scope, a long range estimate (LRE) was completed. The 3R design is working on revising the LRE estimate. **Table 5** displays the LRE cost estimates for the RCUT improvements at the intersections at Vistana Drive and Meadow Creek Drive. The LRE cost estimates for each intersection includes the upstream/downstream U-Turn locations associated with both RCUT improvements. Detailed LRE summary sheets are provided in **Appendix I**.

Table 5: RCUT Improvements LRE Cost Estimate

Intersection Along S.R. 535	Long Range Estimate Cost
S.R. 535 and Vistana Drive	\$1,487,338.23
S.R. 535 and Meadow Creek Drive	\$2,084,258.02

The 3R design team is revising the LRE estimate as they finalize the scope of the project.

Project Visioning Team (PVT)

A PVT comprised of regional agency and municipal representatives was established during the Corridor Planning Study to help guide the planning process. The PVT acted as the initial sounding board for the Study Team as it shared findings and developed alternative strategies for the corridor. The same PVT group was established in the Concept Development Study to maintain consistency. The PVT is comprised of members from the following partner organizations:

- LYNX;
- MetroPlan Orlando;
- Orange County Planning and Traffic Engineering; and
- Osceola County Planning and Traffic Engineering.

A meeting was held with the PVT group on June 12, 2019 to discuss the results of the Concept Development Study and the S.R. 535 Preferred RCUT Concept. The presentation and meeting notes from the PVT meetings can be found in **Appendix J**.

Next Steps/Summary

The design scope for the scheduled 3R project (FM #439237-1) was revised to include the following elements from this Concept Development Study:

- Two signalized RCUT locations at Vistana Drive and Meadow Creek Drive
 - Including signalized U-Turn locations at Vistana Center Drive and the Chick-fil-A driveway
- Pedestrian crossings with median refuge added at RCUT locations

The revised design scope also includes the placement of a directional median at the Lake Bryan Beach Boulevard intersection, as proposed by FDOT Traffic Operations in a separate study. The letting date for the 3R was updated and is now September 2020 (Fiscal Year 2021) as per the date of this report.

Additional improvements were evaluated as part of this Concept Development Study but were not included in the revised 3R design scope. The improvements are listed below:

- Widening of existing sidewalks to eight-feet wide
- TSM&O short- and long-term strategies

These improvements may be implemented on the S.R. 535 study corridor as future projects either by FDOT or by the local jurisdictions.

APPENDIX A – DATA COLLECTION MATRIX

APPENDIX B – FIELD REVIEW SUMMARY

APPENDIX C – SAFETY ASSESSMENT SUPPORTING DOCUMENTATION

APPENDIX D – MEETING SUMMARIES

AUGUST 30, 2018 – RESURFACING COORDINATION MEETING

AUGUST 30, 2018 – TSM&O MEETING

SEPTEMBER 19, 2018 – RCUT DISCUSSION WITH FDOT DESIGN

OCTOBER 2, 2018 – MEETING WITH FDOT TRAFFIC OPERATIONS

OCTOBER 18, 2018 – INTERNAL NEXT STEPS MEETING

JANUARY 30, 2019 – KICKOFF MEETING WITH FDOT ROW OFFICE

FEBRUARY 18, 2019 – INTERNAL CHECK-IN MEETING

MARCH 7, 2019 – 2ND MEETING WITH FDOT TRAFFIC OPERATIONS

MARCH 14, 2019 – MEETING WITH FDOT PROGRAM MANAGEMENT

APPENDIX E – AUTOTURN ANALYSIS PLAN SHEETS

APPENDIX F – ICE FORMS

APPENDIX G – RCUT DRAFT CONCEPTS

DRAFT SUBMITTED DECEMBER 4, 2018

DRAFT SUBMITTED JANUARY 21, 2019

DRAFT SUBMITTED FEBRUARY 11, 2019

COMMENTS RECEIVED FROM FDOT DESIGN

COMMENT RESPONSES

DRAFT SUBMITTED MARCH 6, 2019

DRAFT SUBMITTED MARCH 12, 2019

DRAFT SUBMITTED MARCH 18, 2019

COMMENTS RECEIVED FROM FDOT PROGRAM MANAGEMENT

COMMENT RESPONSES

APPENDIX H – DRAINAGE ANALYSIS SUPPORTING DOCUMENTATION

APPENDIX I – RCUT LONG RANGE ESTIMATES

APPENDIX J – PVT MEETING SUPPORTING DOCUMENTATION