

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