

Executive Summary.

The Florida Department of Transportation (FDOT) District One (Requestor) is preparing an Interchange Operational Analysis Report (IOAR) to document the traffic operational and highway safety benefits of transforming the traditional diamond interchange into a Diverging Diamond Interchange (DDI) at I-75 (SR 93) at Pine Ridge Road (CR 896) in Collier County, Florida. The proposed modifications are required to alleviate future traffic operational and safety concerns for the interchange of I-75 (SR 93) at Pine Ridge Road (CR 896).

Methodology

A Methodology Letter of Understanding (MLOU) was prepared to describe the methodology for the analysis and evaluation of this IOAR. The MLOU is approved by the FDOT District Interchange Review Coordinator (IRC). The traffic projections in the IOAR were developed using existing field traffic counts and the model outputs from the District 1 Regional Planning Model v.1.0.3 (D1RPM). The D1RPM model is calibrated to base year 2010 conditions and includes a future year scenario for 2040. The analysis years for this study include Existing Year 2019, Opening Year 2025, and Design Year 2040. The operational analysis for this study was performed using the Highway Capacity Software (HCS) version 7 and Vissim version 2020 (service pack 10).

Existing Conditions

The existing conditions simulation models for the study area were developed using Vissim, a widely used, behavior-based multi-purpose traffic microsimulation program. Vissim tracks individual vehicle movements and interactions with more detail than typical Highway Capacity Manual (HCM) methods and quantifies the performance of individual movements and overall delays, LOS and queue lengths for freeways, ramps, and intersections. Existing intersection operational analysis indicates that the I-75 (SR 93) ramp terminals and adjacent intersections at Pine Ridge Road (CR 896) currently meet the Level of Service (LOS) target D. None of the observed queue lengths at these intersections exceed the given storage lengths. Based on the existing freeway merge and diverge analysis, each of the freeway merge and diverge segments are operating at LOS target D or better. A five-year period crash data analysis resulted in 93 crashes within the ramp merge/diverge area. Of these crashes, there were two fatalities from 2013 to 2017 and five severe injury crashes within the study area over the observed period. The crash analysis indicated that 'hit-fixed object' and 'read-end' crashes are the most prominent crash types within the study area.

Future Conditions

Operational analyses were performed for two alternatives: the No-Build and Build Alternative. The No-Build Alternative will serve as a baseline for comparison against the Build Alternative. No-Build 2040 operational analysis indicates that I-75 southbound north of Pine Ridge Road (basic freeway segment and off-ramp) in the AM peak hour and I-75 northbound north of Pine Ridge Road (basic freeway segment and on-ramp) in the PM peak hour are operating at LOS F. Both locations are operating over-capacity, which indicates the need for additional lanes on I-75 and two-lane on- and off-ramps north of Pine Ridge Road. I-75 southbound south of Pine Ridge Road (basic freeway segment) is operating at LOS E in the AM peak, as is I-75 northbound south of Pine Ridge Road (basic freeway and off-ramp) in the PM peak hour. The proposed DDI is considered an Interim improvement and any mainline improvements will be considered as part of the larger I-75 master planning effort.

The results of No-Build 2040 intersection analysis indicate the following intersections will operate at LOS E or F in the Design Year (2040):

- Pine Ridge Road and Livingston Road intersection
- Pine Ridge Road and Whippoorwill Lane intersection
- Pine Ridge Road and I-75 SB Ramps

The results of the No-Build 2040 intersection analysis indicate that the maximum queue lengths for several movements at the study intersections are expected to exceed the storage length in the Design Year (2040). Based on the 2040 queue analysis, the I-75 southbound off-ramp queues are expected to spillback onto the southbound I-75 mainline. However, the queues on the northbound off-ramp are not expected to spillback onto the I-75 mainline. Overall, the operational conditions are expected to worsen by the Design Year (2040) under the No-Build Alternative.

In order to accommodate the future travel demand while enhancing safety within the interchange area, one Build Alternative was developed. The build alternative proposes the conversion of the existing diamond interchange configuration to a Diverging Diamond Interchange (DDI). The DDI concept retains the same two traffic signals, but they no longer require left turning vehicles to cross opposing streams of traffic. These signals also ensure the safe merging of I-75 ramp traffic to Pine Ridge Road. As the two main traffic signals no longer need the left-turn phases to accommodate the ramp traffic, it allows for the signals to be operated with only two phases creating a substantial improvement in the throughput and operational efficiency.

Compared to the No-Build Alternative, the Build Alternative is projected to provide better operating conditions. Under the Build Alternative, each of the study intersections at Pine Ridge Road will operate at LOS target D or better during the Design Year (2040). The queue lengths are not expected to spillback into the I-75 mainline from the off-ramp segments. The advantages and disadvantages to the DDI concept are summarized in **Table E 1**.

Table E 1: Diverging Diamond Interchange – Advantages and Disadvantages

Advantages	Disadvantages
Eliminates left-turn phases from the signalized intersection	Unusual traffic pattern may be confusing to some drivers and visitors
Reduces through movement delay	
Increases throughput	
Reduces travel time	
Improves safety by reducing conflict points	
Accommodates bicycle and pedestrian movements	
Eliminates the need for additional right-of-way	

Compliance with FHWA General Requirements

The Federal Highway Administration (FHWA) Interchange Access Policy was checked to assure that the adequate level of service is provided in terms of safety and mobility. The FHWA's Policy on Access to the Interstate System provides the requirements for the justification and documentation necessary to substantiate any proposed changes in access to the Interstate System. This policy also facilitates decision-making regarding proposed changes in access to the Interstate System in a manner that considers and is consistent with the vision, goals, and long-range transportation plans of a

metropolitan area, region, and State. All new or modified points of access must be approved by FHWA and developed in accordance with federal laws and regulations (as specified in 23 U.S.C. 109 and 111, 23 C.F.R. 625.4, and 49 C.F.R. 1.48(b)(1)). The following documents the adherence of the proposed I-75 at Pine Ridge Road improvements to FHWA's two Policy Points:

FHWA Policy Points 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)).

An operational and safety analysis was conducted to evaluate the future alternatives. The measure of effectiveness, including vehicle delays for the intersections at I-75 and Pine Ridge Road Interchange, Pine Ridge Road at Livingston Road, Pine Ridge Road at Whippoorwill Lane, Pine Ridge Road at Napa Boulevard, and Pine Ridge Road at Vineyards Boulevard, were compared between the No-Build and Build Alternatives.

Under the No-Build Alternative, most of the study intersections will operate at LOS E or worse during both the AM and PM peak hours, with the exceptions of Pine Ridge Road at I-75 NB Ramps, Pine Ridge Road at Napa Boulevard and Pine Ridge Road at Vineyards Boulevard. The 2040 No-Build queue analysis indicates that queues on southbound off-ramp could adversely affect the flow of traffic along I-75.

Under the Build Alternative, each of the I-75 ramp terminals and adjacent intersections at Pine Ridge Road will operate a LOS target D or better in the Opening (2025) and Design (2040) Years. Compared to the No-Build Alternative, the congestion and delay at the I-75 ramp terminals and adjacent intersections at Pine Ridge Road will be significantly improved under the Build Alternative during both the AM and PM peak hours in the Design Year (2040). These improvements will also aid in mitigating of the queuing issue present under the No-Build Alternative.

Although the safety analysis did not suggest that any locations had a higher crash rate than the statewide average with a high confidence level, the proposed improvements under the 2040 Build Alternative are expected to reduce crash frequency at five locations within the study area, providing a combined crash frequency reduction of 21.4 percent at these locations compared to not implementing any improvements. Furthermore, it is expected that these improvements will decrease the congested

condition along Pine Ridge Road within the interchange influence area, which will also improve the safety condition in the Design Year (2040).

In conclusion, the recommended improvements will provide better traffic operations to reduce congestion and enhance the safety of the interchange and nearby intersections.

FHWA Policy Points 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 proposed Build Alternative will provide full access to all of the traffic movements on Pine Ridge Road to and from I-75. The design will meet current standards for the projects on the interstate system and comply with the American Association of State Highway and Transportation Officials (AASHTO) and FDOT design standards.