Hollywood, FL

June 13-14, 2024

2024 TRANSPORTATION SYMPOSIUM

I-95 at Glades Road Diverging Diamond Interchange (DDI)

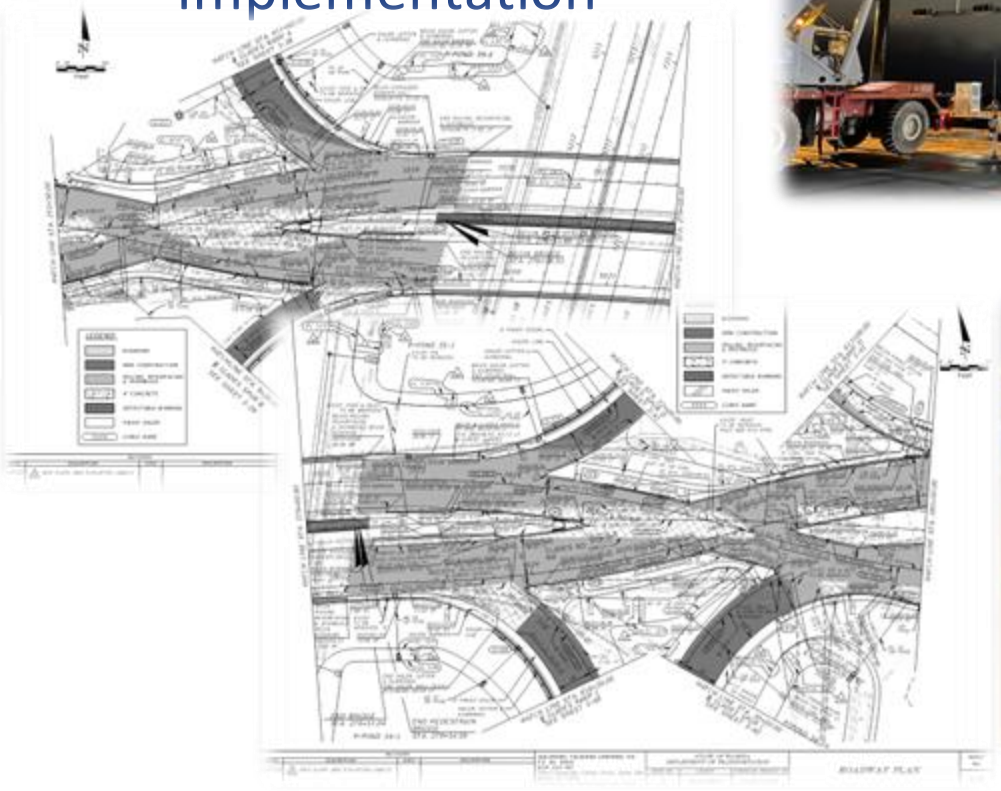
Vanita Saini, PE - Daniel Smith, PMP - Yamila Hernandez, PE

FDOT District IV and WSP USA Inc.

FDOT

Objectives

- **Best Practices and Lessons Learned**
  - Design
  - Construction
  - Implementation



TRANSPORTATION SYMPOSIUM

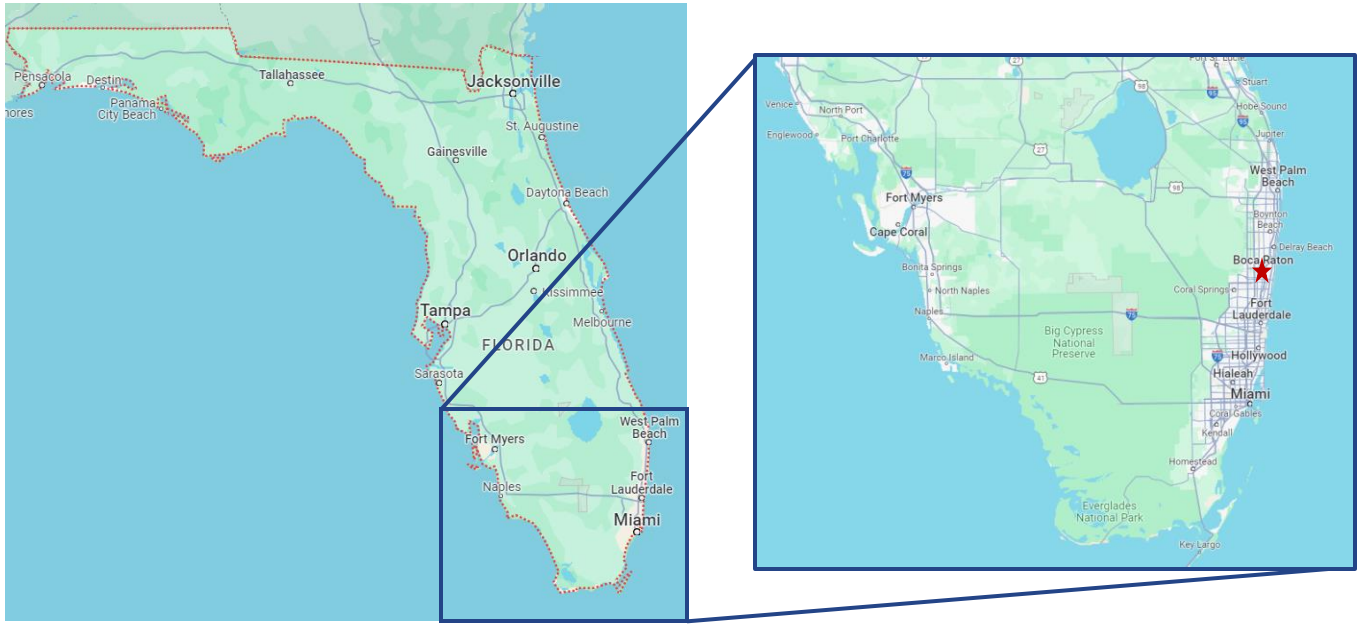
About the Project

PROJECT LOCATION:

SR 9/I-95 at Glades Road interchange, Palm Beach County, Florida (City of Boca Raton)

SCOPE:

- Interchange reconfiguration and roadway improvements along Glades Road from Butts Road to West University Drive



TRANSPORTATION SYMPOSIUM

Project Purpose and Need

- Reconfigure Glades Road Interchange to improve traffic operations, reduce congestion, and increase safety
- Implement interchange design to address traffic spillback onto I-95
- Alleviate existing and future traffic congestion thereby improving safety at the interchange

Table 4.5: 2020 & 2040 No-Build – Intersection Analysis Results

Intersection	Control Type	Opening Year 2020		Design Year 2040	
		AM Delay (s) / LOS	PM Delay (s) / LOS	AM Delay (s) / LOS	PM Delay (s) / LOS
Glades Road (SR 808) at Butts Road	Signalized(1)	41.5 / D	112.3 / F	49.1 / D	127.7 / F
Glades Road (SR 808) at NW 22nd Way	Signalized(1)	20.2 / C	63.9 / E	38.2 / D	116.6 / F
Glades Road (SR 808) at I-95 SB Ramp	Signalized(1)	39.4 / D	47.4 / D	89.9 / F	140.8 / F
Glades Road (SR 808) at I-95 NB Ramp	Signalized(1)	57.8 / E	30.9 / C	87.8 / F	46.8 / D
Glades Road (SR 808) at Airport Road	Signalized(1)	59.4 / E	72.4 / E	92.5 / F	105.2 / F
Glades Road (SR 808) at W University Drive	Signalized(1)	63.7 / E	61.0 / E	77.0 / E	78.8 / E
Glades Road (SR 808) at E University Drive	Signalized(1)	49.9 / D	47.7 / D	58.6 / E	51.0 / D

(1) Delay and LOS reported from Synchro-HCM 2010

Table 4.6: 2020 & 2040 No-Build – Off-Ramp Signals Queuing Analysis Results

Intersection	Approach	Movement	Available Storage (ft)	Queue (ft)	
				Opening Year 2020 AM (PM)	Design Year 2040 AM (PM)
Glades Road at I-95 SB Off-Ramps	Southbound	L (EB)	1,765	2,800 (880)	4,205 (1,155)
		R (WB)	1,825	1,230 (2,185)	3,420 (4,930)
Glades Road at I-95 NB Off-Ramps	Northbound	L (WB)	1,325	830 (895)	1,080 (1,105)
		R (EB)	1,325	3,450 (2,115)	4,620 (2,905)

Note: Queue lengths exceeding available storage are shown in RED.

Source: 2018 I-95 at Glades Road approved IMR

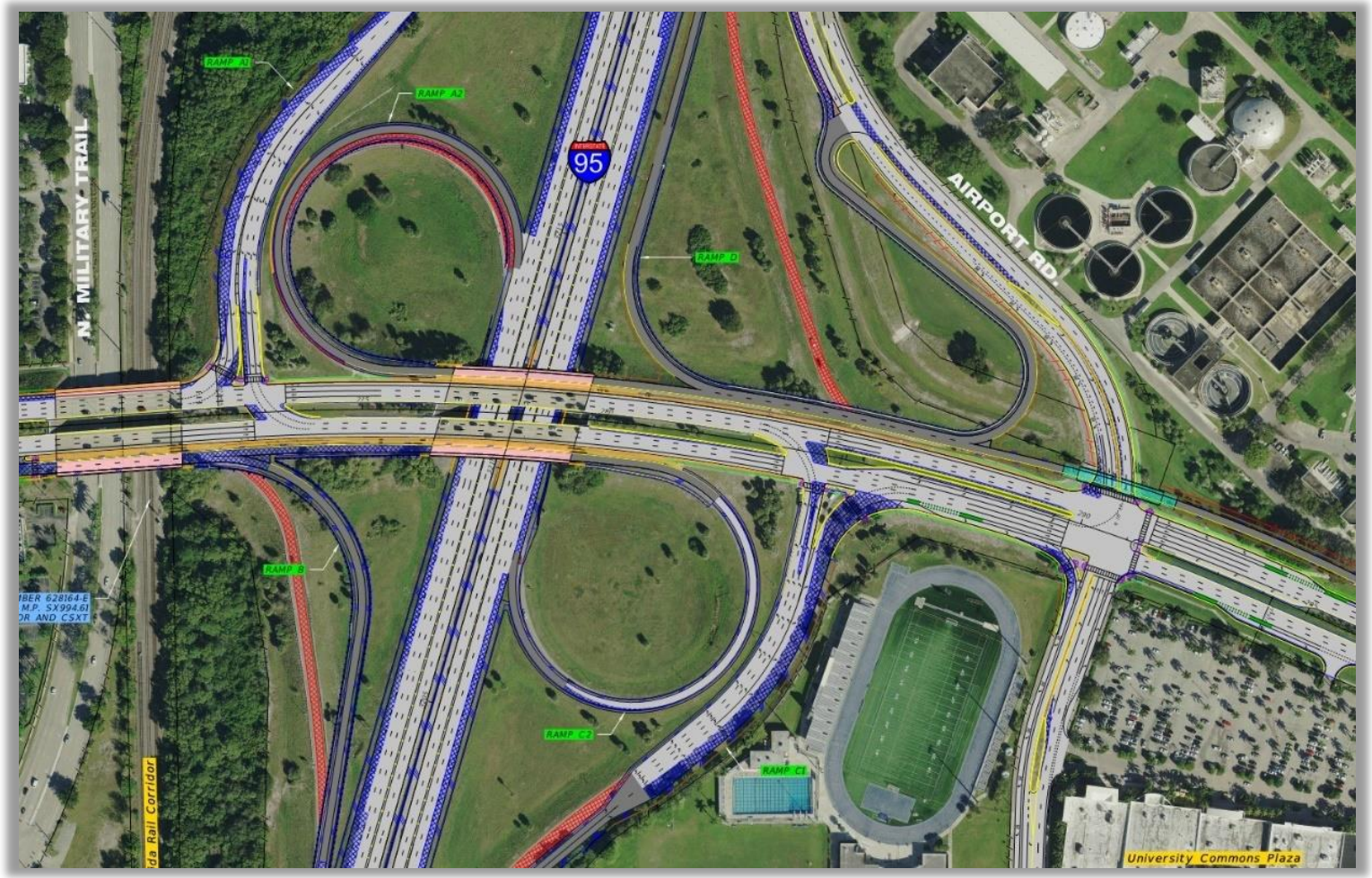
TRANSPORTATION SYMPOSIUM

Project Background

- I-95 PD&E Study from south of Glades Road to north of Yamato Road. Location Design and Concept Acceptance (LDCA) in 2006
- I-95 PD&E Study from south of Glades Road to south of Linton Blvd. Location Design and Concept Acceptance (LDCA) in 2010
- I-95 at Glades Road (SR 808) Interchange Modification Report (IMR) Approval in 2018
- I-95 at Glades Road (SR 808) Interchange Reevaluation Concurrence in 2021

Glades Interchange Concept

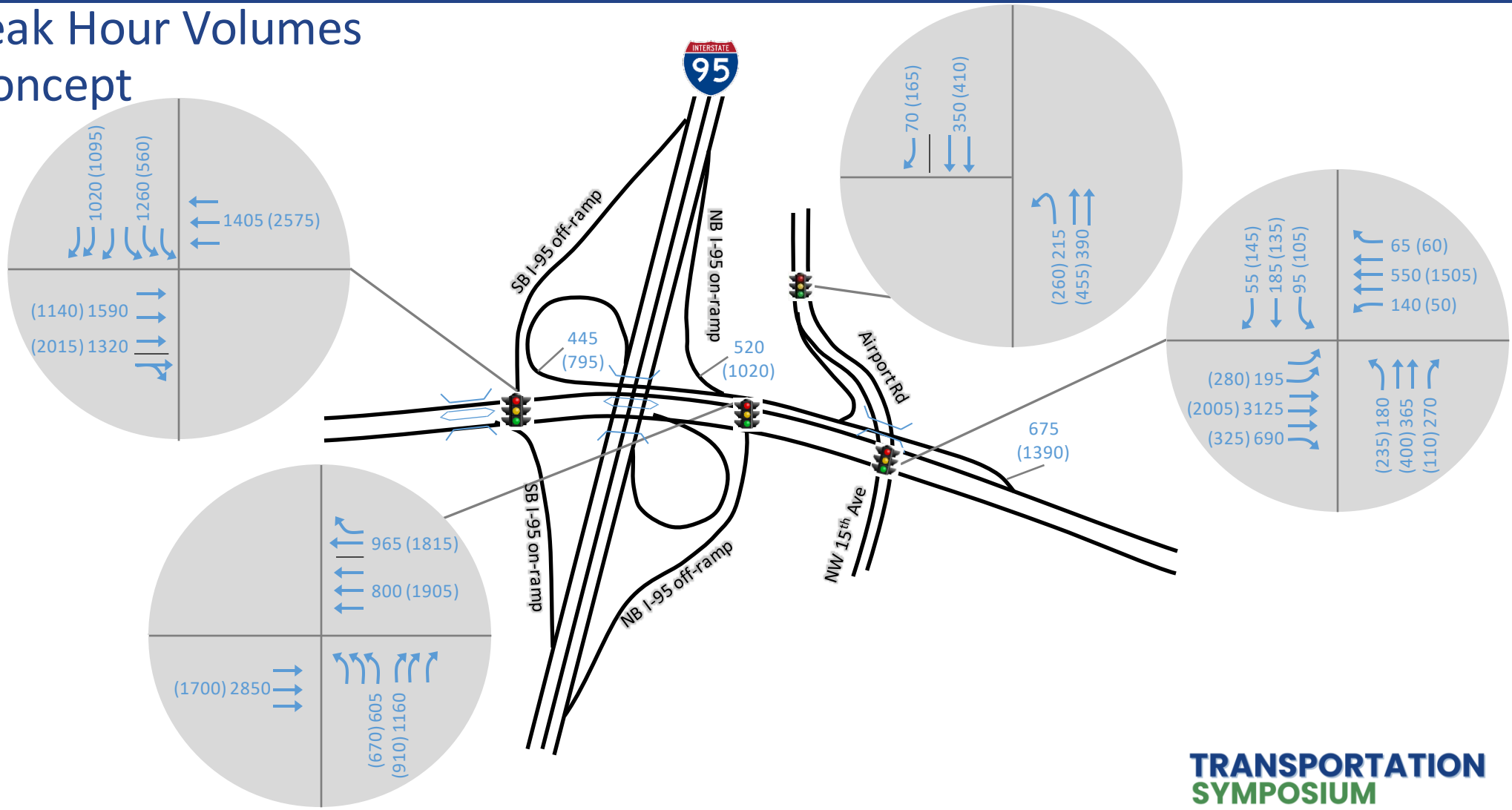
- Single-point entrances added to address weaving and to pull Interstate commuters from the arterial onto C-D roads.
- Additional lane(s) proposed at I-95 exit ramps.
- Grade-separated flyover bridge allowing I-95 commuters to bypass the Glades Road / NW 15th Avenue / Airport Road Intersection. I-95 commuters traveling NB along NW 15th Avenue would be required to cross Glades Road and enter the Interstate via a left-turn entrance at a new signalized intersection located along Airport Road.



TRANSPORTATION SYMPOSIUM

Glades Interchange Concept

Projected 2040 Peak Hour Volumes for Interchange Concept



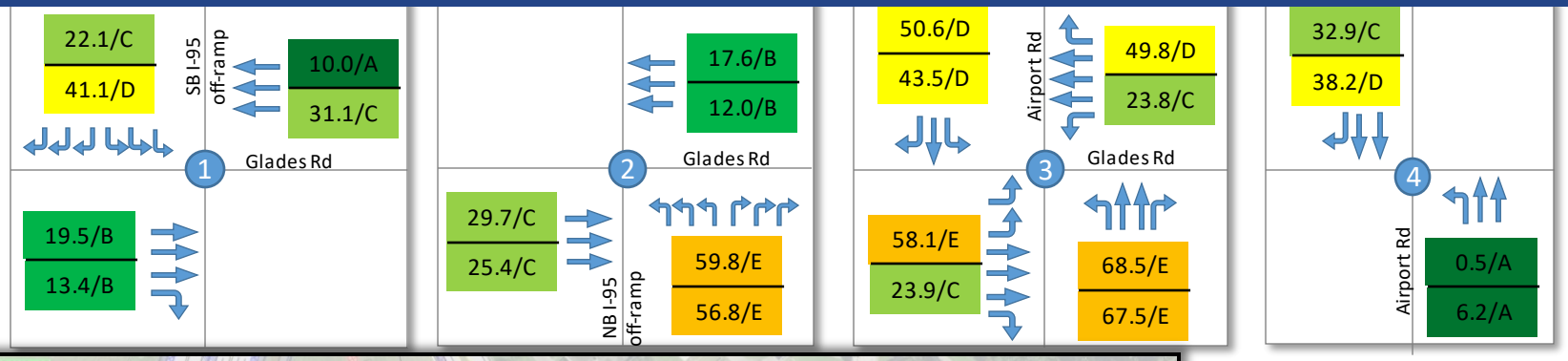
TRANSPORTATION SYMPOSIUM

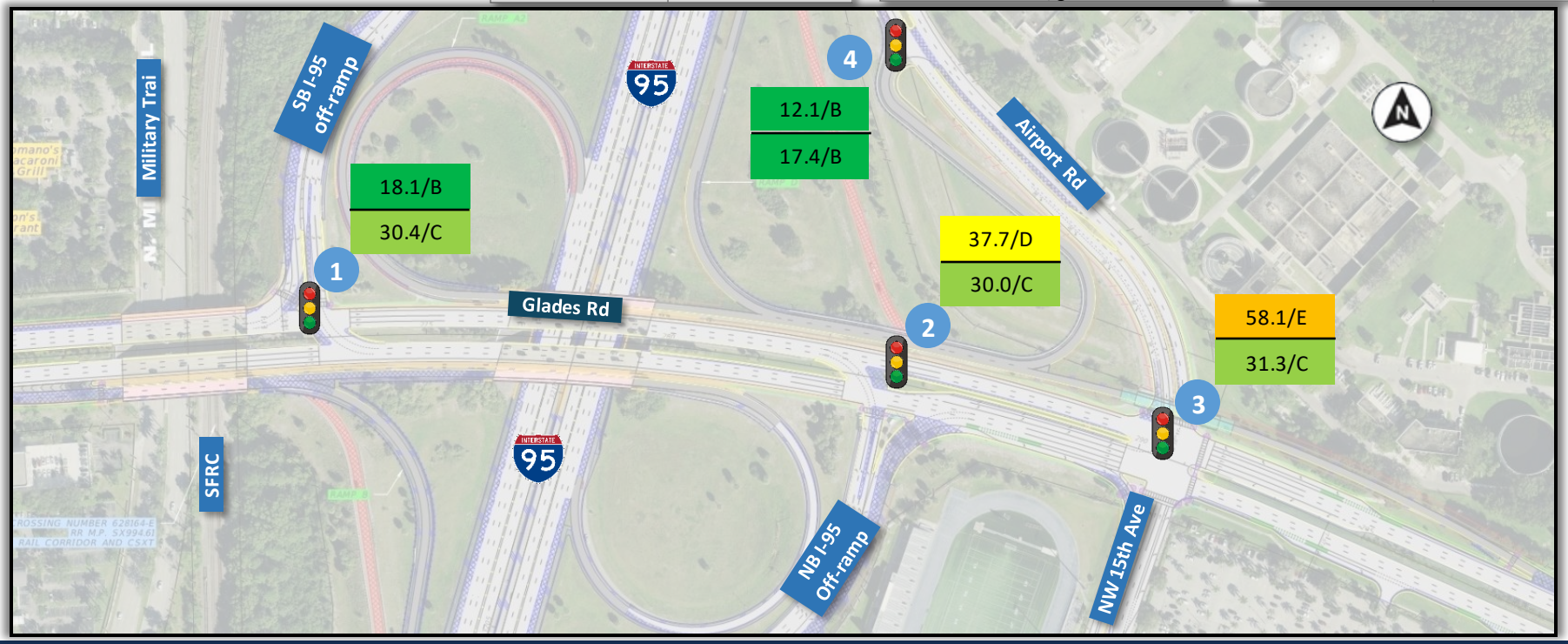
Glades Interchange Concept

Interchange Concept (2040)

(Lane configuration, Delay and LOS)

Level Of Service	AM Delay / LOS
A B C D E F	PM Delay / LOS





TRANSPORTATION SYMPOSIUM

Alternative Technical Concept Design Change

Description:

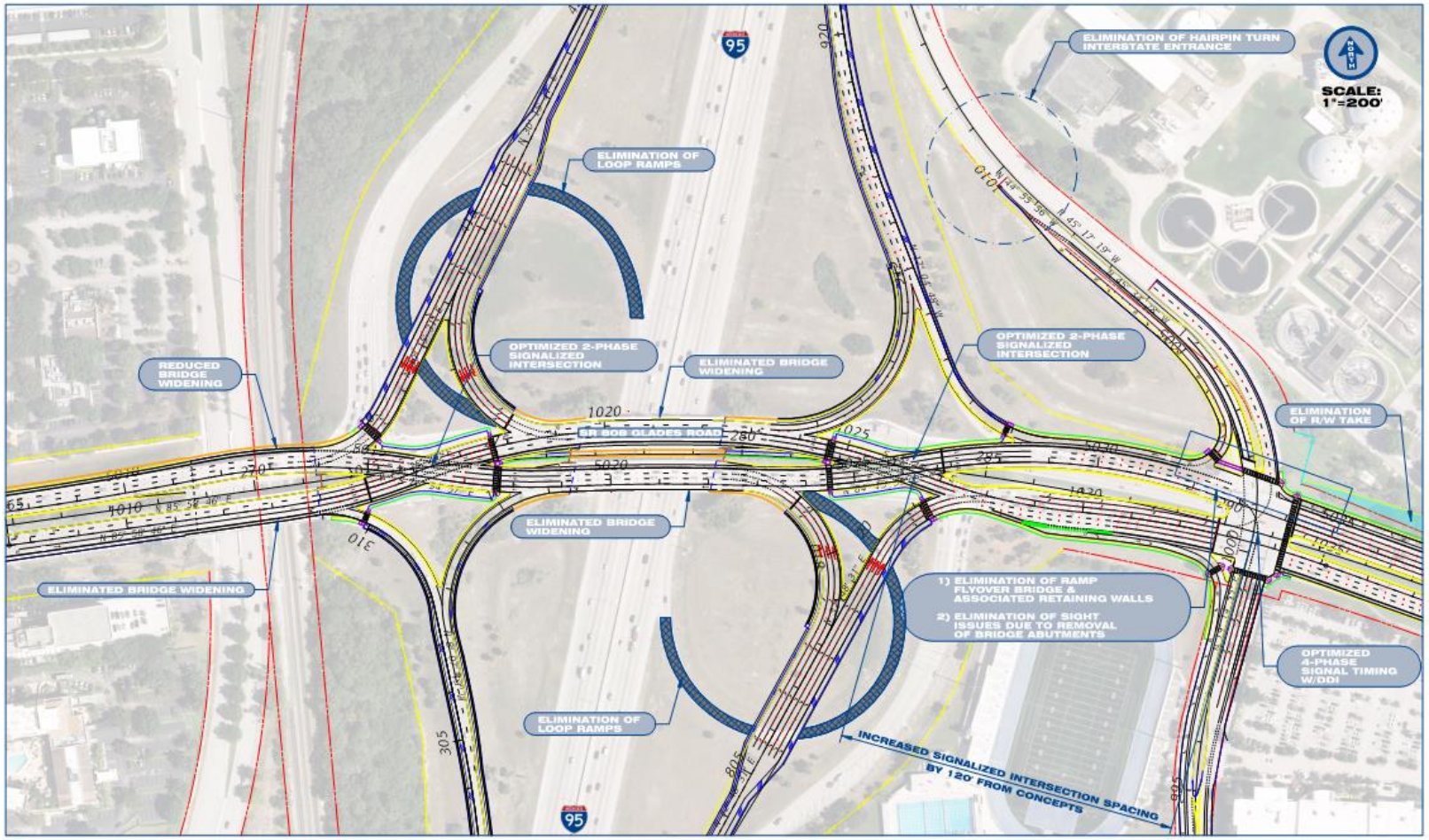
Proposed Alternative Technical Concept (ATC) changed the I-95 (SR 9)/Glades Road interchange from a modified existing partial cloverleaf (ParClo) interchange, as identified in the SR 9 (I-95) Interchange Modification Report (IMR) for Glades Road (SR 808) Interchange for the 2040 recommended build alternative, to a DDI.

Benefits:

- Reduced impacts to existing infrastructure
  - Eliminated ramp flyover bridge over Airport Road
  - Eliminated bridge widening for Glades Road EB & WB bridges over I-95 and EB bridge over Military Trail / SFRC
  - Reduced bride widening for Glades Road WB bridge over Military Trail / SFRC
  - Eliminated 0.38 Acres of R/W acquisition from the Boca Raton Water Treatment Plant Property
  - Enhanced safety and fewer crashes due to reduction of conflict points. Proposed DDI 14 Conflict Points vs. FDOT Concept Modified ParClo Design 18 Conflict Points.
  - Optimized 2-phase signal operations at intersections within the interchange

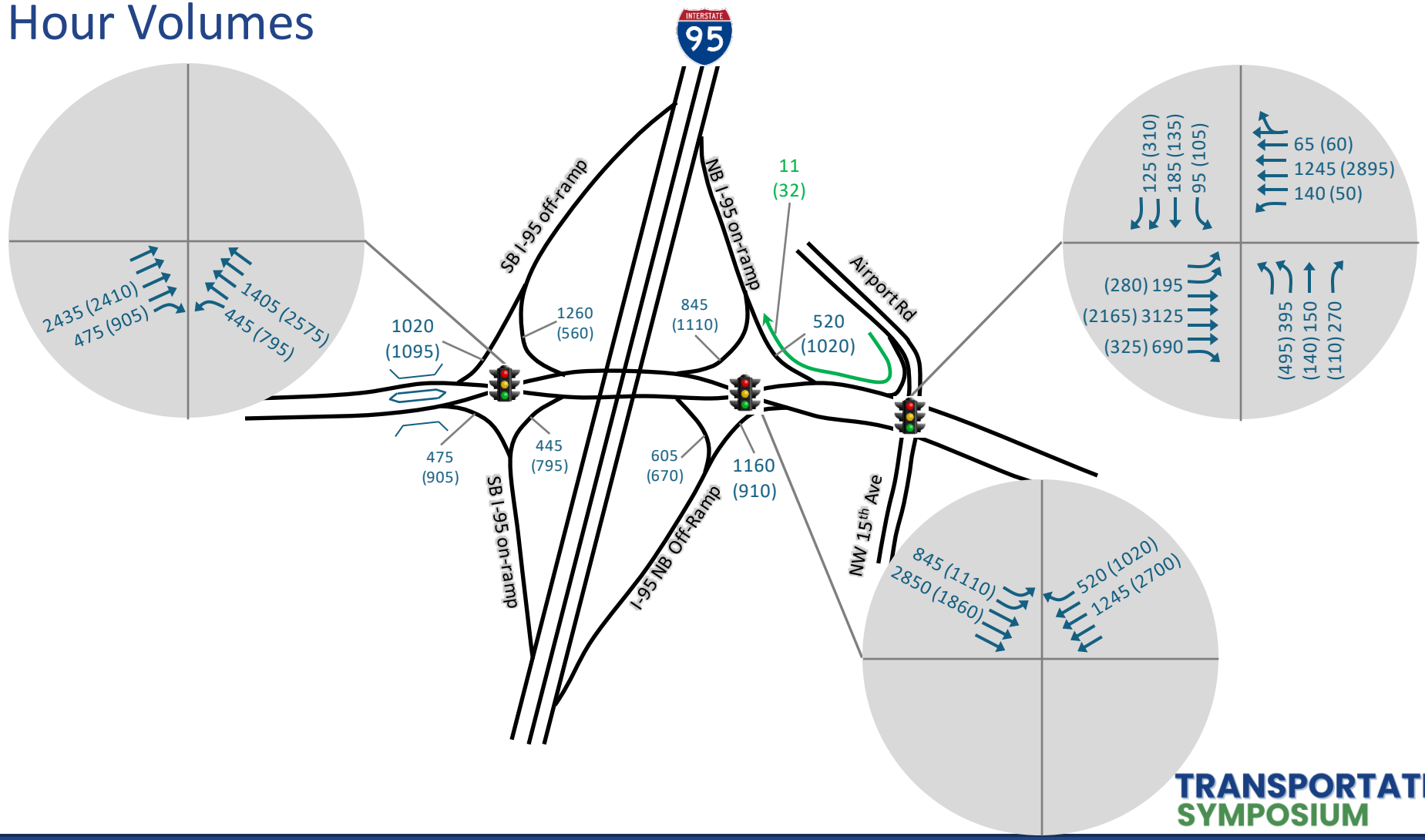
Glades Interchange ATC

- Enhanced motorist/pedestrian/bicyclist safety and reduction of overall conflict points.
- Elimination of auxiliary lane widening along I-95 Mainline beneath Glades Road due to the elimination of proposed loop ramps from RFP Concept.
- Reduction of signal phases at ramp terminal intersections. Crossover intersections allow motorists to enter Interstate via free-flow movements.
- Comprehensive pavement marking and signage plan to ensure all users understand proper lane guidance in advance of the required movement(s).



Glades Interchange ATC

Projected 2040 Peak Hour Volumes for DDI Concept



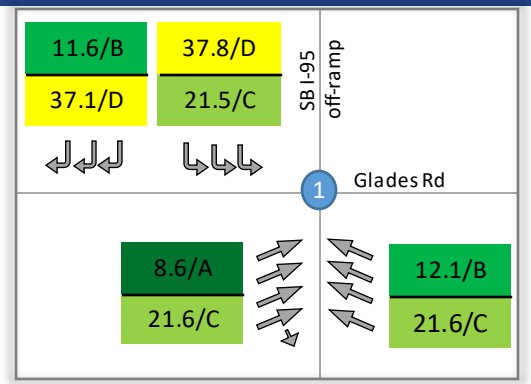
TRANSPORTATION SYMPOSIUM

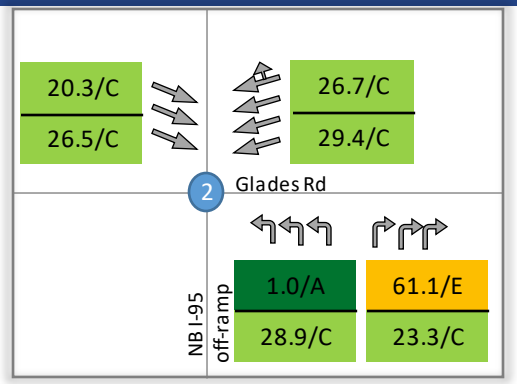
Glades Interchange ATC

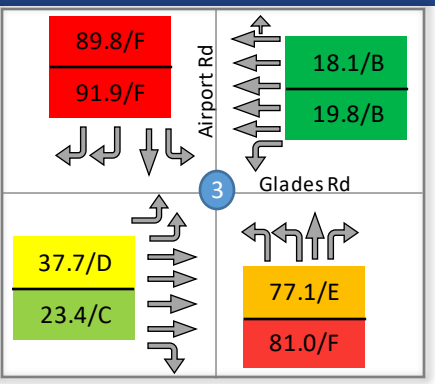
DDI Concept (2040)

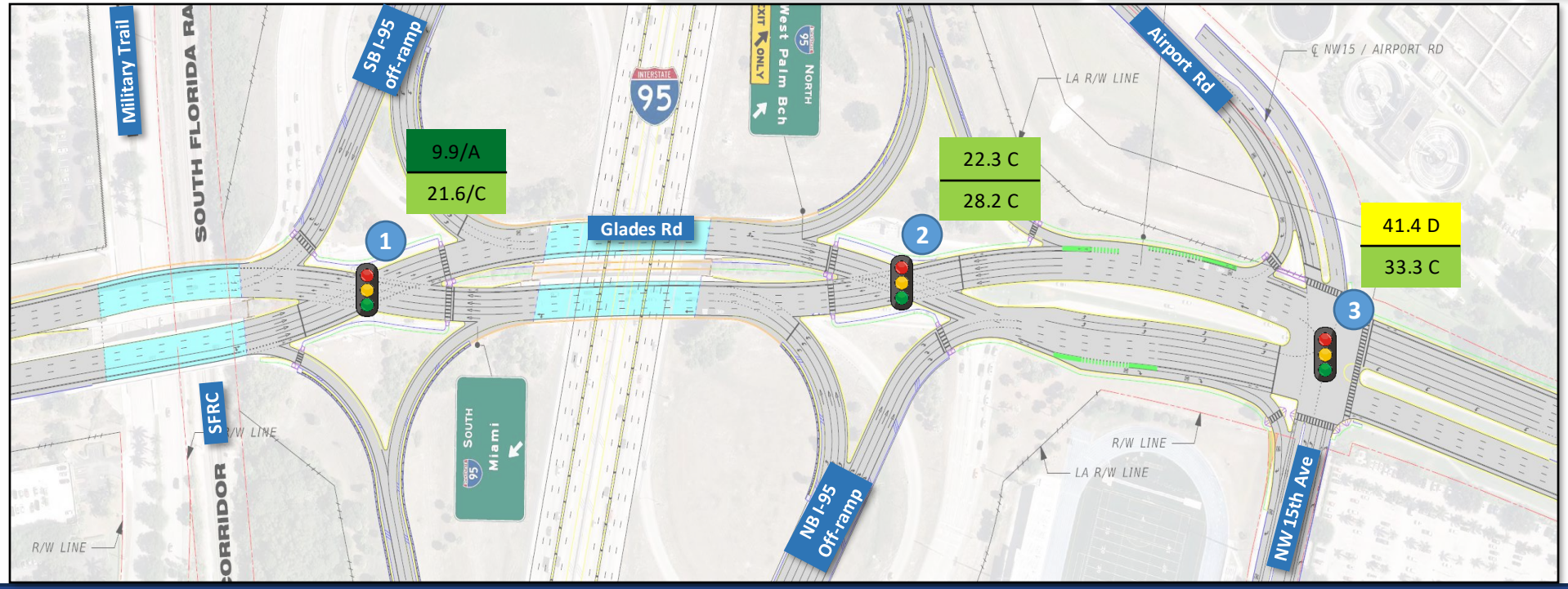
(Lane configuration, Delay and LOS)

Level Of Service						AM Delay / LOS
A	B	C	D	E	F	PM Delay / LOS









TRANSPORTATION SYMPOSIUM

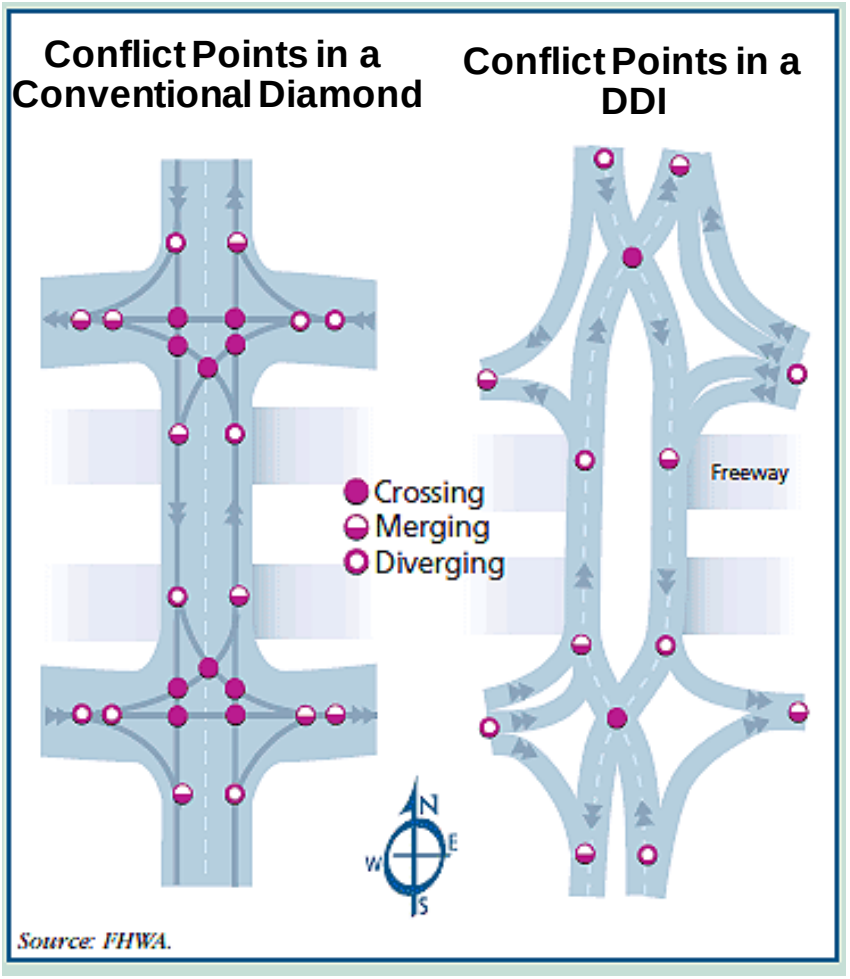
Diverging Diamond Interchange Defined

A Diverging Diamond Interchange is a form of diamond interchange that allows the two directions of traffic on the crossroad to temporarily divide and cross to the opposite side of the road to provide easier left-turns to and from the freeway.

TRANSPORTATION SYMPOSIUM

Diverging Diamond Interchange Advantages

- Fewer conflict points (14 for DDI, 26 for conventional diamond)
- Improved intersection sight distance
- Pedestrian crossings are shorter
- “Free flow” or simple left and right turns from freeway
- Increases left turn lane capacity without needing additional lanes
- Only two phases needed for traffic signals, shorter cycle length
- Bridge widening is reduced
- Construction time is reduced



TRANSPORTATION SYMPOSIUM

Glades Diverging Diamond Interchange

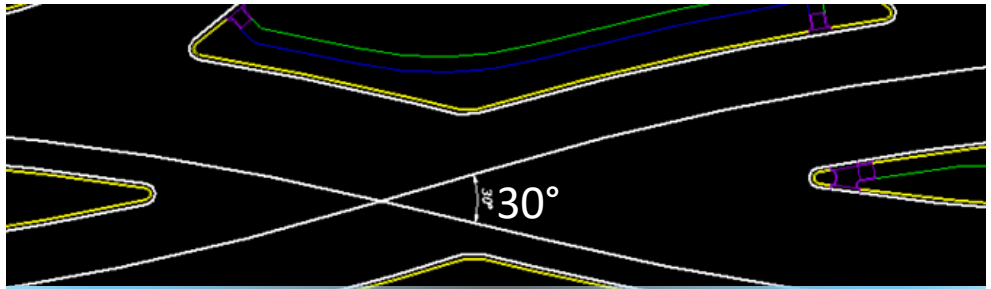
Alternative	AM Peak			PM Peak		
	Southbound Interchange	Northbound Interchange	Airport Road	Southbound Interchange	Northbound Interchange	Airport Road
Concept						
DDI						

LEGEND	Level of Service (LOS)
	LOS E; Severe Congestion
	LOS D; Moderate Congestion
	LOS C; Some Congestion
	LOS B or Better; Best Traffic Conditions

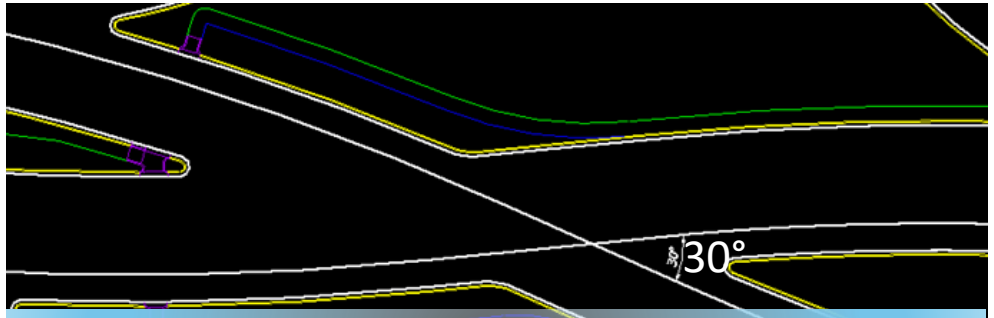
TRANSPORTATION SYMPOSIUM

Glades DDI Design

- Geometric Design that complies with 2018 AASHTO A Policy on Geometric Design of Highways and Streets
- Crossover angle of 30 degrees (angle between tangent segment of EB & WB alignments) that accommodates geometric parameters such as normal crown cross slope



West Crossover Intersection

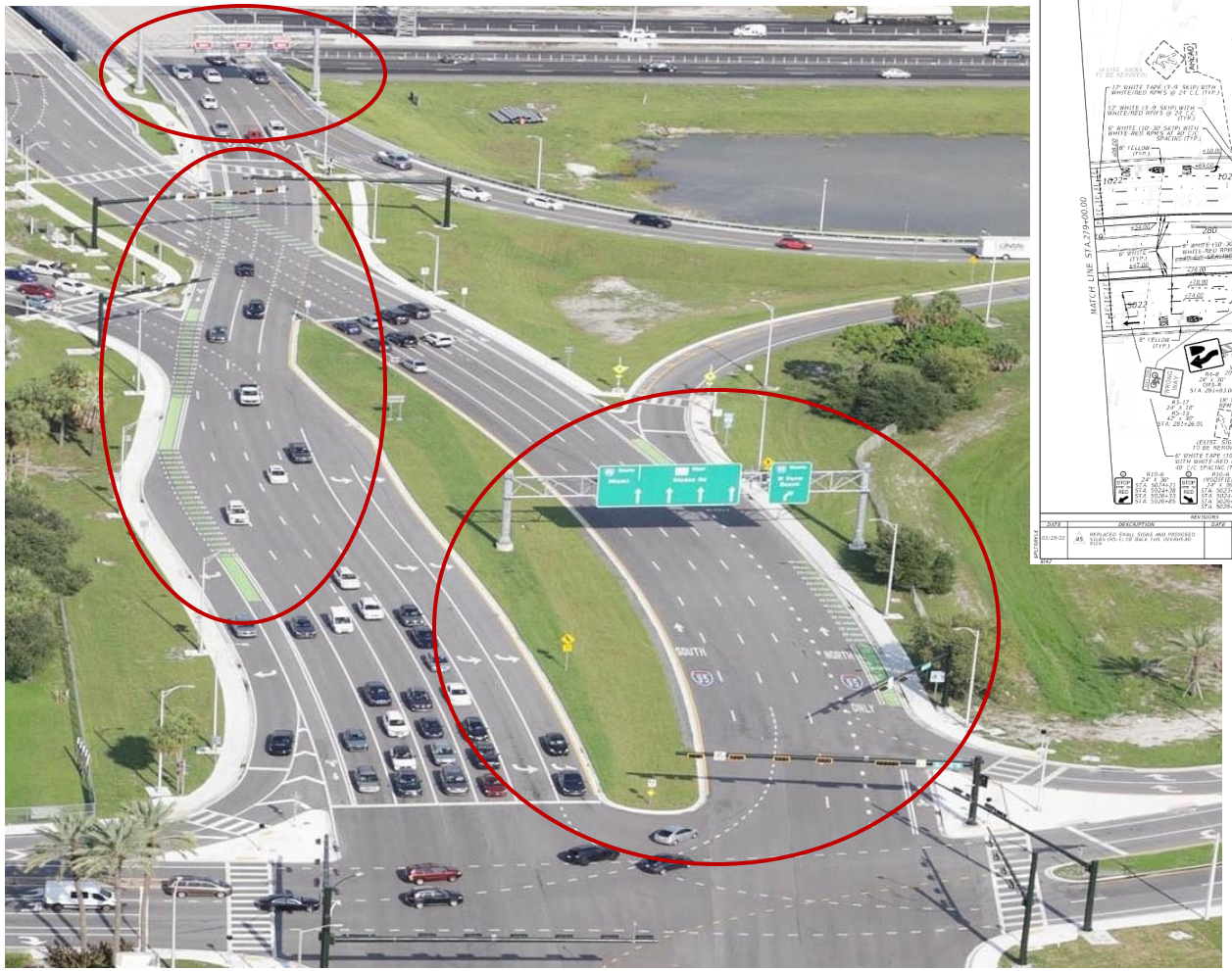


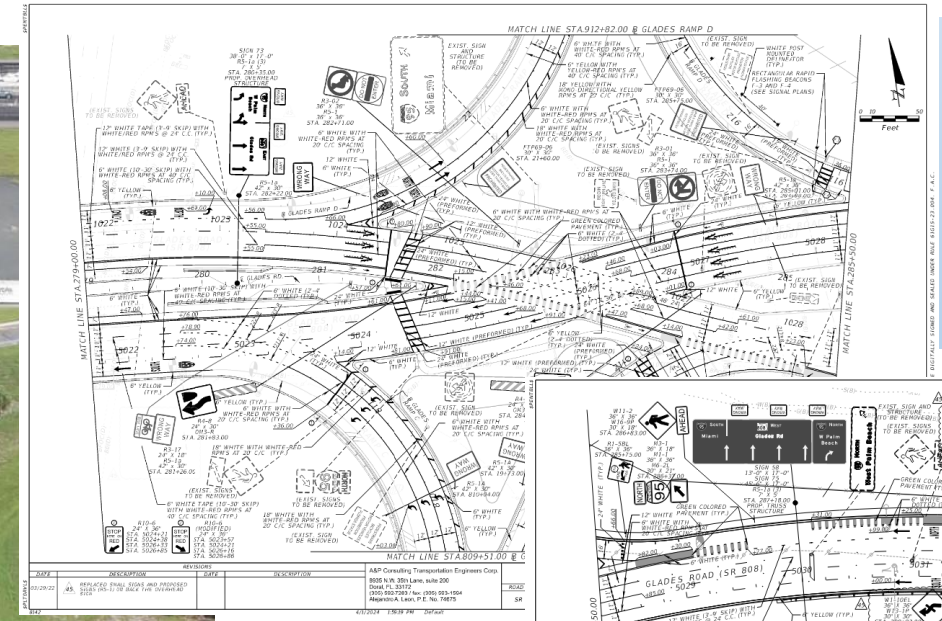
East Crossover Intersection

Eyebrow geometry that minimizes likelihood of wrong-way movements

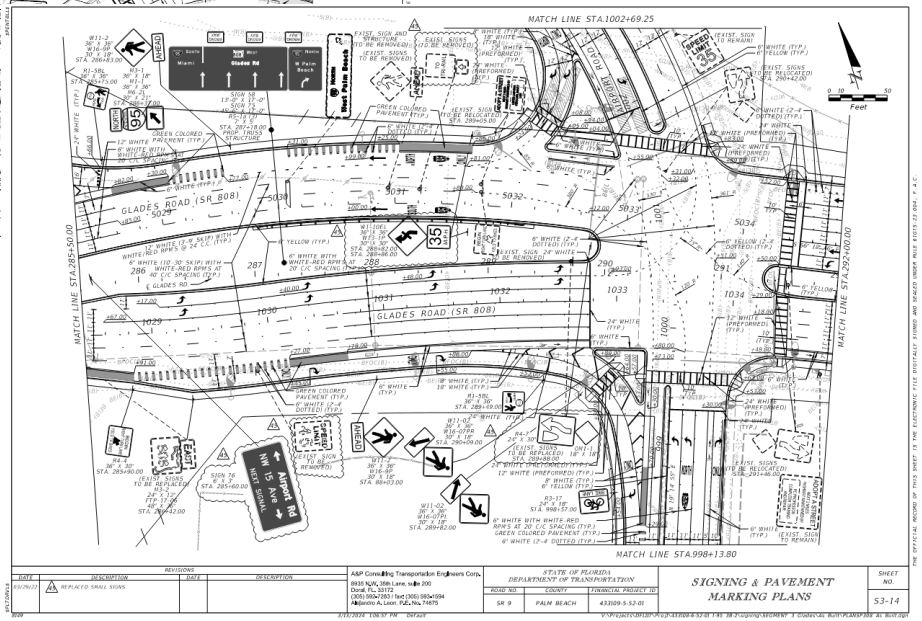
TRANSPORTATION SYMPOSIUM

Glades DDI Design





Supplemental signs and pavement markings providing lane guidance in advanced of decision points.



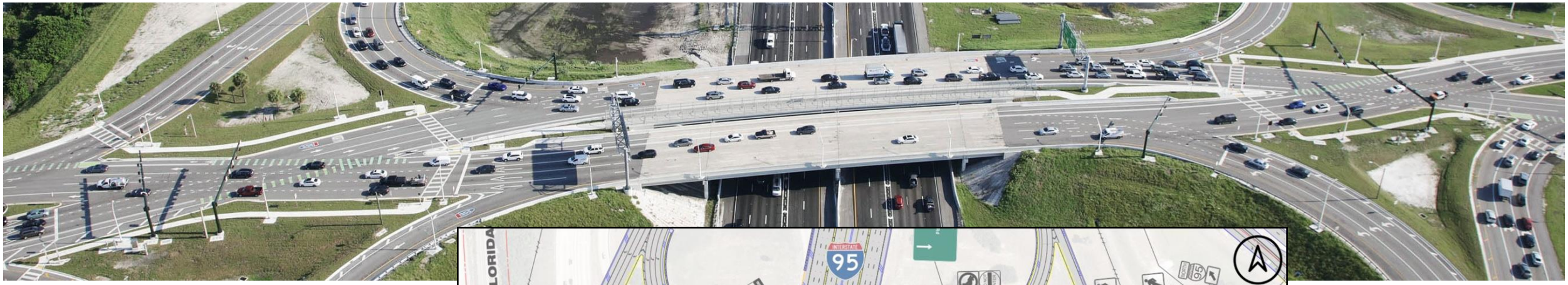
COMMUNITIES

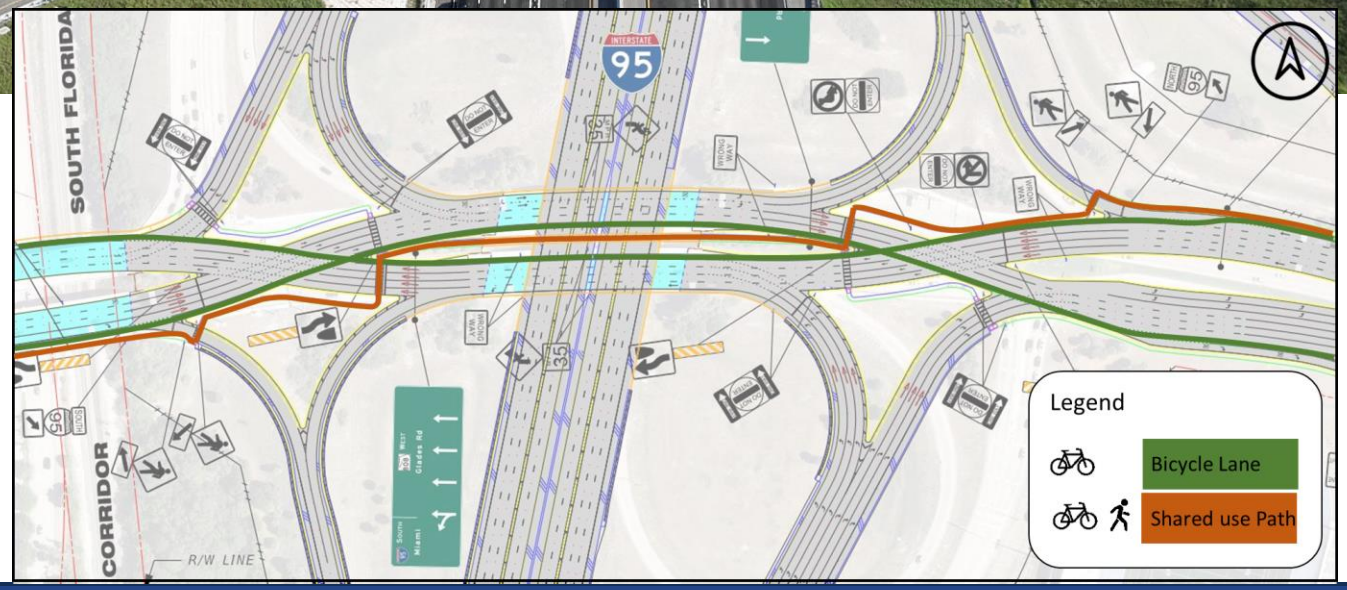
SAFETY

TRANSPORTATION SYMPOSIUM

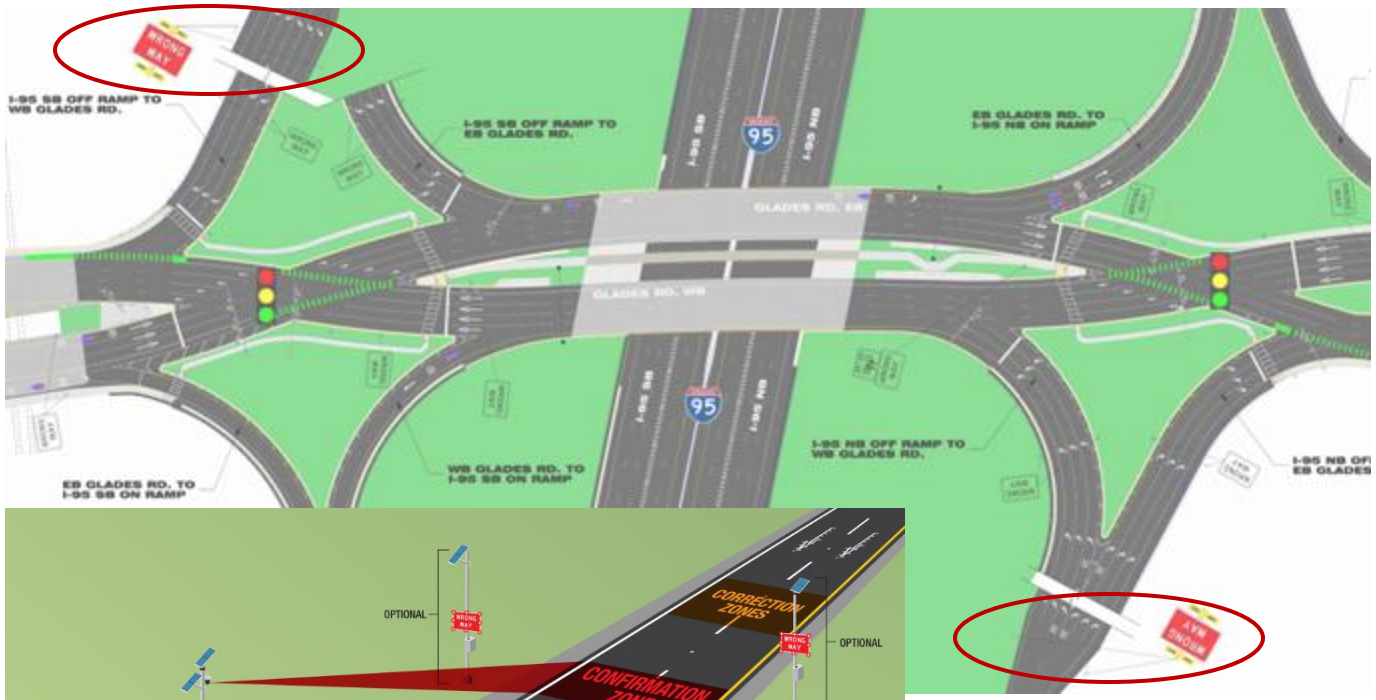
Glades DDI Design

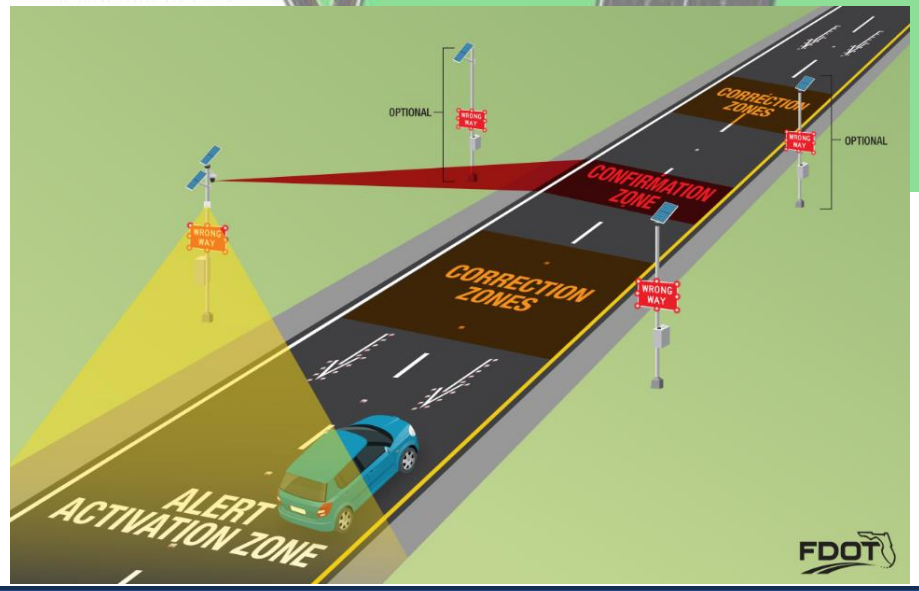
Enhanced safety for bicycles and pedestrians with a seven-foot buffered bicycle lane and a new 10-foot shared use path for pedestrians and recreational cyclists through the interchange

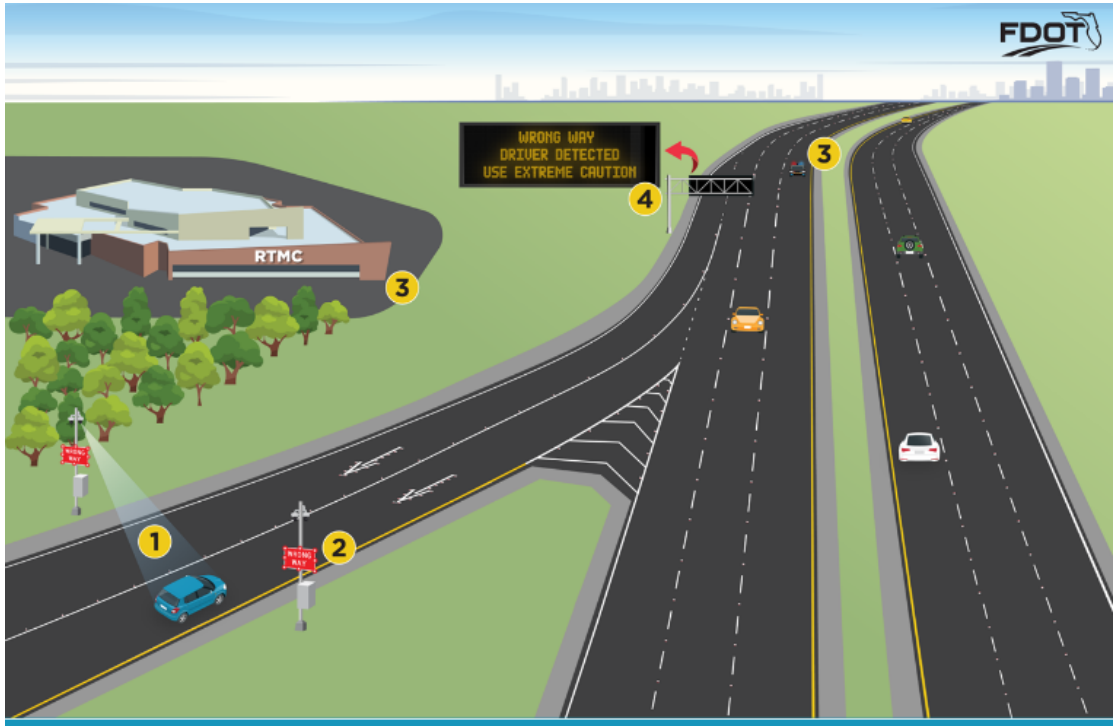




Glades DDI Design







HOW WRONG-WAY VEHICLE DETECTION SYSTEM WORKS

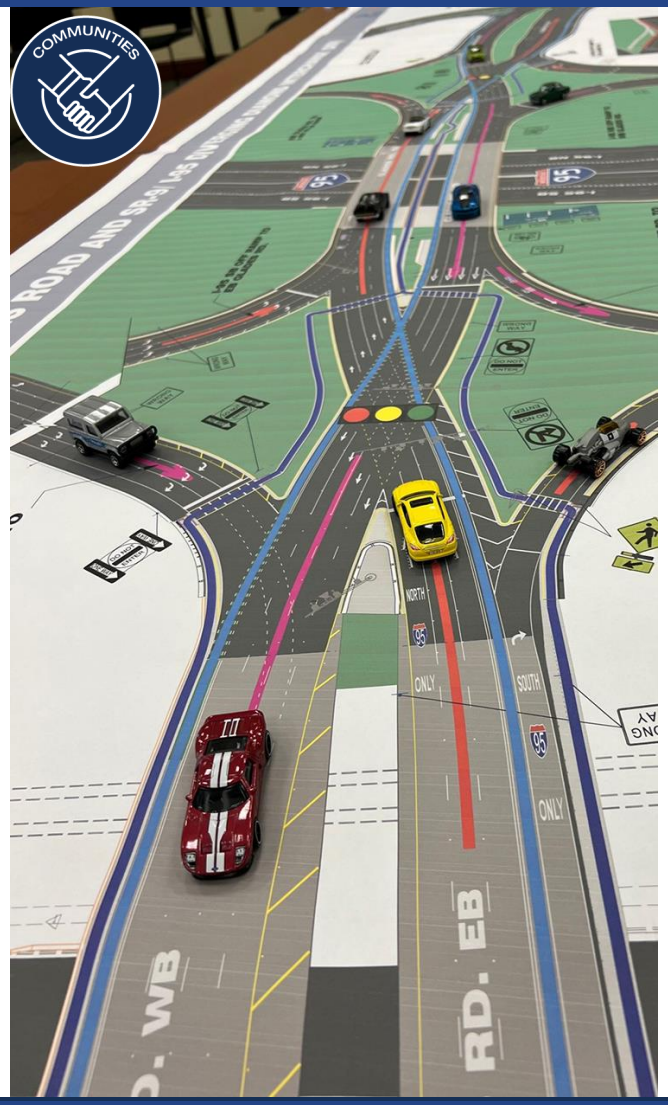
1. **Detects Vehicle:** Signs located on the exit ramps use system to detect vehicle traveling the wrong way.
2. **Triggers lights:** Flashing lights are turned on along sign border to alert the driver he/she is traveling in the wrong direction.
3. **Notifies officials**: Detection system sends alert immediately to operators at an FDOT Regional Transportation Management Center (RTMC) and law enforcement officials.
4. **Alerts other drivers:** RTMC system broadcasts a wrong-way driver alert on message boards along the freeway.

TECHNOLOGY COMMUNITIES SAFETY

TRANSPORTATION SYMPOSIUM

Glades DDI Stakeholder Outreach

- ✓ Boca Raton High School
- ✓ Palm Beach County School Board
- ✓ FAU Research Park
- ✓ FAU
- ✓ Public Meeting/Open House
- ✓ City of Boca
- ✓ Palm Beach State college
- ✓ FAU Stadium
- ✓ Boca Raton Airport
- ✓ Boca Raton Utilities



- ✓ University Commons Shopping Plaza
- ✓ Boca Raton Homeowner's Association
- ✓ Palm Beach Traffic Incident Management
- ✓ Palm Beach County TPA, TAC
- ✓ Palm Beach County TPA CAC
- ✓ PALM BEACH COUNTY TPA Bicycle, Trailways, Pedestrian Advisory Committee
- ✓ Whole Foods University Commons

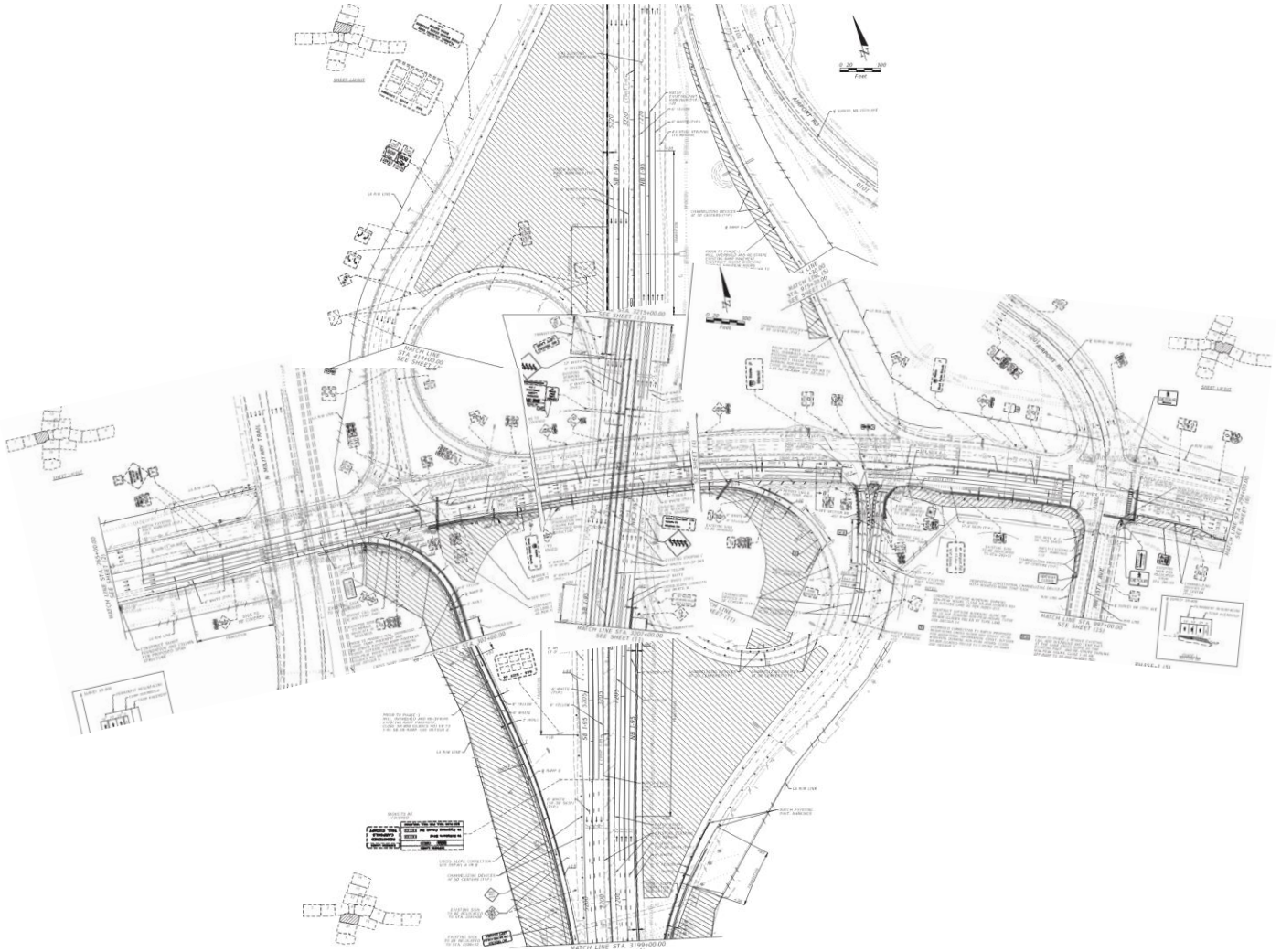
TRANSPORTATION SYMPOSIUM

Glades DDI Stakeholder Outreach-Strategies

- Mobile Billboards
- PSA at FAU Stadium, Field, and Gym Sporting Events
- In-person presentations for FAU, St. Andrews School and Boca Raton High School
- Attend the Mayor's Town Forum
- Bi-monthly Coffee with the Contractor
- Regularly meetings with business owners
- Social Media Campaign and Updates
- Staffed Boca Traffic Management Center (TMC) [300+ signal timing tweaks over 8 weeks]

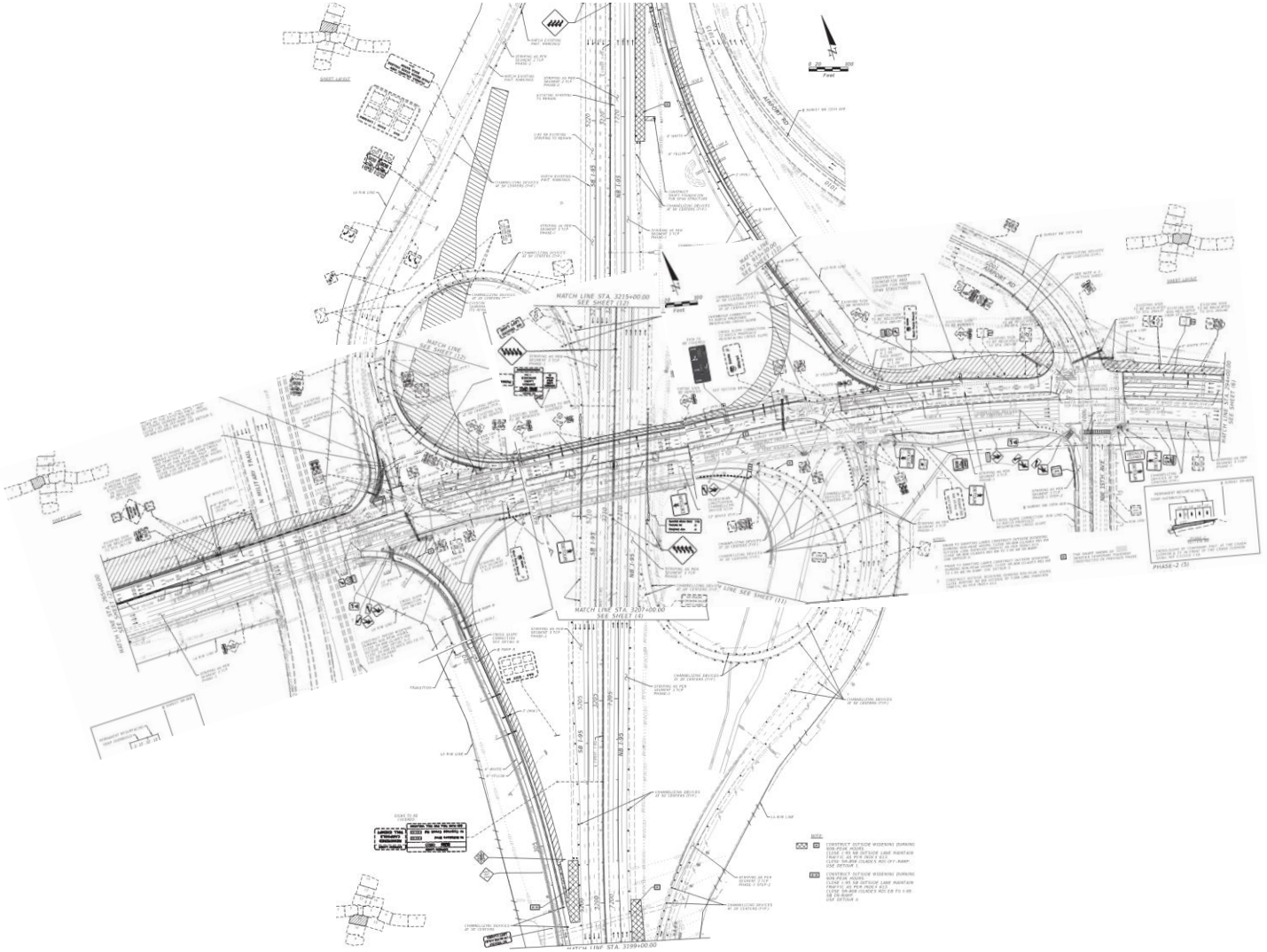
TRANSPORTATION SYMPOSIUM

Glades DDI Temporary Traffic Control



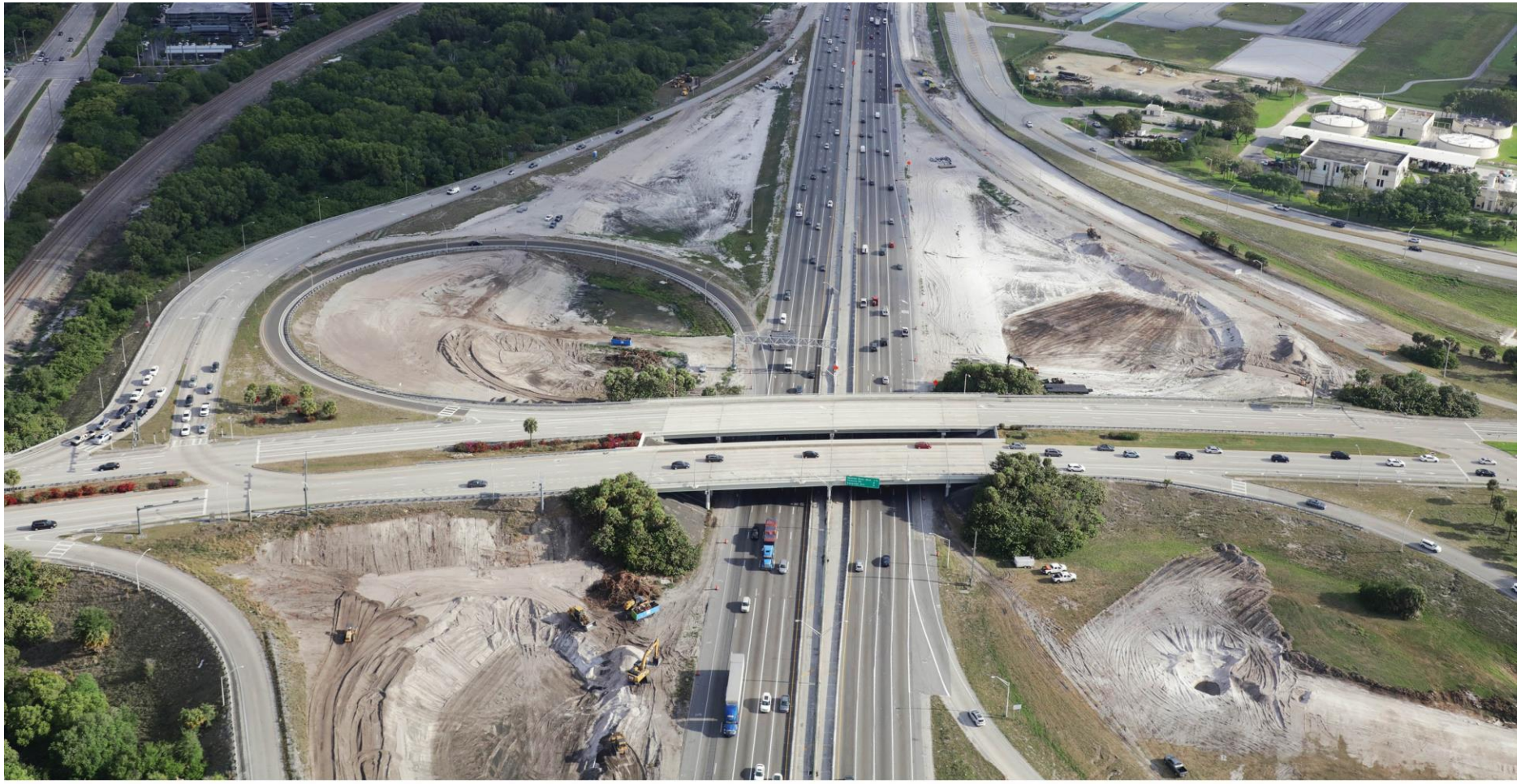
TRANSPORTATION SYMPOSIUM

Glades DDI Temporary Traffic Control



TRANSPORTATION SYMPOSIUM

Glades DDI Construction



TRANSPORTATION SYMPOSIUM

Glades DDI Construction

TRANSPORTATION SYMPOSIUM

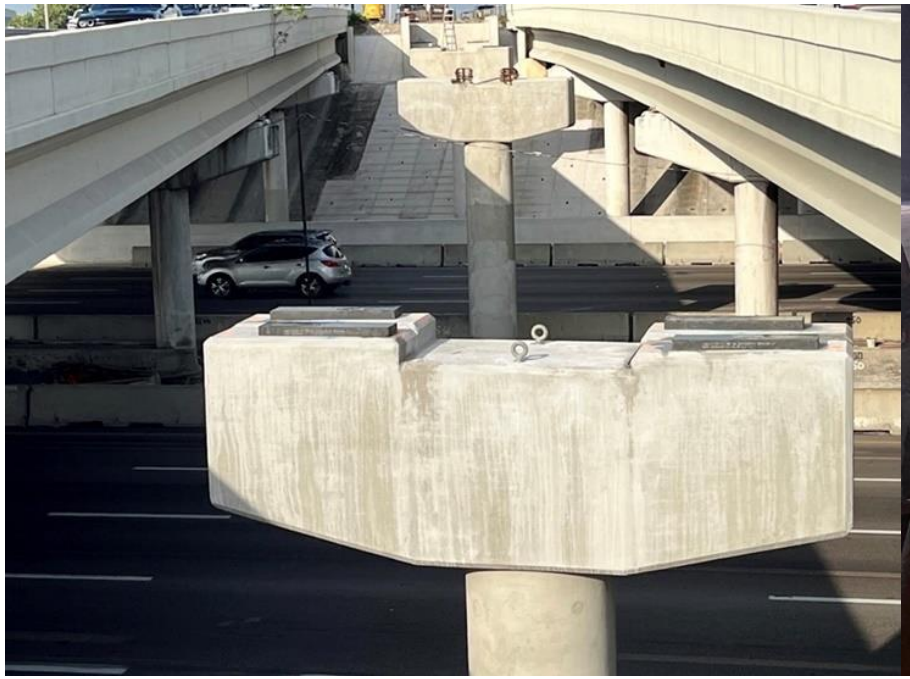
Glades DDI Construction

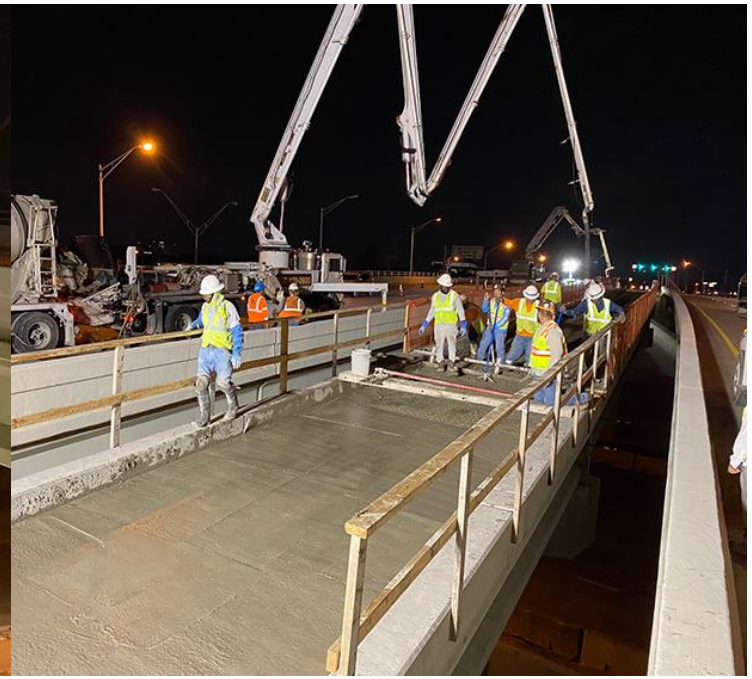
TRANSPORTATION SYMPOSIUM

Glades DDI Construction

TRANSPORTATION SYMPOSIUM

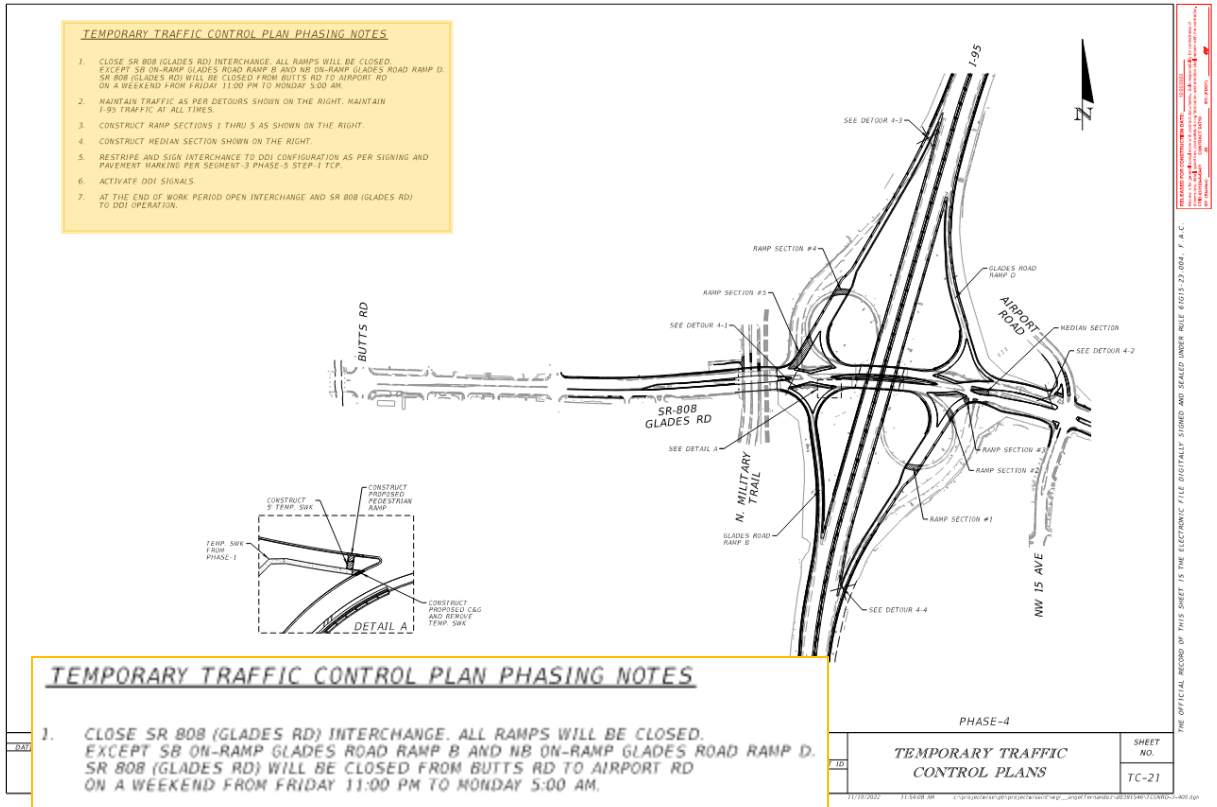
Glades DDI Construction





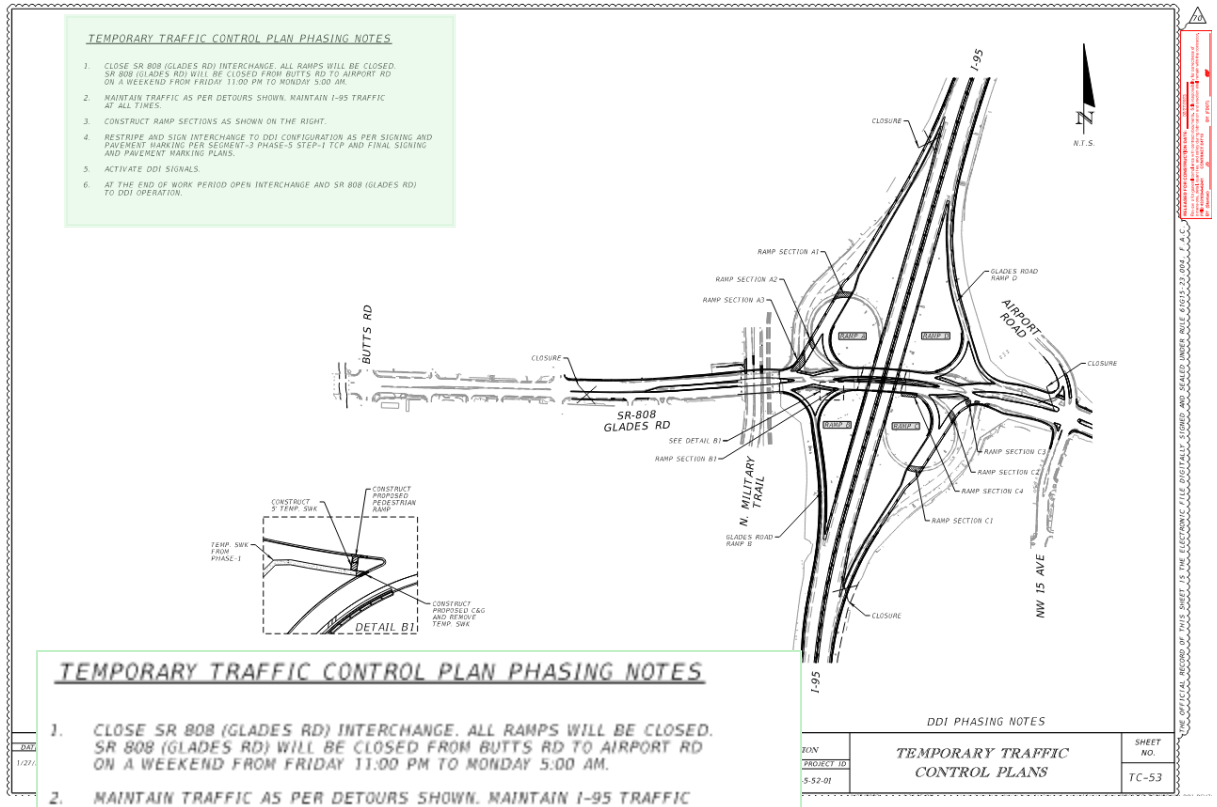
TRANSPORTATION SYMPOSIUM

Glades DDI Temporary Traffic Control-Change



TEMPORARY TRAFFIC CONTROL PLAN PHASING NOTES

1. CLOSE SR 808 (GLADES RD) INTERCHANGE. ALL RAMPS WILL BE CLOSED. EXCEPT SB ON-RAMP GLADES ROAD RAMP B AND NB ON-RAMP GLADES ROAD RAMP D. SR 808 (GLADES RD) WILL BE CLOSED FROM BUTTS RD TO AIRPORT RD ON A WEEKEND FROM FRIDAY 11:00 PM TO MONDAY 5:00 AM.
2. MAINTAIN TRAFFIC AS PER DETOURS SHOWN ON THE RIGHT. MAINTAIN I-95 TRAFFIC AT ALL TIMES.
3. CONSTRUCT RAMP SECTIONS 1 THRU 5 AS SHOWN ON THE RIGHT.
4. CONSTRUCT MEDIAN SECTION SHOWN ON THE RIGHT.
5. RESTRIPE AND SIGN INTERCHANGE TO DDI CONFIGURATION AS PER SIGNING AND PAVEMENT MARKING PER SEGMENT-3 PHASE-5 STEP-1 TCP.
6. ACTIVATE DDI SIGNALS.
7. AT THE END OF WORK PERIOD OPEN INTERCHANGE AND SR 808 (GLADES RD) TO DDI OPERATION.

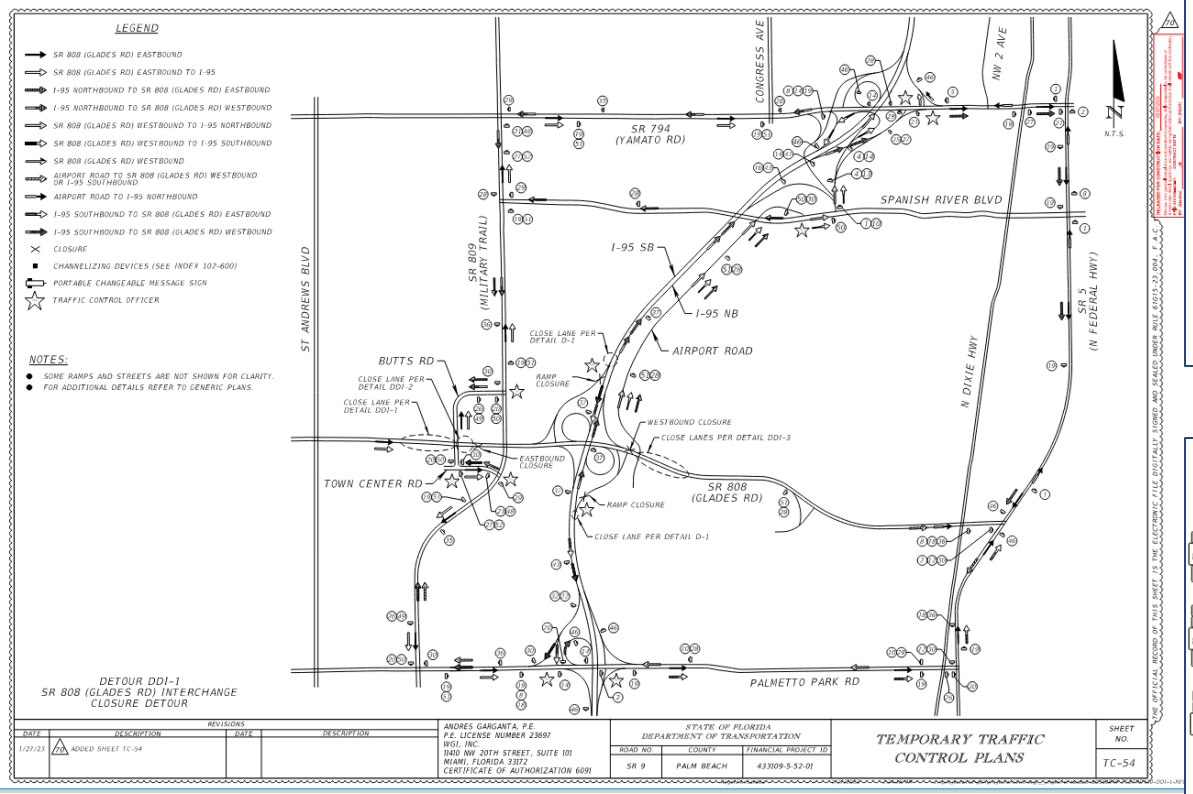


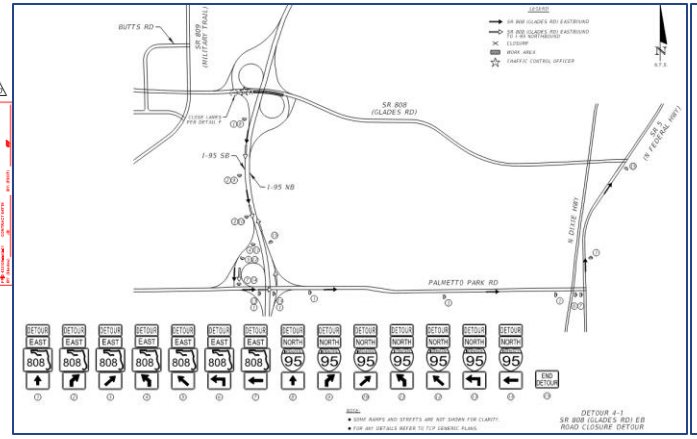
TEMPORARY TRAFFIC CONTROL PLAN PHASING NOTES

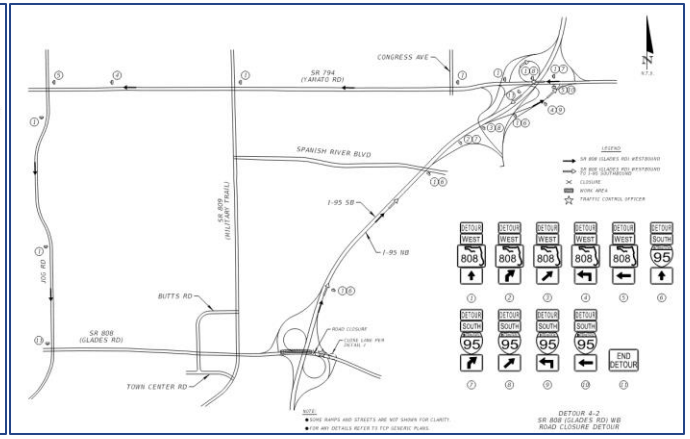
1. CLOSE SR 808 (GLADES RD) INTERCHANGE. ALL RAMPS WILL BE CLOSED. SR 808 (GLADES RD) WILL BE CLOSED FROM BUTTS RD TO AIRPORT RD ON A WEEKEND FROM FRIDAY 11:00 PM TO MONDAY 5:00 AM.
2. MAINTAIN TRAFFIC AS PER DETOURS SHOWN. MAINTAIN I-95 TRAFFIC AT ALL TIMES.
3. CONSTRUCT RAMP SECTIONS AS SHOWN ON THE RIGHT.
4. RESTRIPE AND SIGN INTERCHANGE TO DDI CONFIGURATION AS PER SIGNING AND PAVEMENT MARKING PER SEGMENT-3 PHASE-5 STEP-1 TCP AND FINAL SIGNING AND PAVEMENT MARKING PLANS.
5. ACTIVATE DDI SIGNALS.
6. AT THE END OF WORK PERIOD OPEN INTERCHANGE AND SR 808 (GLADES RD) TO DDI OPERATION.

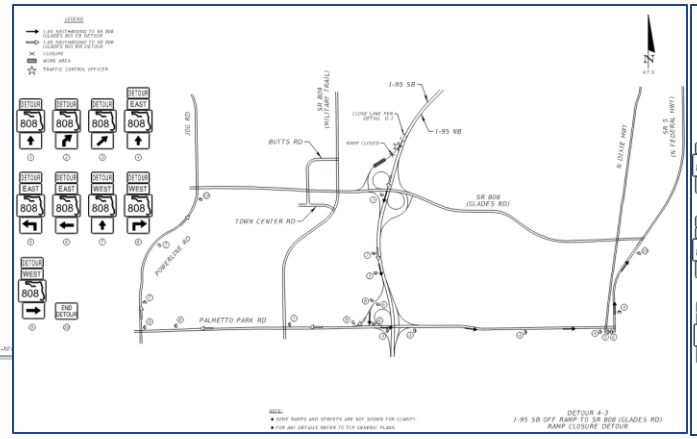
TRANSPORTATION SYMPOSIUM

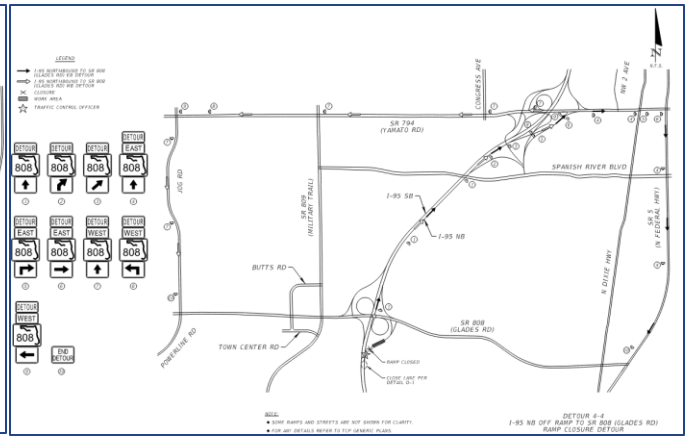
Glades DDI Temporary Traffic Control-Change







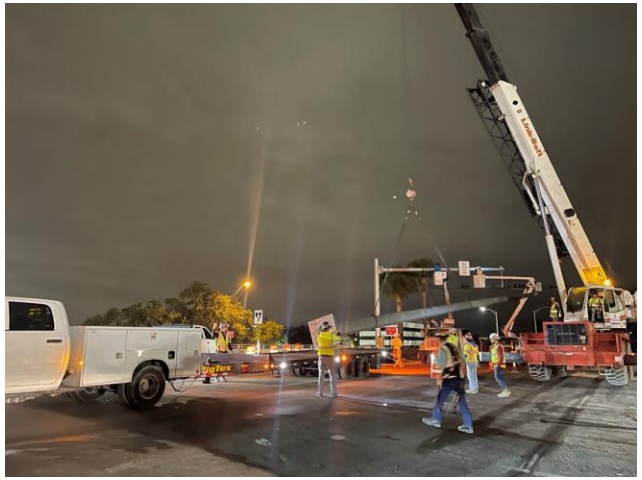




One Weekend Closure Detour VS Four Weekend Closures

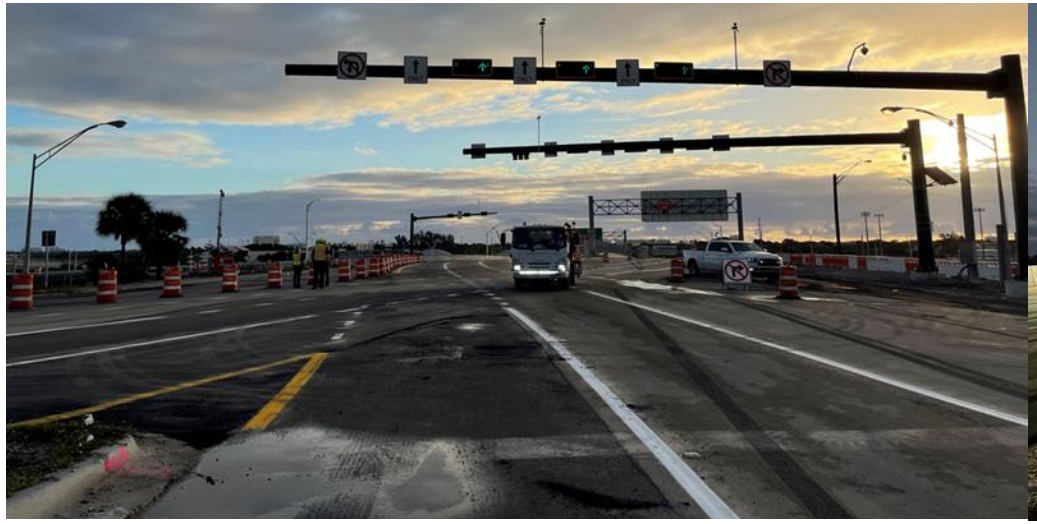
TRANSPORTATION SYMPOSIUM

Glades DDI Construction-Weekend Closure



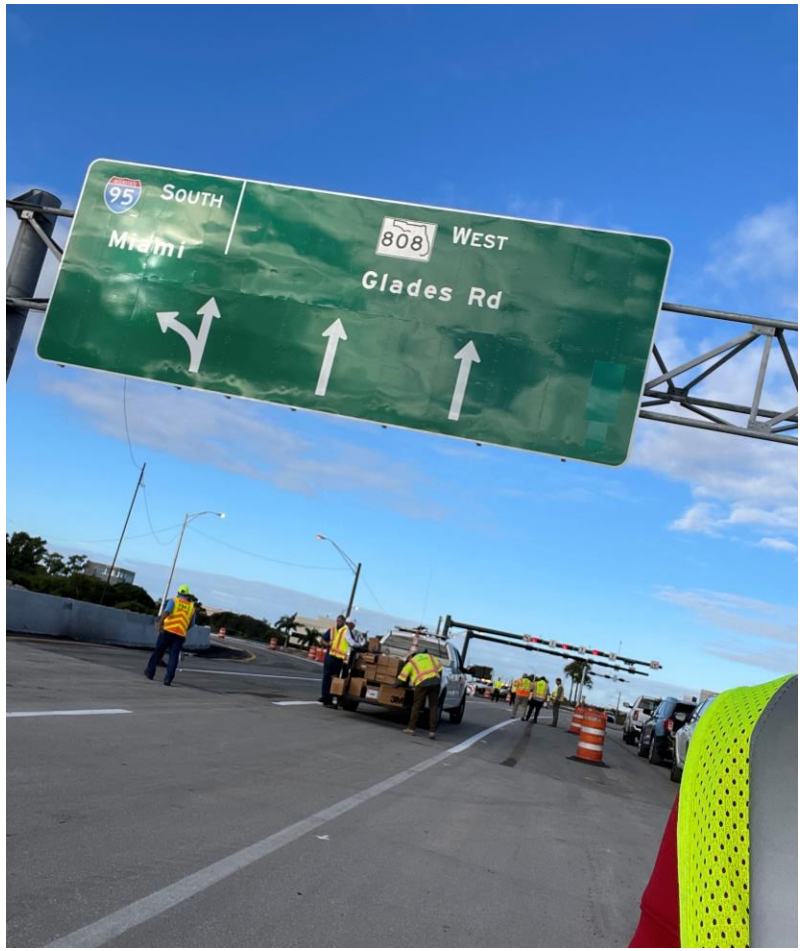
TRANSPORTATION SYMPOSIUM

Glades DDI Construction-Weekend Closure



TRANSPORTATION SYMPOSIUM

Glades DDI Construction-Weekend Closure



TRANSPORTATION SYMPOSIUM

Glades DDI Construction

TRANSPORTATION SYMPOSIUM

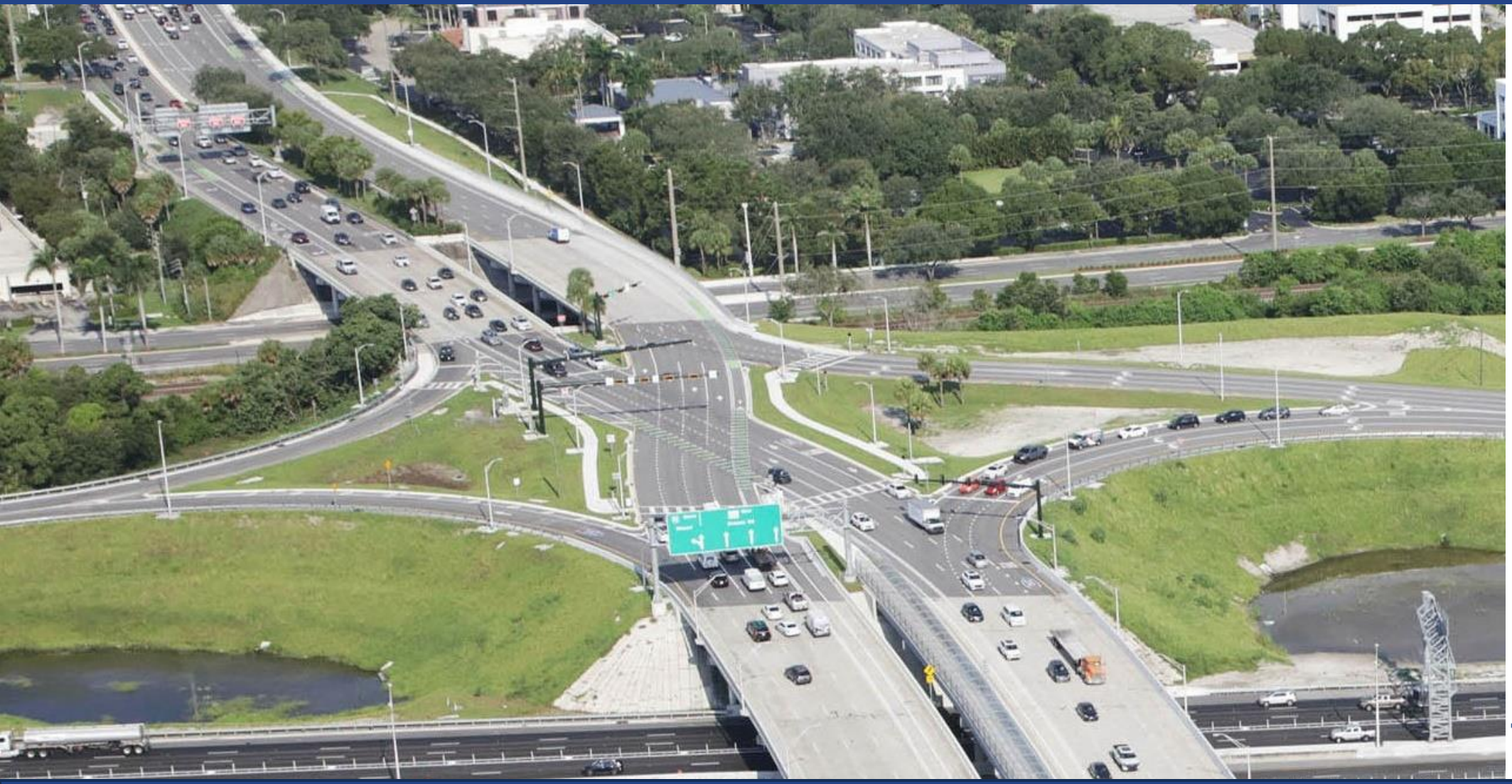
Glades DDI Final

TRANSPORTATION SYMPOSIUM

Glades DDI Final (east crossover)

TRANSPORTATION SYMPOSIUM

Glades DDI Final (west crossover)



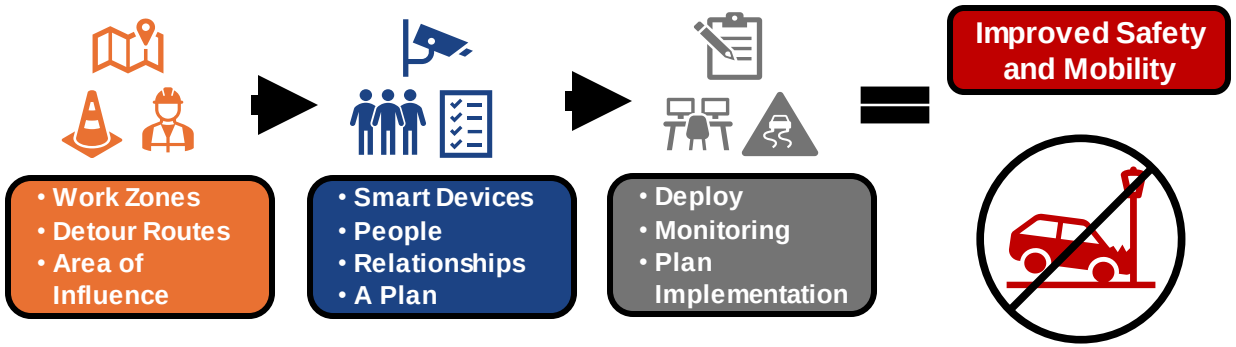
TRANSPORTATION SYMPOSIUM

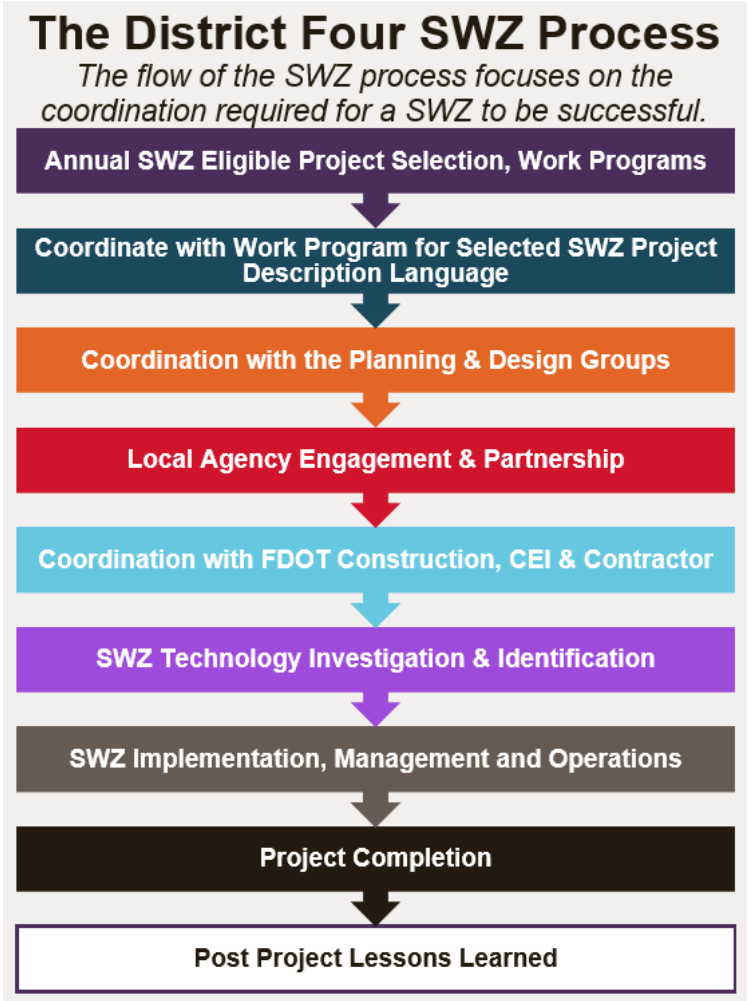
Glades DDI Smart Work Zone (SWZ) Overview

What is the District Four SWZ Process?

What is a Smart Work Zone?

Technology + People + Relationships + A Plan





TRANSPORTATION SYMPOSIUM

Stakeholder Communication Ecosystem

Project Overview

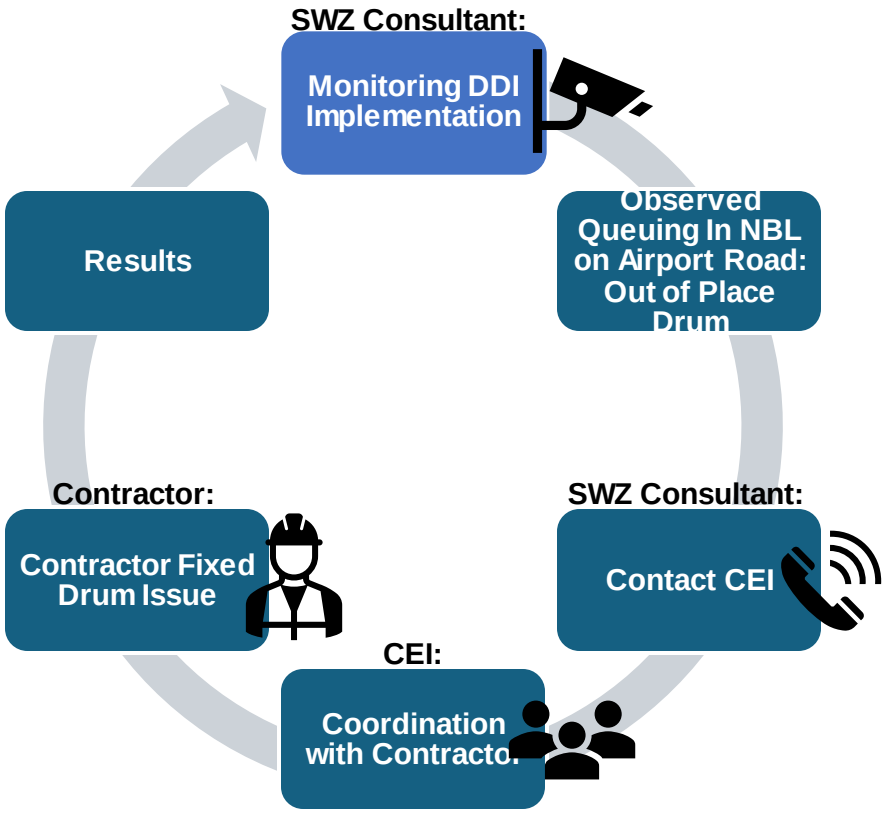
- Roles each stakeholder needs to fulfill
- Considerations to improve DDI operation

Education

- Assist the public with understanding the new layout, allowing them to meet the team and asks questions

Smart Work Zone Elements

- Feedback from the public, monitoring, data collection, and weekly briefings.

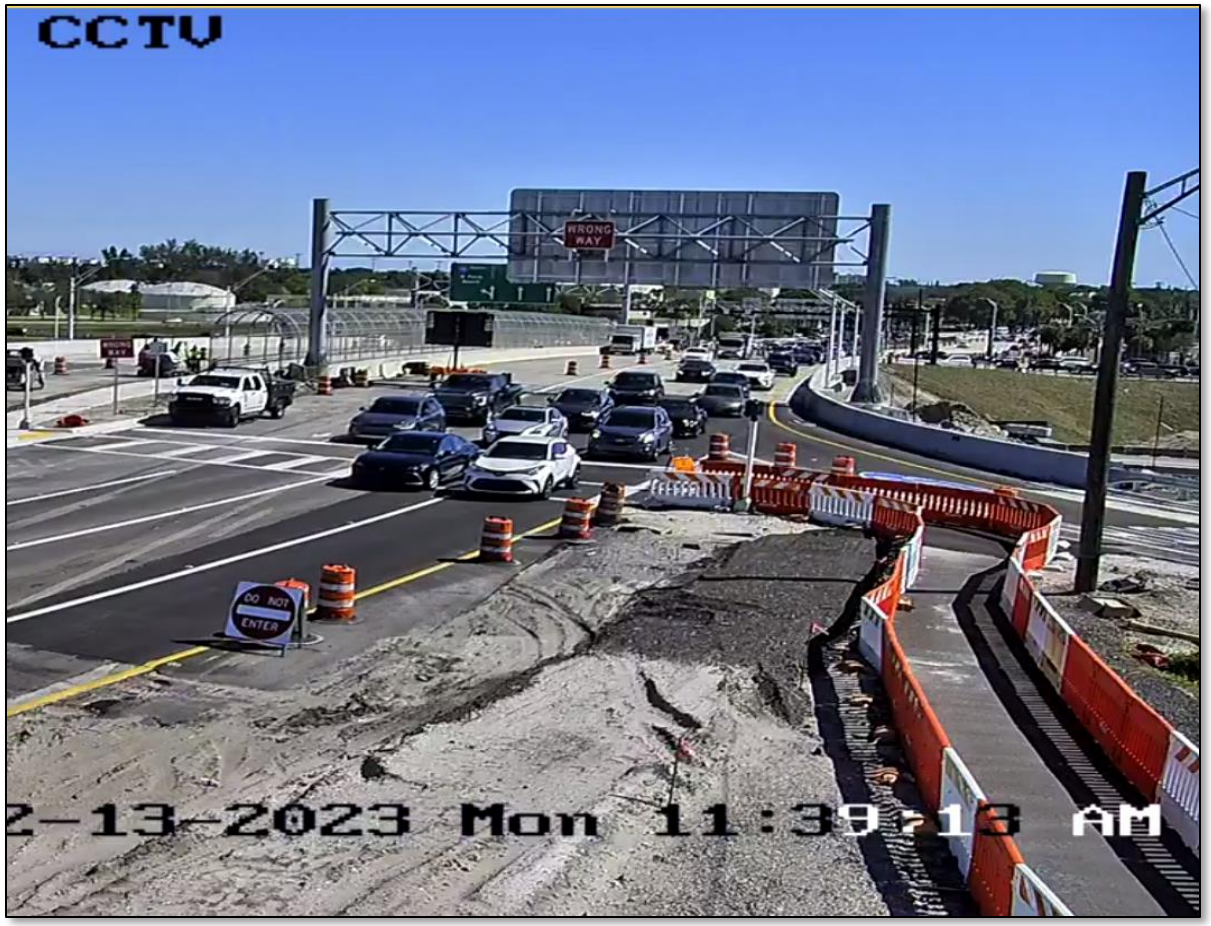


TRANSPORTATION SYMPOSIUM

Glades DDI Operations Lessons Learned

Stop Bar Compliance

- Observed sneakers and creepers.
- Recommendations of:
  - “Stop Here On Red” signs.
- Pedestrian crossing signs.
- Robust striping.
- Team verifying stop bar locations.
- Old MOT faded striping – drivers need clean message.
- Thermo-plastic vs. paint for temporary MOT



Glades DDI Operations Lessons Learned

Conflict Points SBL Movement, Weaving

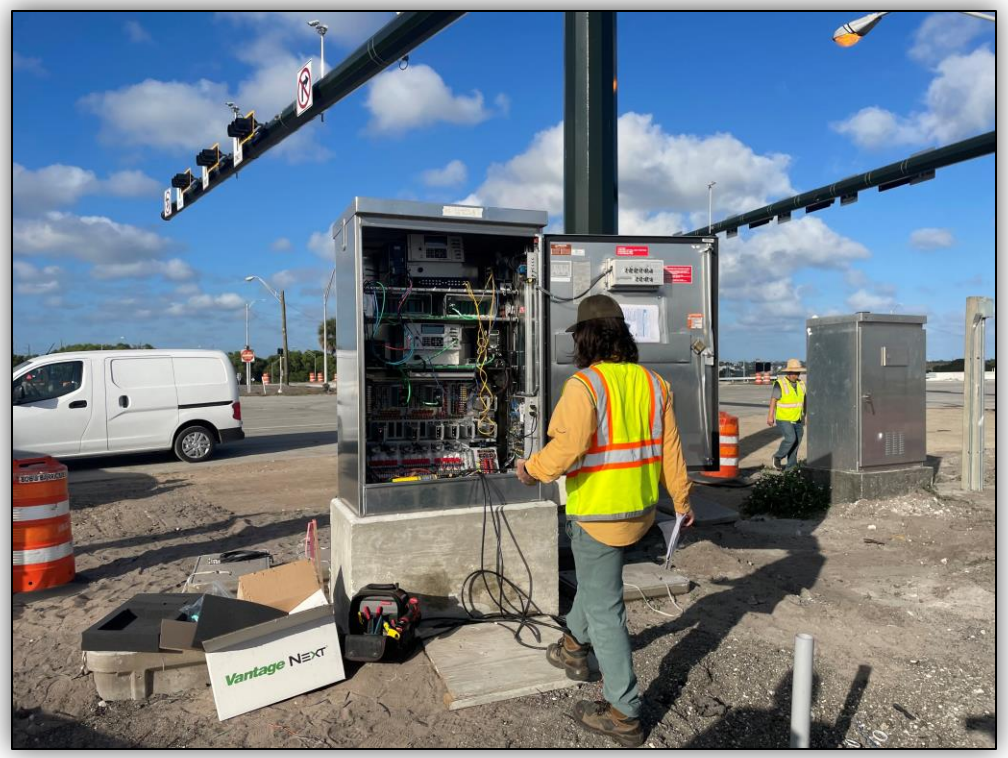
- EBT sneakers are creating conflict with SBL movement as they don't have time to get in the line of sight of SBL turning vehicles.
- Since all lanes are not yet available, all departure lanes don't have a receiving lane causing weaving.

TRANSPORTATION SYMPOSIUM

Glades DDI Operations Lessons Learned

Signalization: Traffic Signal System

- Highly Recommend a “single traffic controller”
  - Glades Road running two controllers. (1 might be better)
  - Run the system in “Overlap” and other technology solutions
- Be cautious of standard “phasing and timing” in design
  - This is not a standard signal
  - Must be field adjusted due to dynamic nature of Freeway demand. (Hint, driver behavior)



Safety Reminder

TRANSPORTATION SYMPOSIUM

Contact Us

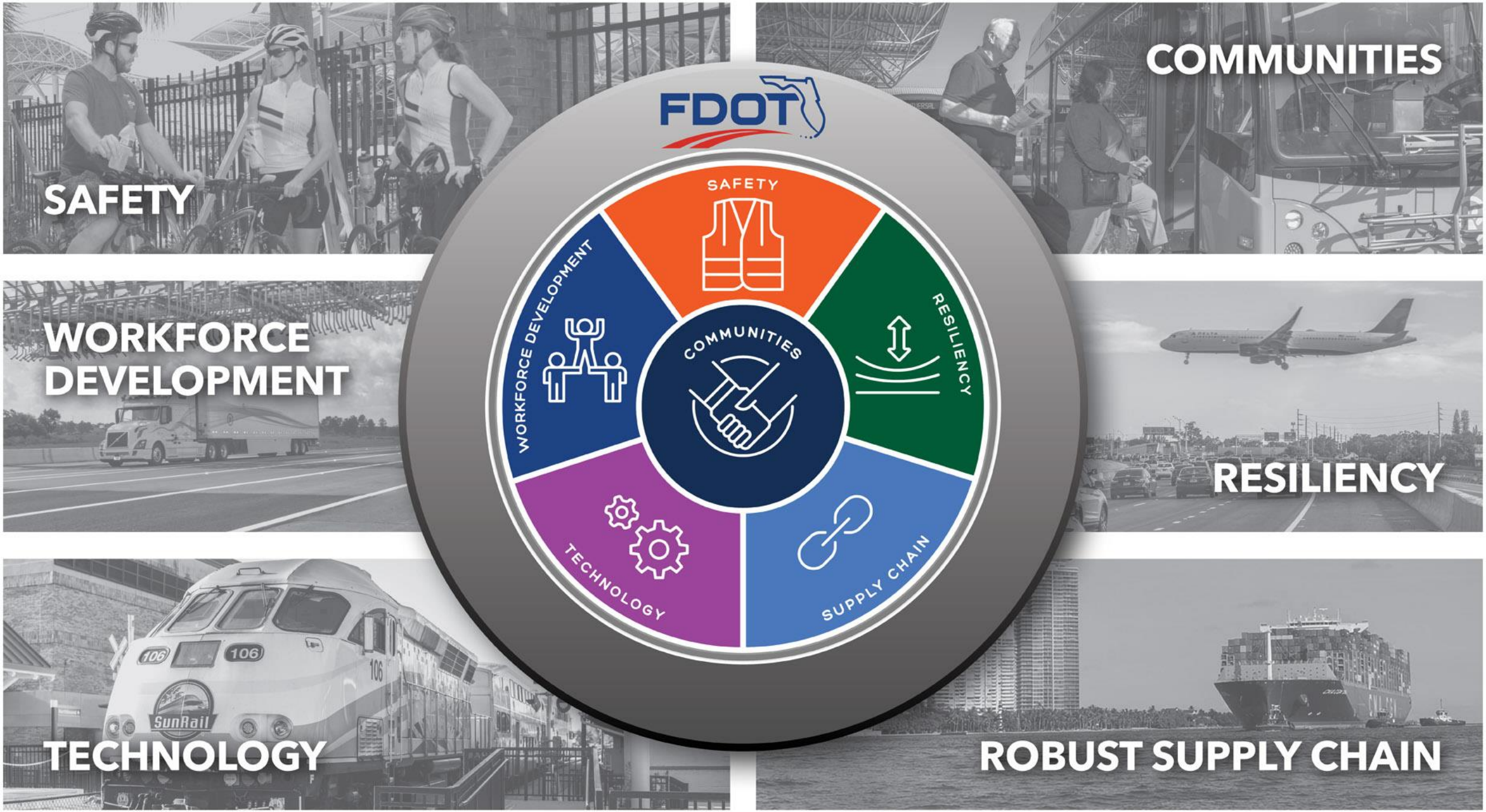
Vanita Saini, P.E.
Project Manager
Florida Department of
Transportation, District Four
3400 West Commercial Boulevard
Fort Lauderdale, FL 33309

Phone: 954-777-4468
Toll Free: 866-336-8435, ext. 4468

Email:
vanita.saini@dot.state.fl.us

TRANSPORTATION SYMPOSIUM

Thank You / Questions


FDOT
SAFETY
COMMUNITIES
WORKFORCE DEVELOPMENT
RESILIENCY
TECHNOLOGY
SUPPLY CHAIN
SAFETY
COMMUNITIES
WORKFORCE DEVELOPMENT
RESILIENCY
TECHNOLOGY
SUPPLY CHAIN
106
SunRail