Orlando, FL

November 7-8, 2024

2024 TRANSPORTATION SYMPOSIUM

Evolutions in Safety Engineering

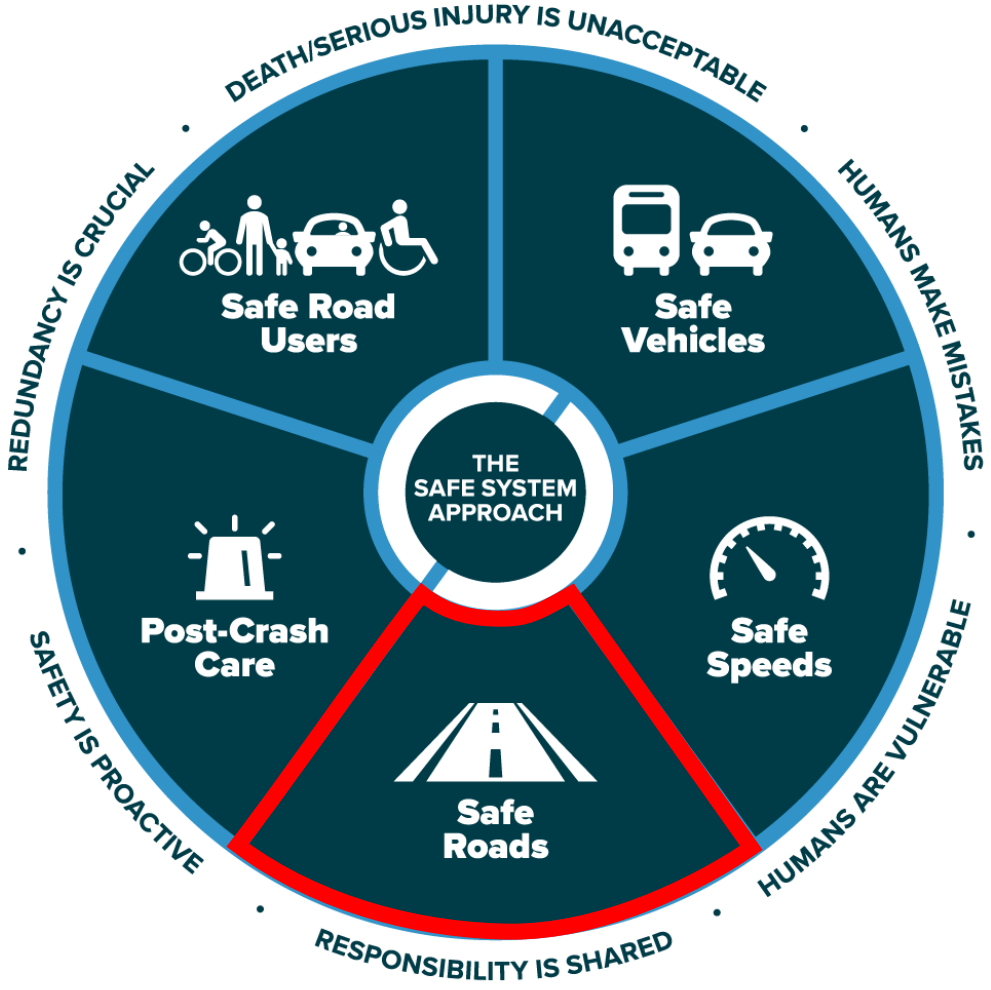
Central Office: Brenda Young, P.E.
District 4: Tracey Xie, P.E.
District 5: Naziru Isaac, P.E.
District 6: Misleidys Leon, P.E.

Florida Department of Transportation

FDOT

Safe System Approach

Engineering for Human Factors



Safety Infrastructure Focus: Anticipating Human Error

Proven Effective Countermeasures

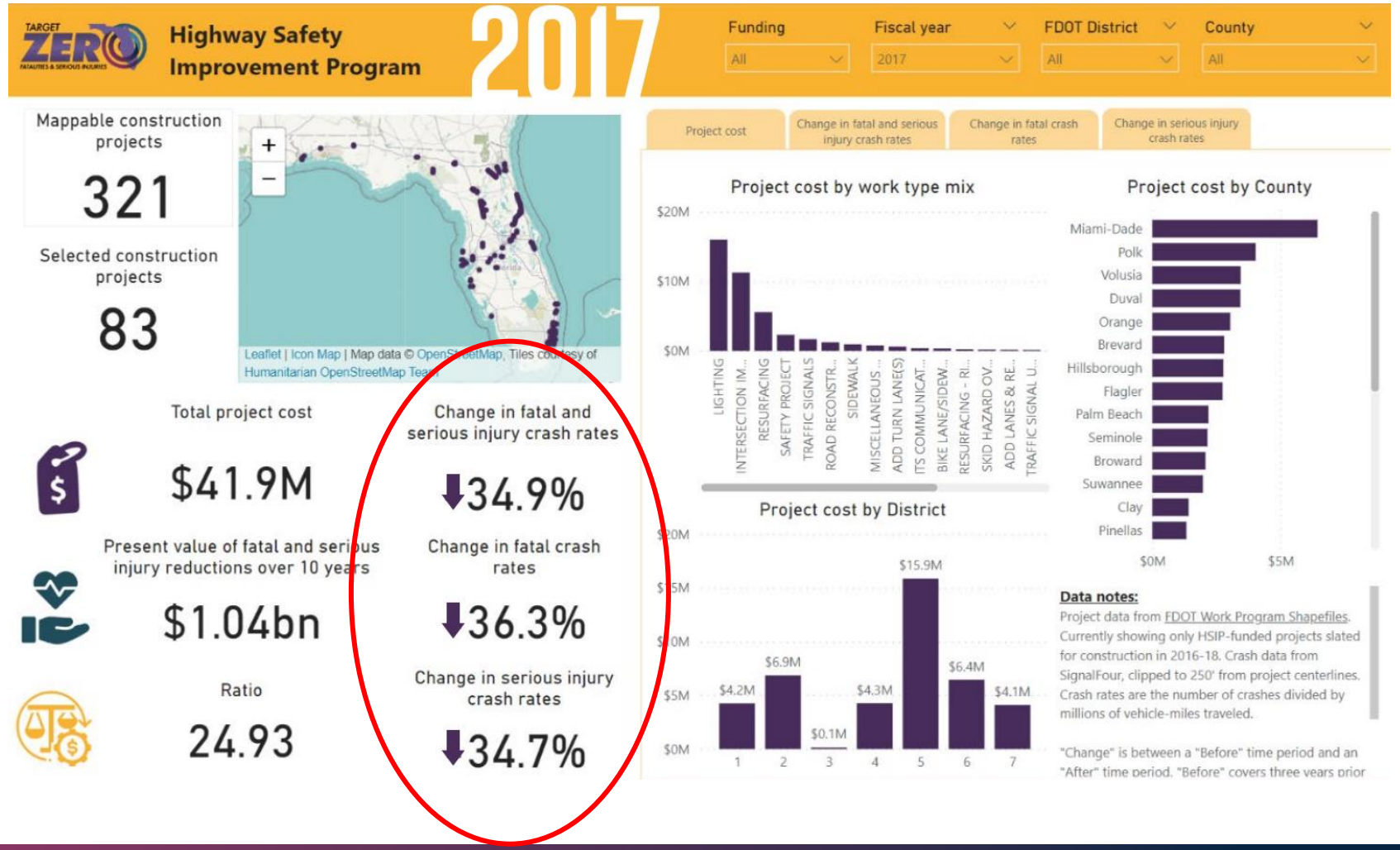
Prevention → Provide Safe Recovery → Reduce Crash Severity

LANE DEPARTURES

INTERSECTIONS

PEDESTRIANS AND BICYCLISTS

Current Effective Safety Improvements

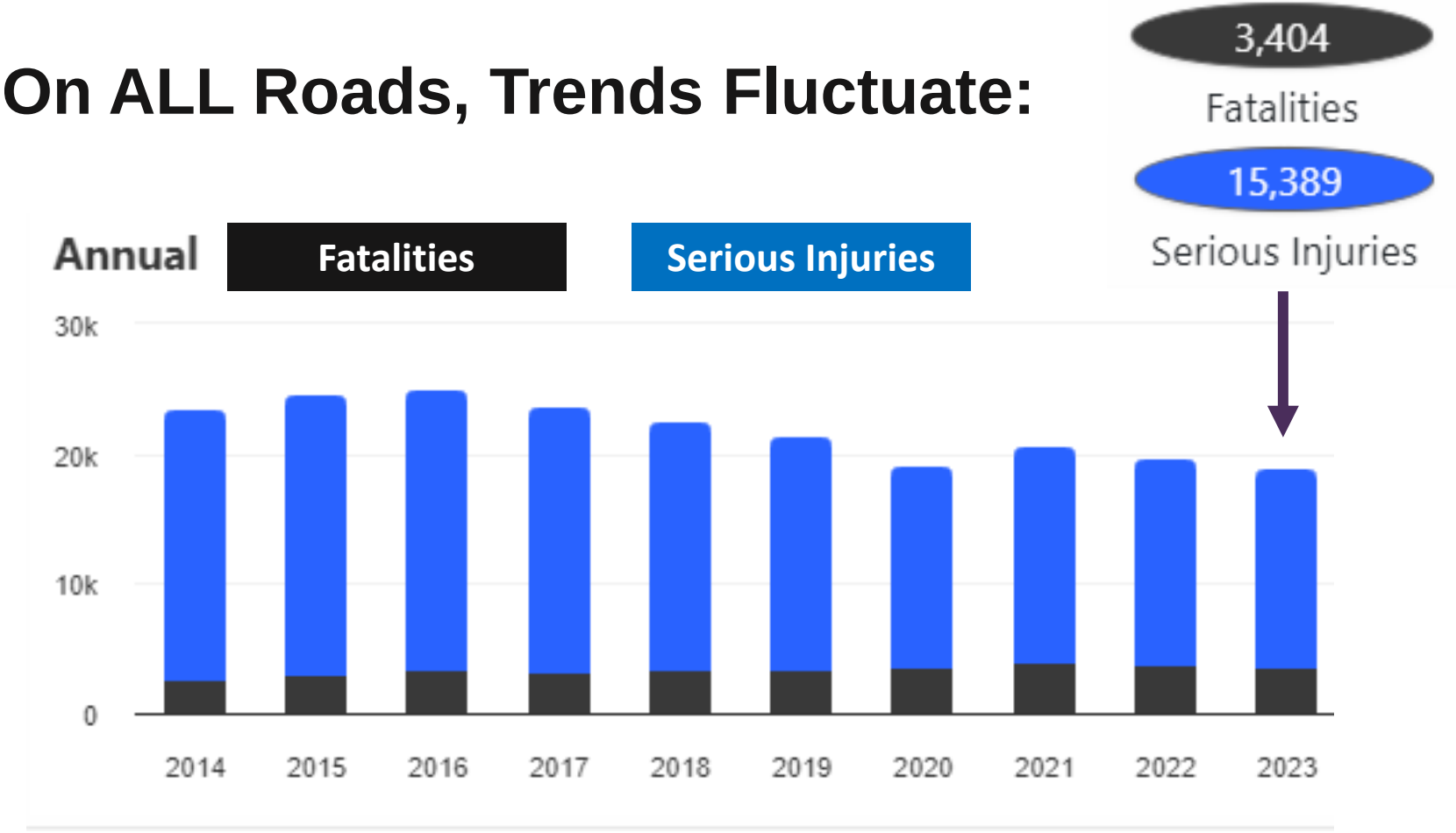


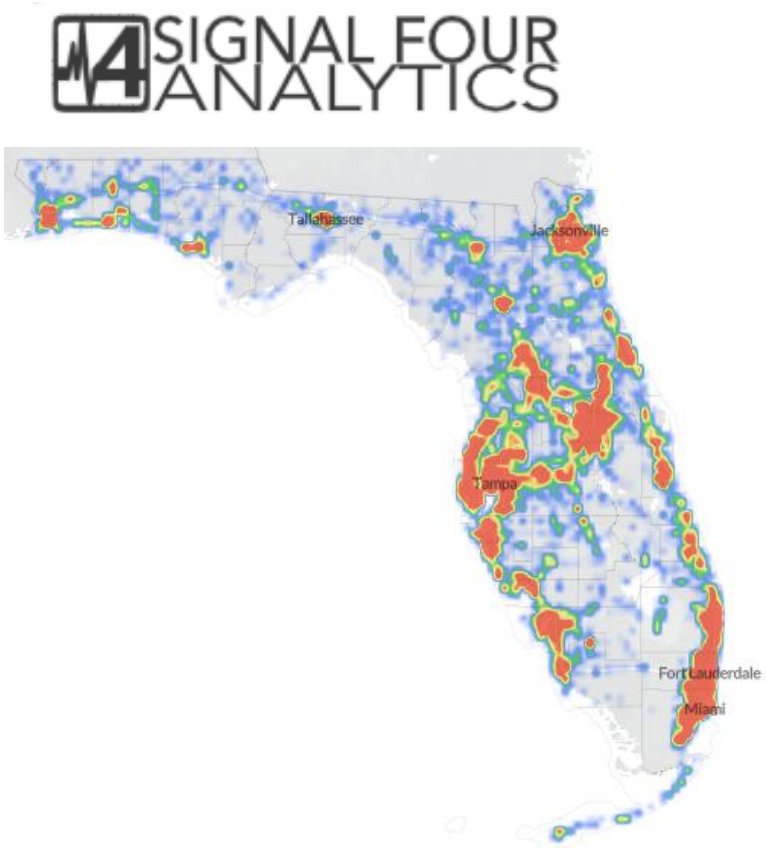
- ✓Positive gains in safety performance on Highway Safety Improvement Program projects

However, there are not projects on all roadways every year…

Need to Impact Long-Term Statewide Trends

On ALL Roads, Trends Fluctuate:





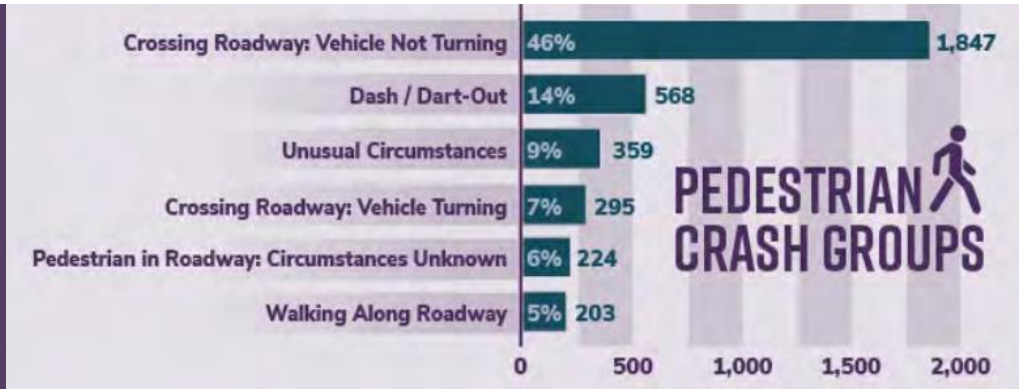
PEDESTRIAN & BICYCLE

4% of Crashes but 27% of Fatalities

Midblocks

74% Pedestrians

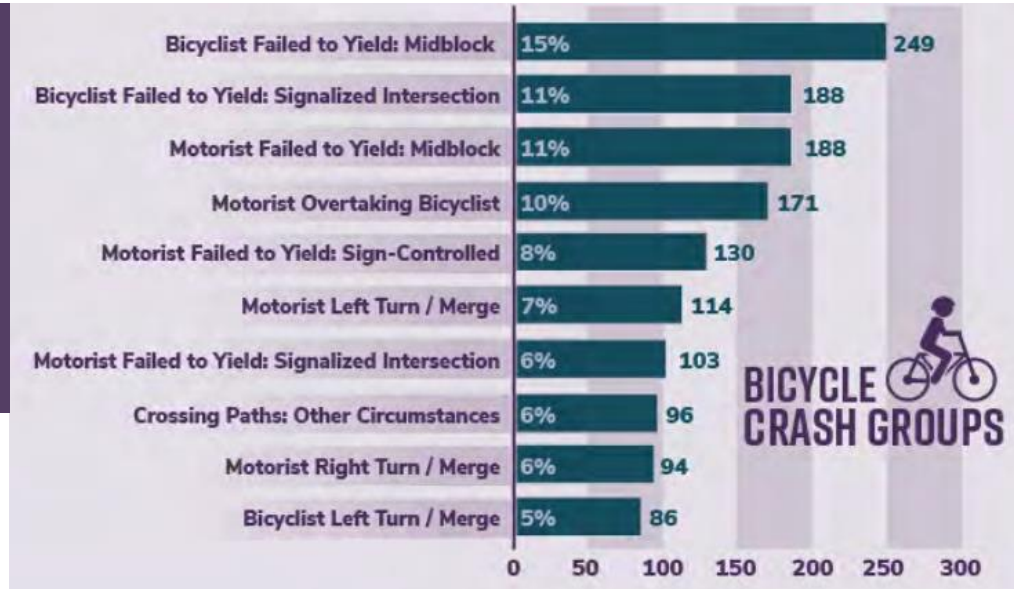
53% Cyclists

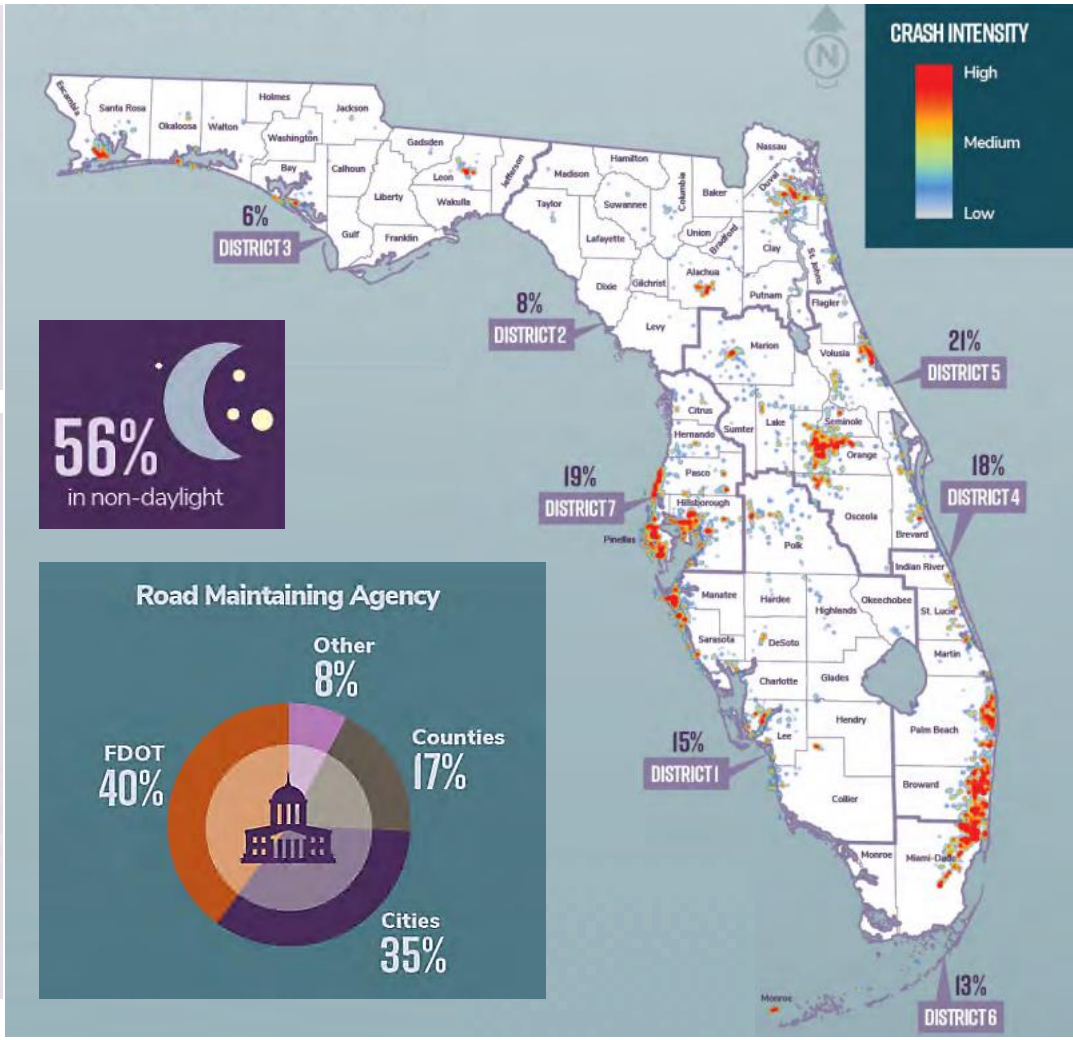


Intersections

26% Pedestrians

47% Cyclists





Pedestrian Fatalities and Serious Injuries at Midblock Locations – Most Common Conflicts

PEDESTRIAN FAILED TO YIELD AT MIDBLOCK LOCATION

MOTORIST FAILED TO YIELD AT MIDBLOCK LOCATION

DASH AT MIDBLOCK LOCATION

DART-OUT AT MIDBLOCK LOCATION

47% IN C3C

36% IN C4

62% ON 40 AND 45 MPH ROADS

87% ON 4 AND 6-LANE ROADS

80% IN DARK CONDITIONS

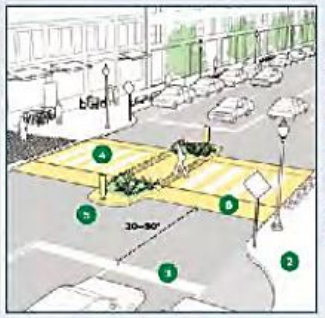
FDOT

TARGET ZERO
FATALITIES & SERIOUS INJURIES

Proven Effective Midblock Countermeasures

High-visibility crosswalks can help make pedestrians on the crosswalk more visible and reduce pedestrian injury crashes up to 40%. Data and Image Source: FHWA

Pedestrian refuge islands can reduce pedestrian crashes by 32%. Data and Image Source: FHWA



Raised crossings make the pedestrian more prominent in the driver's field of vision. Approach ramps may reduce vehicle speeds and improve motorist yielding and reduce pedestrian crashes by 45%. Data Source: FHWA; Image Source: NACTO

Advance stop or yield markings improve visibility of pedestrians; prevent multiple-threat crashes and reduce pedestrian crashes up to 25%. Data Source: FHWA; Image Source: SR A1A in Brevard County

Pedestrian Hybrid Beacons are ideal for multilane roadways and can reduce pedestrian crashes by 55%. Image Source: PHB on US 441 in Orange County

In-pavement flashing lights reinforced by well maintained retro reflective markings can enhance crosswalk visibility at night. Image Source: SR A1A in Brevard County

Pedestrian scale lighting increases visibility of pedestrians in the crosswalk and provides a feeling of safety and security to pedestrians crossing the road. Image Source: US 441 rendering in Orange County

Rapid Rectangular Flashing Beacons can reduce crashes up to 47% and increase motorist yielding rates up to 98%. Data Source: FHWA Image Source: RRFB on SR A1A in Brevard County

Curb extensions improve the ability of pedestrians and motorists to see each other and reduces crossing distance.
Photo Source: NACTO Urban Street Design Guide

Project Highlights

‘New’ Tools for Pedestrian Safety

- ✓Channelization
- ✓Raised Crosswalks
- ✓Speed Management

District Experiences:

Tracey Xie, P.E.
District 4 Traffic Safety Program Engineer

Misleidys Leon, P.E.
District 6 Traffic Safety Program Engineer

Naziru Isaac, P.E.
District 5 Roadway Design Engineer

Pedestrian Channelization Barrier Before/After Study – District 4

FDOT

TARGET ZERO
FATALITIES & SERIOUS INJURIES

June 13, 2024

Guidelines to identify/prioritize locations

Two Tier Process:

- Demand Based Screening – Identify locations with potential for high pedestrian/bicycle traffic

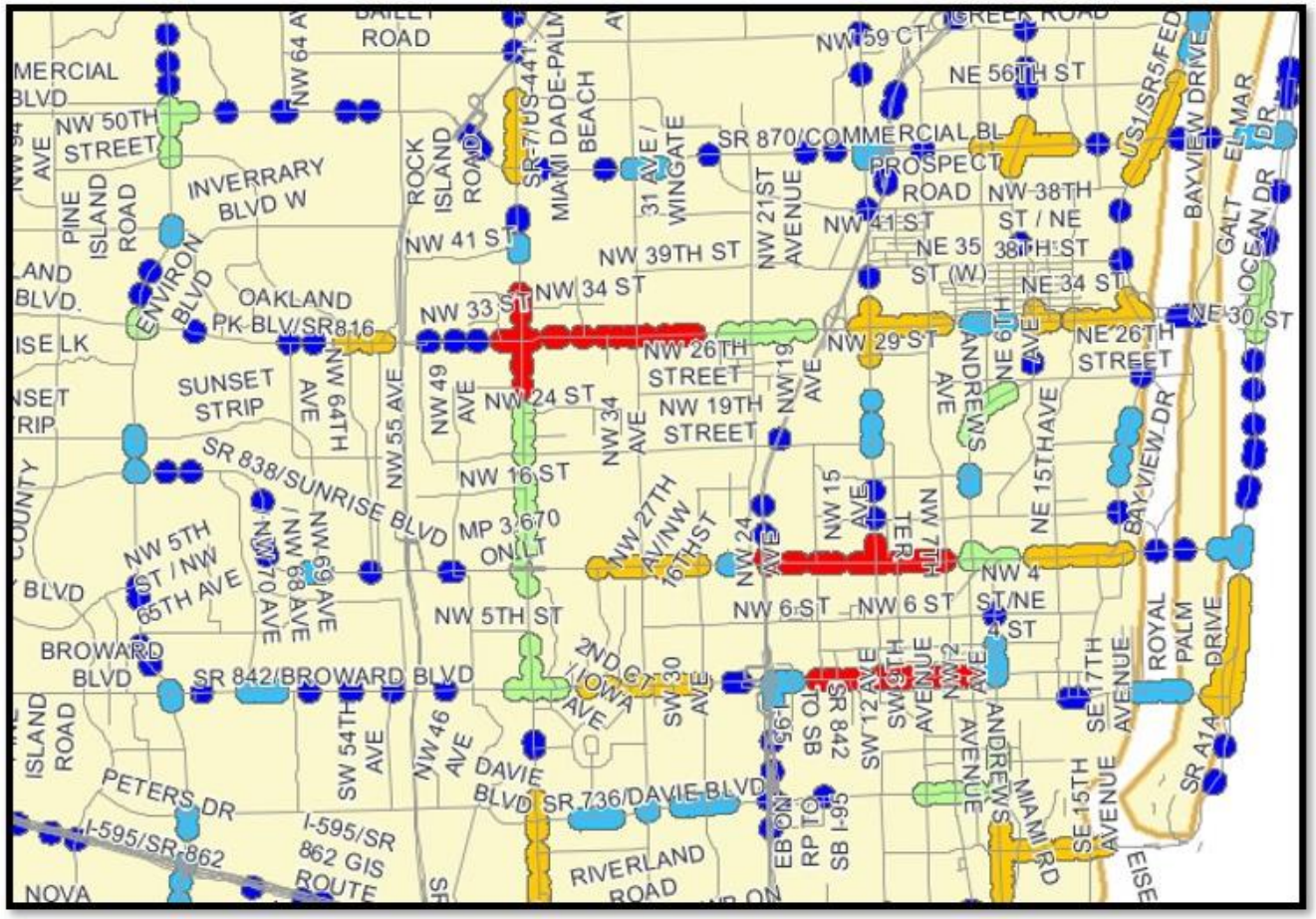
  ✓Identify generators such as Bus Stops, Park, Schools, Libraries, Convenience Stores, etc.

  ✓Account for socioeconomic factors such as population density, auto ownership, age, low-income areas, etc.

- Facility Based Screening - Based on Risk Factors/Potential for crashes

  ✓Median width, speed limit, & number of lanes, ADT

  ✓Lack of facilities (bike lanes, sidewalks, crosswalks, lighting, etc.)



SR 816 (Oakland Park Blvd.) between NW 55th Ave and NW 56th Ave

Installed between February 2017 and July 2017

Location Characteristics:

- Six-lane divided w/ raised median (18 to 20’ median; 4 to 5’ traffic separator); 45 mph speed limit
- Two signalized intersections (apprx. 900’ apart);
- Seven bus stops in the vicinity; (2 along OPB, EB 400’ E. of 56th Ave; and WB 100’ W. of 55th Ave);
- Surround land uses (Shopping Plazas, Restaurants, City Hall); Residential areas north/south of OPB

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TARGET ZERO FATALITIES & SERIOUS INJURIES

Pedestrian Channelization Barrier

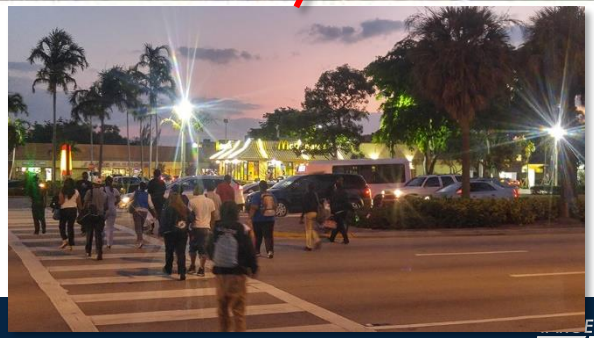
Median Barrier

Roadside Barrier

Before/After Study - Approach

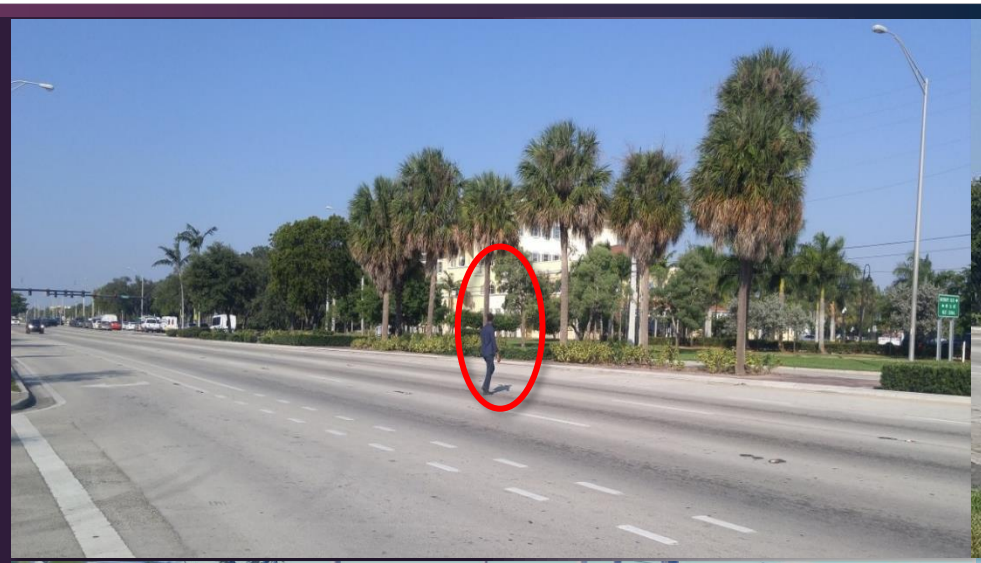
- Simple Before/After Study (no control site)
- Data Collection (before and after periods)
  - Data collection by zone (total of 5 zones)
  - Pedestrian/bicycle crossing counts collected on weekday and weekend
    - 13-hour video recording (by Caltrans)
    - Summarize number of crossings by zone
- Field Reviews (before and after periods)
  - Observe pedestrian/bicycle crossing behavior/path during peak periods
- Measures of Effectiveness
  - Number of pedestrian/bicycle crossings
  - Percentage of pedestrian/bicycle crossings by zone
- Before/After Comparison
- Statistical Analysis
  - Z-test

Data Collection Zones



Pedestrian Crossing (August 2017)

“Before” Condition



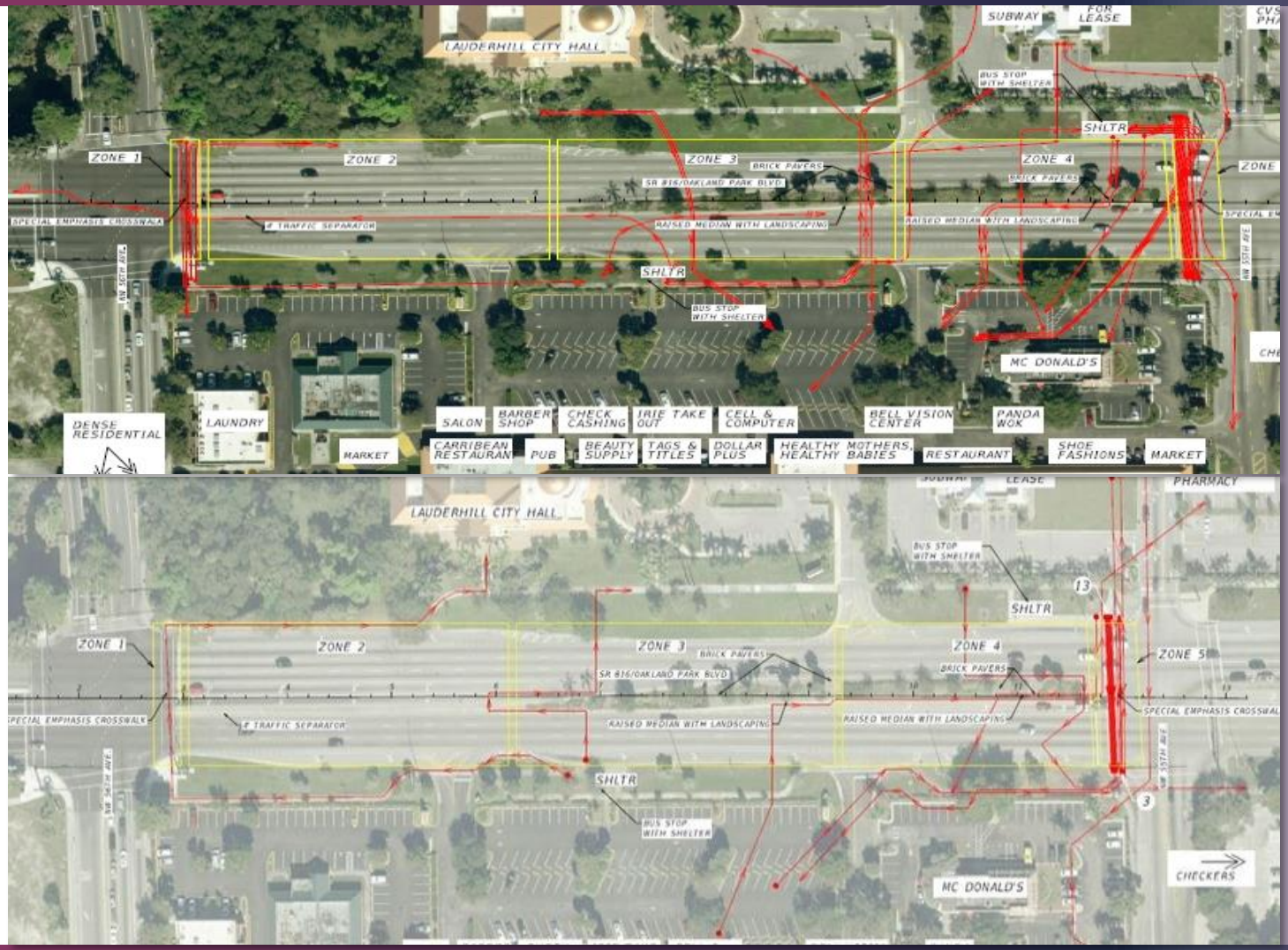
“After” Condition

Pedestrian Crossing (May 28, 2024; 5.30-6.30 PM)

Pedestrians Crossing from WB Bus Stop in Zones 4 and 5 (“After” Condition)

Pedestrian Crossing in the crosswalk (“After” Condition)

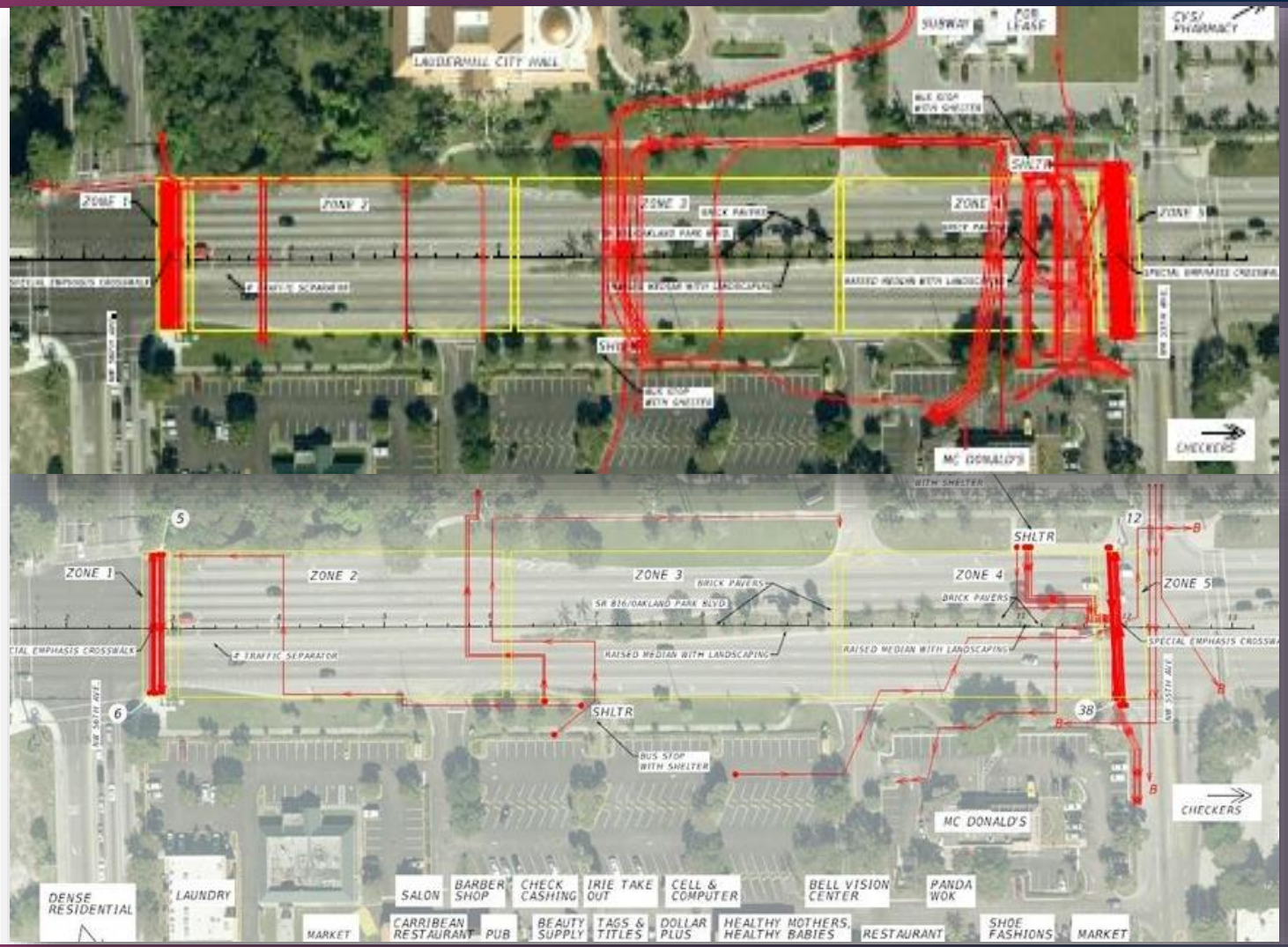
Pedestrian/Bicycle Crossing Paths - AM



Before (50%Crosswalk; 50% Midblock)

After (83%Crosswalk; 17% Midblock)

Pedestrian/Bicycle Crossing Paths - PM



Before
(61% Crosswalk;
39% Midblock)

After
(86%Crosswalk;
14% Midblock)

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TARGET ZERO
FATALITIES & SERIOUS INJURIES

Pedestrian Crossing Paths (May 28, 2024; 5.30-6.30 PM)

Statistical Analysis Results

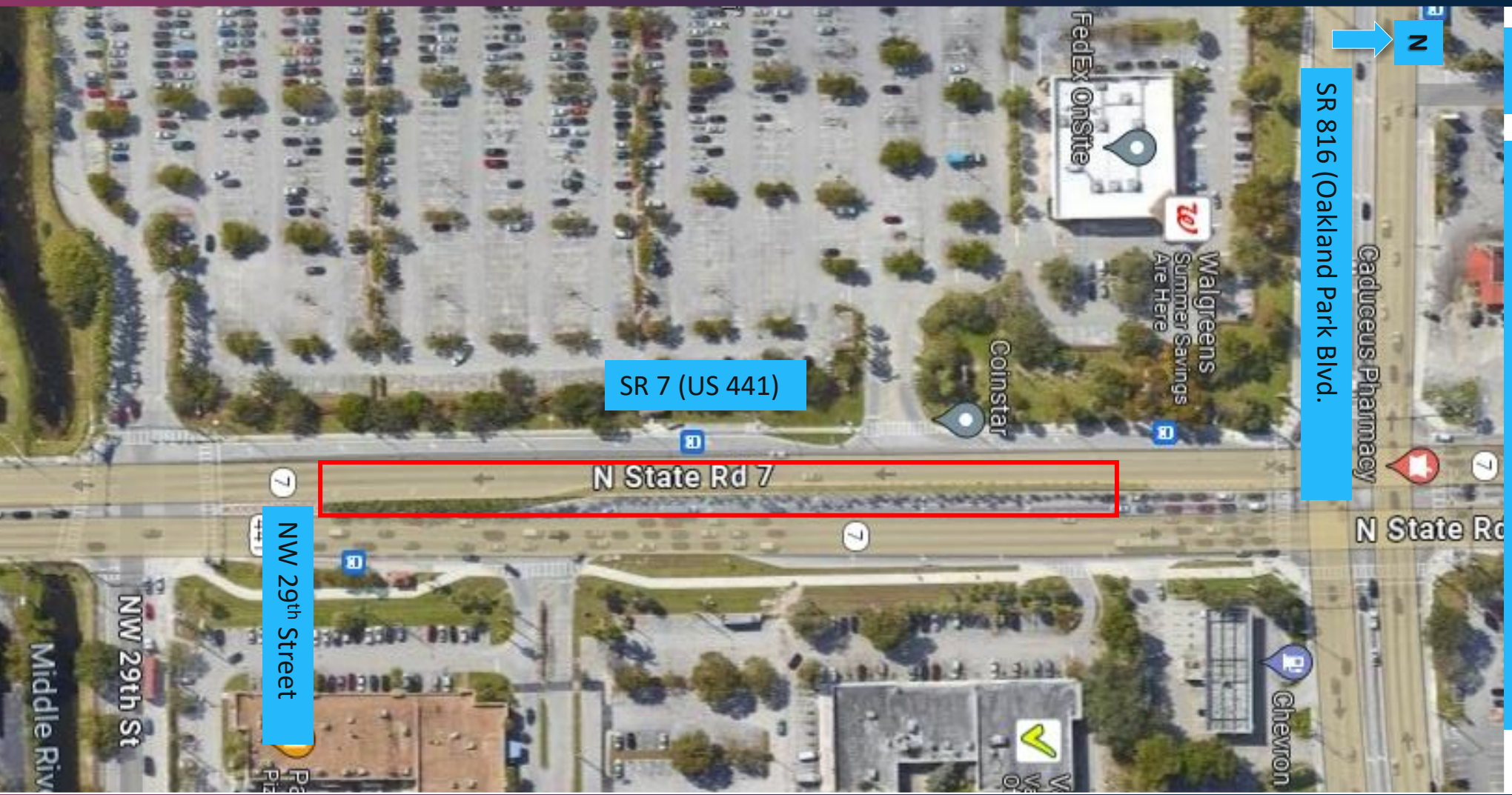
Day of Week	Crossing Location	Proportion of Pedestrians/Bicycles Crossing		Z-Value	Significant at 95% Confidence Level
		Before	After		
Wednesday	Crosswalks (Zones 1 & 5)	70%	87%	7.2050	Yes
	Midblock Locations (Zones 3 & 4)	25%	5%	9.7063	Yes
	Midblock Location (Zone 2 - barrier on the south side of roadway; no barrier in median)	5%	8%	2.1220	Yes
Saturday	Crosswalks (Zones 1 & 5)	66%	84%	6.6816	Yes
	Midblock Locations (Zones 3 & 4)	27%	11%	6.6426	Yes
	Midblock Location (Zone 2 - barrier on the south side of roadway; no barrier in median)	7%	5%	1.1922	No
Wednesday + Saturday	Crosswalks (Zones 1 & 5)	68%	85.6%	9.9228	Yes
	Midblock Locations (Zones 3 & 4)	26%	7.53%	11.6435	Yes
	Midblock Location (Zone 2 - barrier on the south side of roadway; no barrier in median)	6%	6.87%	0.7580	No

No. of Peds/Bikes:
1216 1063

Conclusions

- Median barrier (in Zones 3 and 4)
  - Pedestrian/bicycle crossings at midblock locations reduced from 32% to 14%
  - Pedestrian/bicycle crossings at adjacent crosswalks increased from 68% to 86%
  - Results indicate that most pedestrians/bicyclists who were crossing at midblock locations before are now using the crosswalks
  - Separate comparisons of data collected on weekday/weekend indicated similar results
- Roadside barrier (south side of the roadway in Zone 2)
  - Overall, no significant difference between before/after periods (6% vs. 6.87%)
  - Midblock crossings in Zone 2 increased from 5% to 8% based on data collected on Wednesday; Reduced from 7% to 5% based on data collected on Saturday
  - Number of crossings in Zone 2 were relatively low (49 before vs. 61 after)

SR 7 (US 441) between Oakland Park Blvd. and NW 29th Street



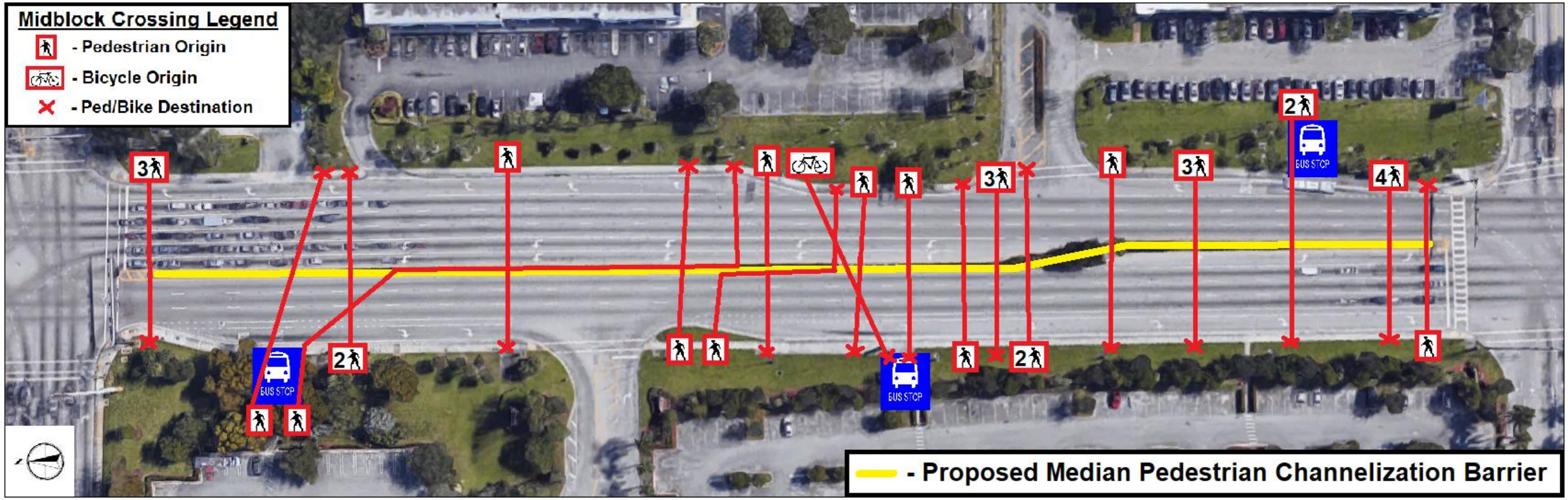
Installed between July 2019 and May 2020

Location Characteristics:

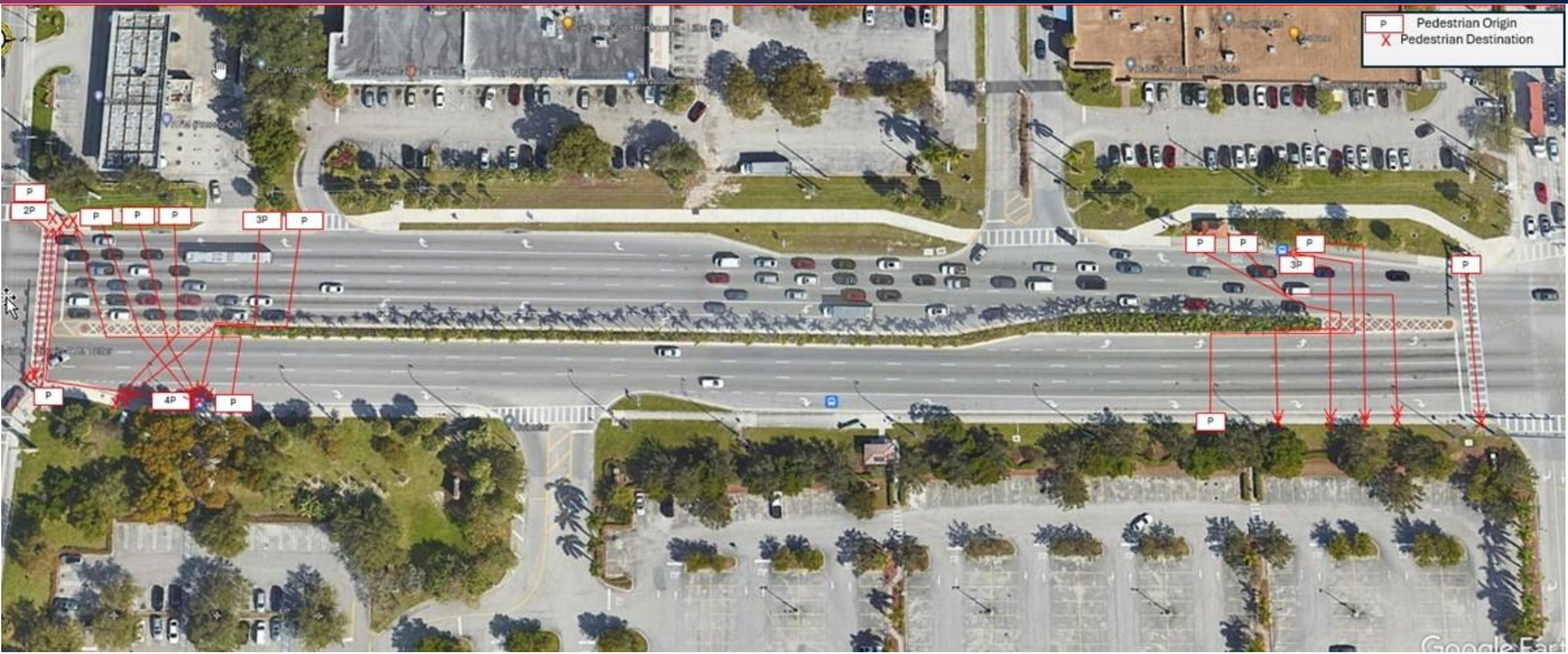
- Six-lane divided w/ raised median (12 to 16’ median; 9 to 12’ traffic separator); 40 mph speed limit
- Two signalized intersections (apprx. 1,150’ apart);
- Three bus stops along OPB (2 SB, 1 NB) within the study area;
- Surround land uses (Shopping Plazas, Restaurants, Gas Station, Pharmacy, Government Offices)

Pedestrian Channelization Barrier – Before/After

Pedestrian Crossing Paths - Before



Pedestrian Crossing Paths - After

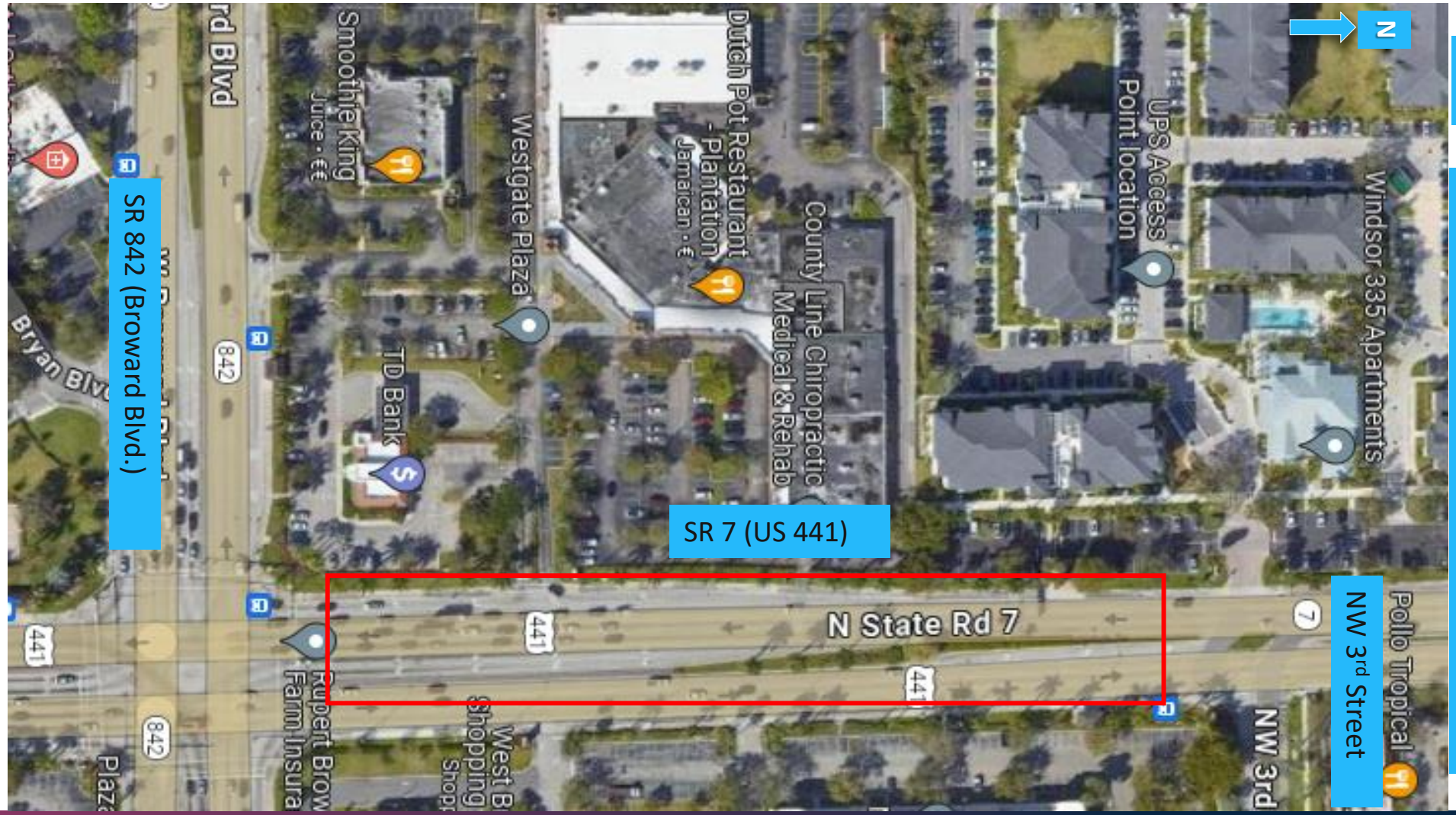


Pedestrian Crossing – Before/After

Pedestrian Behavior Observations (May 28, 2024; 4:45-6 PM)

- Total Pedestrians Observed crossing SR 7 = 24 pedestrians
- Pedestrians crossing at crosswalks= 9 (38%)
- Pedestrians crossing at the traffic separator= 15 (62%)
  - Pedestrians walking along the median barrier = 7
  - Pedestrians crossing at the transit bus stop (between OPB & NW 29th Street) = 0
- Pedestrians crossing within the segment with median barrier= 0

SR 7 (US 441) between Broward Blvd. and NW 3rd Street



Installation from January 2024 to April 2024

Location Characteristics:

- Six-lane divided w/ raised median (10 to 20’ median; 8 to 9’ traffic separator); 40-45 mph speed limit
- One signalized intersection and one directional median opening (apprx. 950’ apart);
- One bus stop along OPB in NB direction within the study area;
- Surround land uses (Shopping Plazas, Restaurants, Pharmacy, Banks)

Pedestrian Crossing Paths – Before/After

Gaps in Pedestrian Channelization Barrier

Field Observations

- Multiple pedestrians crossing at traffic separator where no median fences (45-50 feet from crosswalks)
- Multiple pedestrians crossing at a gap for landscape in the pedestrian channelization barrier
- One pedestrian crossing in crosswalk then walking diagonally to the bus stop.

Lessons Learned/Conclusions

- Extend the pedestrian channelization barrier up to the crosswalk. If not feasible, install Do Not Cross and Use Crosswalk signs whenever a gap exists.
- Do not leave any gaps within the pedestrian channelization barrier.
- Relocate bus stops as close to the crosswalks as possible.
- Install landscaping to the entire width of the median to reduce the potential for pedestrians to walk parallel to the median.

DISTRICT 6

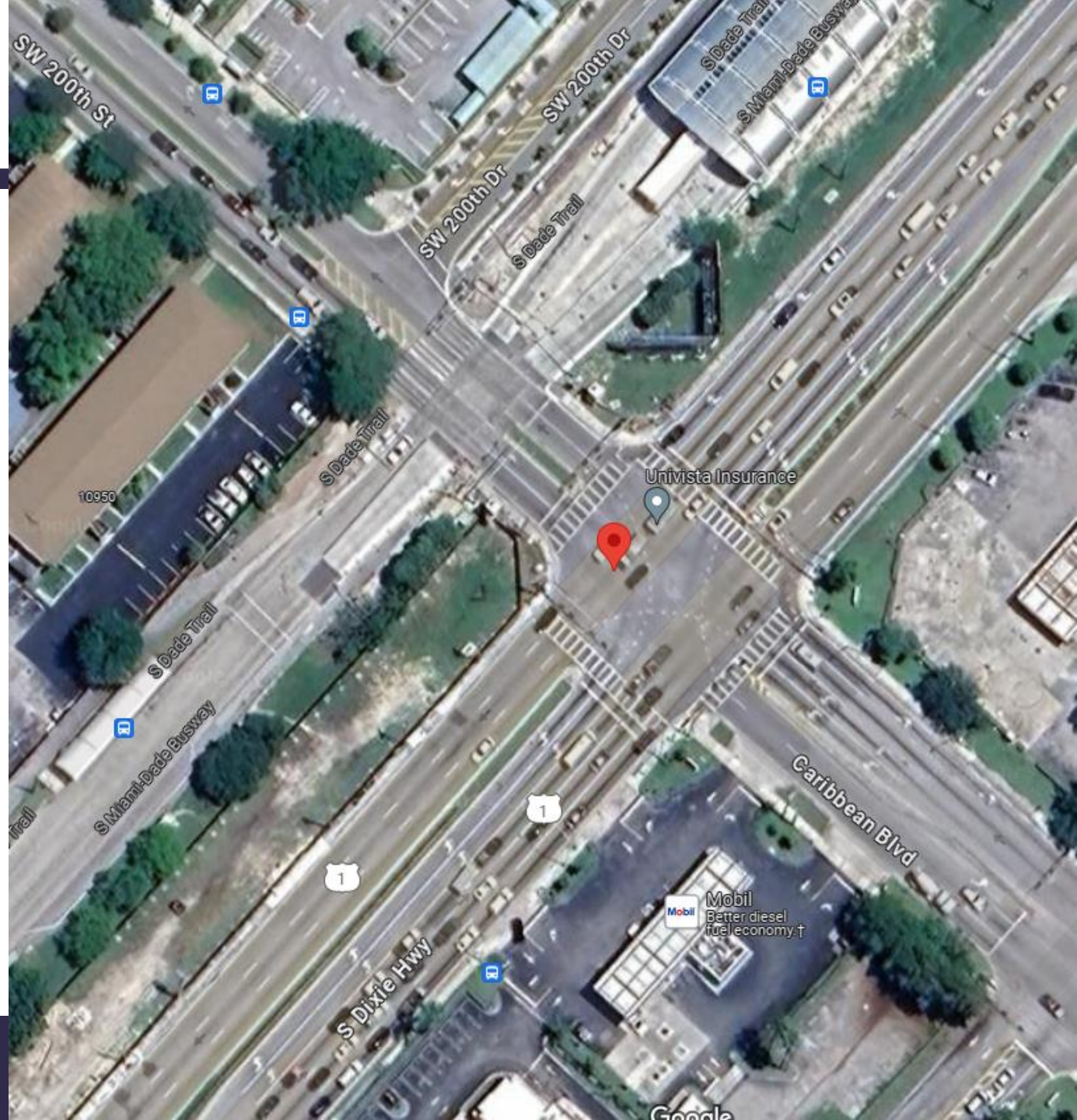
PEDESTRIAN COUNTERMEASURES

1. **PEDESTRIAN CHANNELIZATION**

2. **RAISED CROSSWALKS**

PEDESTRIAN CHANNELIZATION

SR 5/US-1 and SW 200 St



PEDESTRIAN CHANNELIZATION

US-1 AND SW 200 St

- North – south urban principal arterial
- Six lanes divided by 4 ft traffic separators
- Posted speed is 45 mph
- 12 ft lanes
- No crosswalks on the north and west legs
- Pedestrian activity is generated by bus stops and residential buildings

PEDESTRIAN CHANNELIZATION

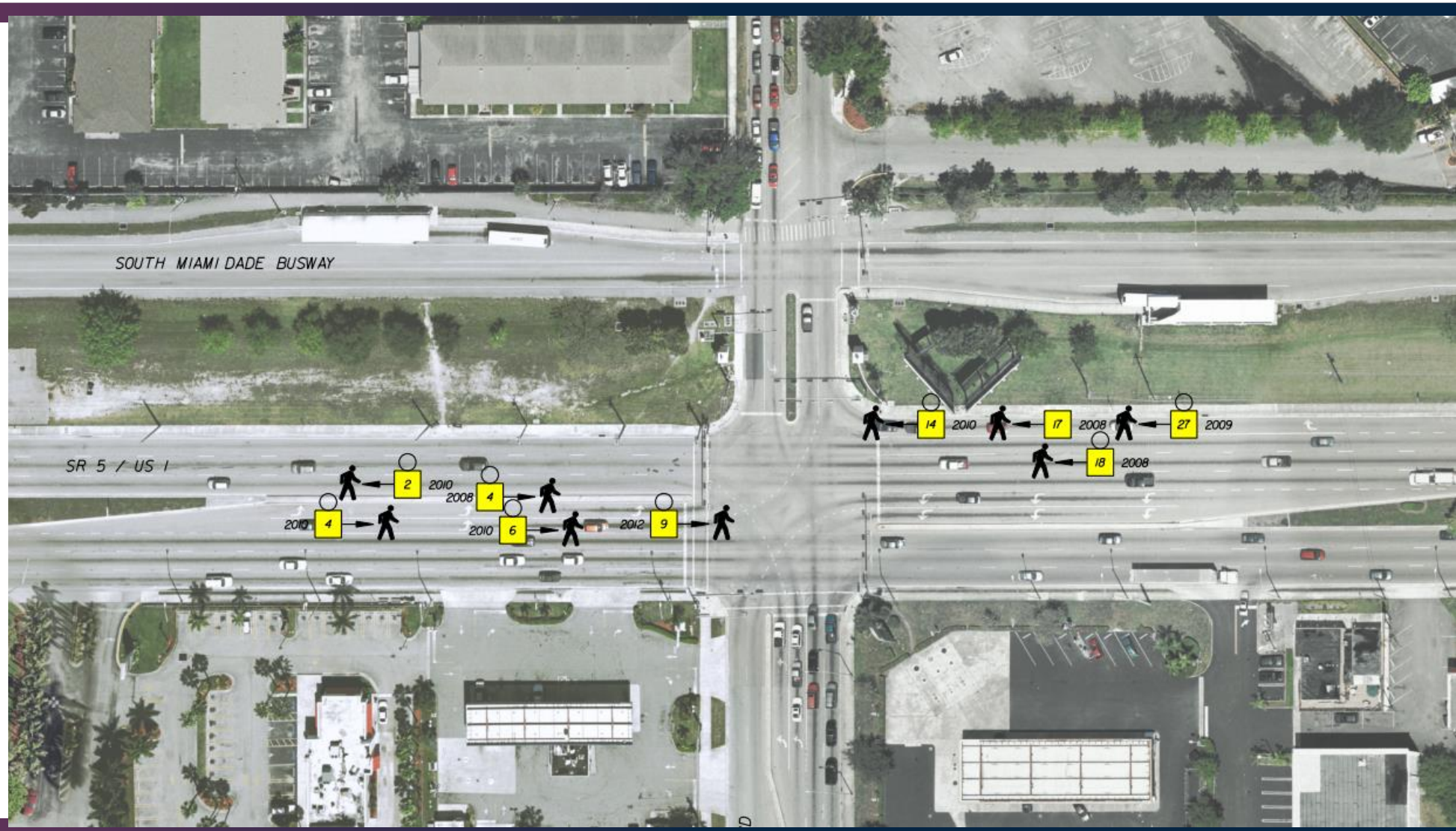
Crash Analysis

US 1 at Caribbean Blvd 6 Lane x 4 Lane, Signalized, with Turn Lanes, 4 Leg Intersection		Number of Crashes Year 2008	2009	2010	2011	2012	5 Year Total Crashes	Mean Crashes Per Year	%	Expected Annual Crash Value Abnormally High Crashes per year 90th percentile	95th percentile	Abnormal 90th Percentile	Abnormal 95th Percentile
CRASH TYPE	Rear End	11	11	13	14	10	59	11.80	47.6%	17.26	18.90		
	Head On	0	0	1	1	1	3	0.60	2.4%	1.64	1.84		
	Angle	2	0	1	4	2	9	1.80	7.3%	9.19	9.92		
	Left Turn	1	4	1	0	0	6	1.20	4.8%	6.13	6.73		
	Right Turn	0	1	0	0	0	1	0.20	0.8%	1.36	1.53		
	Sideswipe	4	4	2	0	0	10	2.00	8.1%	4.92	5.37		
	Backed Into	0	0	0	0	0	0	0.00	0.0%	0.84	0.94		
	Coll. w/ Parked Car	0	1	0	0	0	1	0.20	0.8%	0.57	0.65		
	Coll. w/ Pedestrian	4	1	4	0	0	9	1.80	7.3%	1.80	2.00	X	
	Coll. w/ Bicycle	0	0	0	0	1	1	0.20	0.8%	0.49	0.55		
	Fixed Object	0	3	0	0	1	4	0.80	3.2%	2.01	2.24		
	Ran Off Road	0	0	0	0	0	0	0.00	0.0%	0.11	0.13		
	Overturned	0	0	0	0	0	0	0.00	0.0%	0.28	0.33		
	Other	0	3	3	6	9	21	4.20	16.9%	21.05	23.42		
	Total Crashes	**22**	**28**	**25**	**25**	**24**	**124**	**24.80**	**100.0%**	**54.94**	**59.43**		

- 9 Pedestrian crashes
- 1 Bicycle crash
- 50% occurred midday
- 50% occurred at night
- Review of the police reports revealed most of the crashes involved pedestrians crossing at undesignated locations

PEDESTRIAN CHANNELIZATION

Collision Diagram



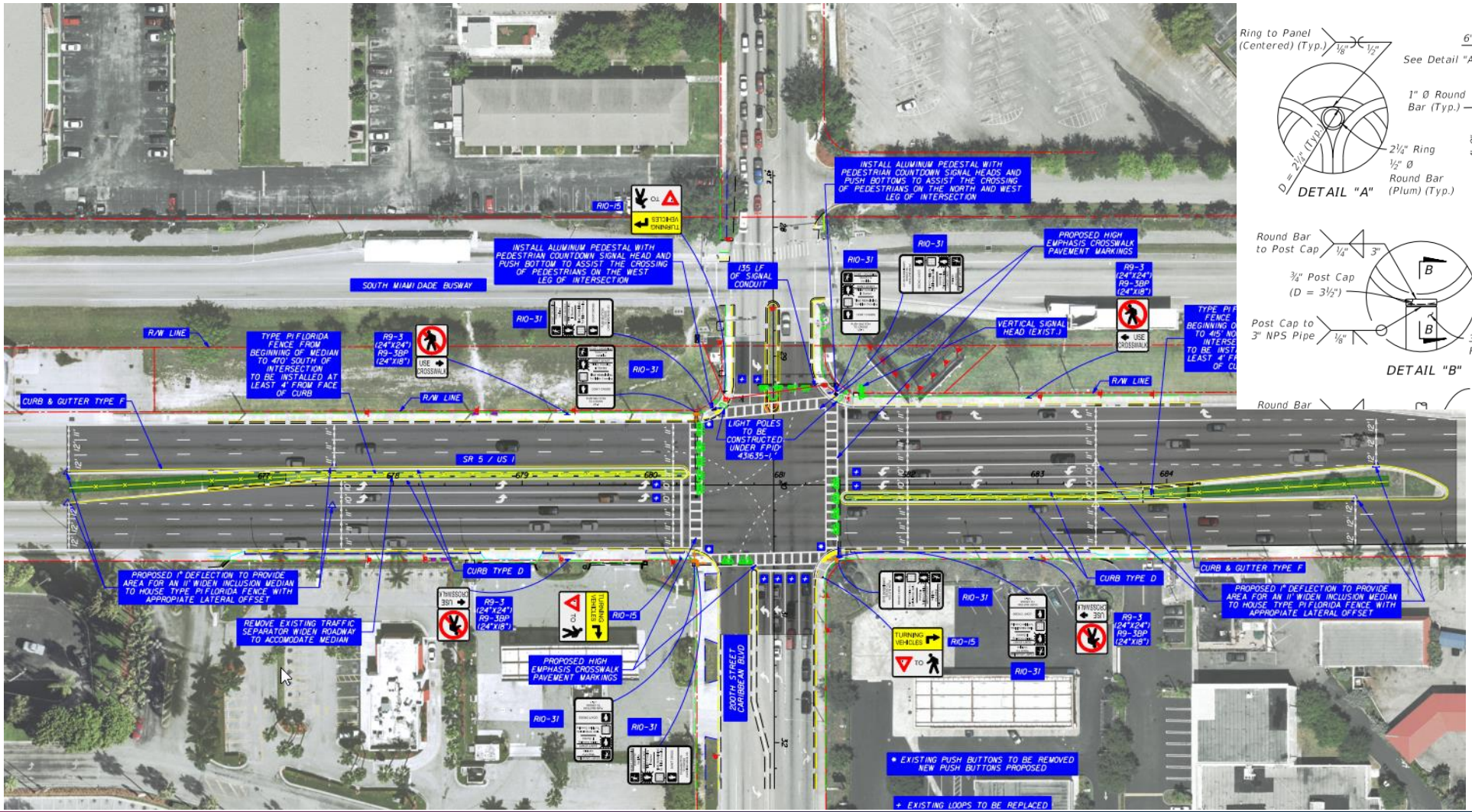
PEDESTRIAN CHANNELIZATION

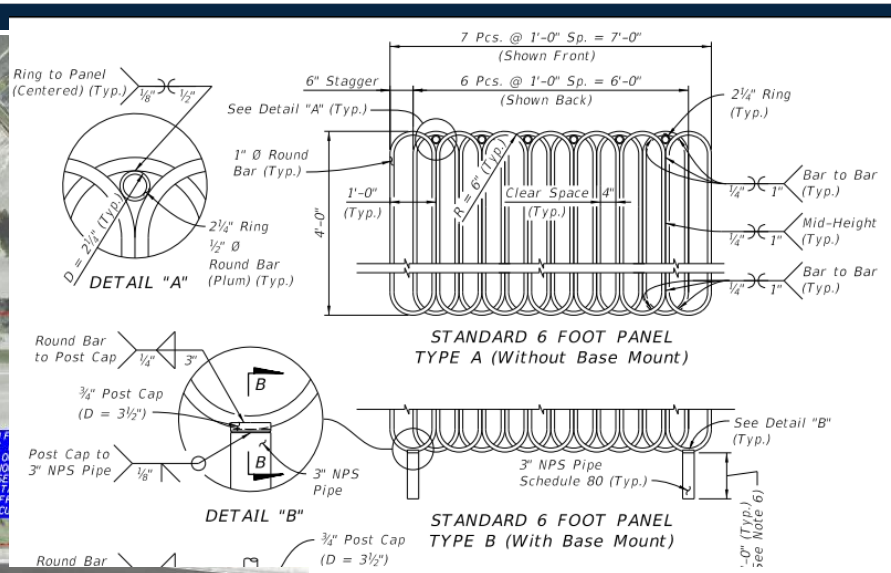
Proposed Improvements

- Provide new crosswalks on the north and west legs
- Install pedestrian push buttons on all legs
- Reduce the lane widths to 11 ft to widen median to accommodate a steel loop fence and landscaping
- Install roadway lighting
- Install signage directing pedestrians to use crosswalks

PEDESTRIAN CHANNELIZATION

Proposed Improvements



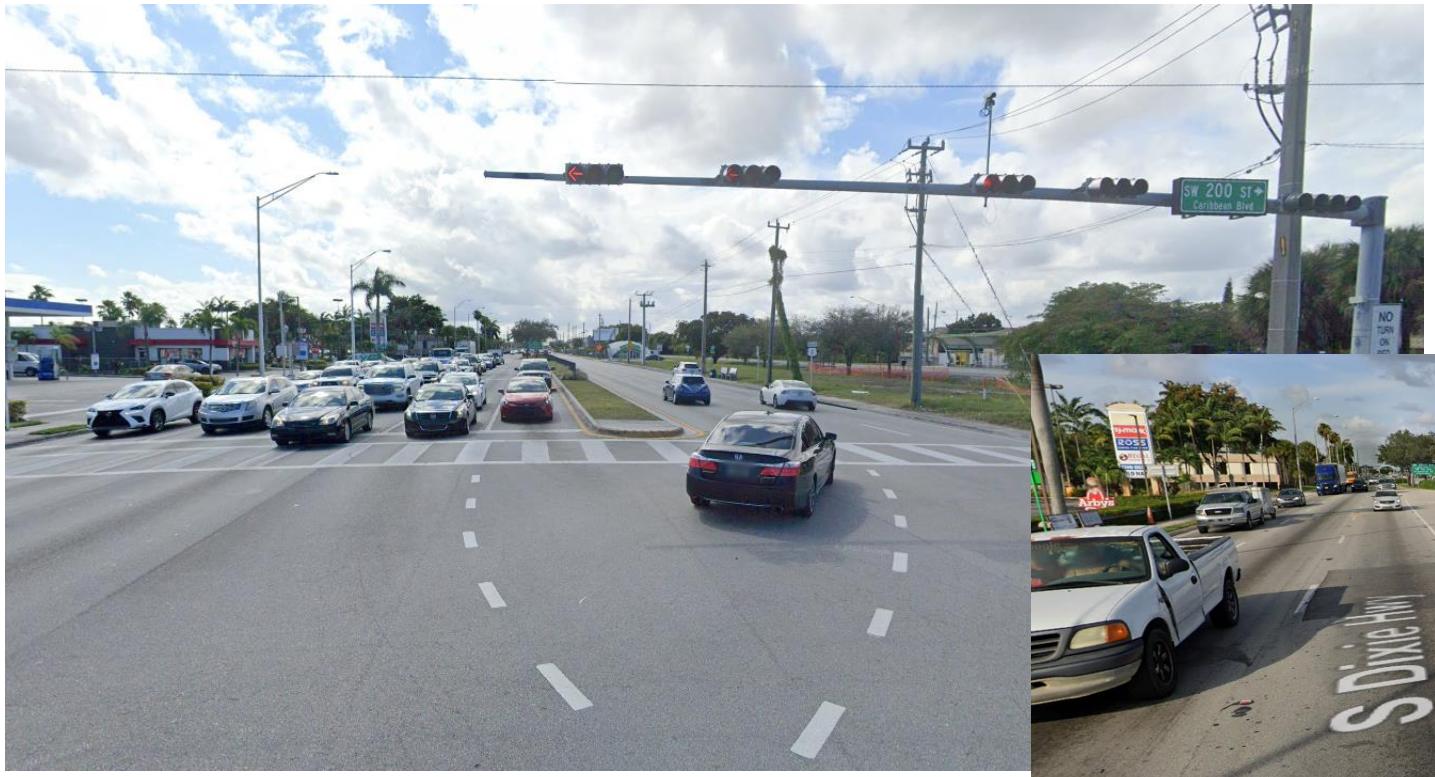


PEDESTRIAN CHANNELIZATION

Before		After	
9	pedestrian crashes	3	pedestrian crashes
1	bicycle crash	0	bicycle crashes
0	fatalities	1	fatality
10	injury crashes	2	injury crashes

- 70% reduction in crash frequency
- Severity increased
- Fatality involved pedestrian walking into the vehicle's path making a U turn
- Recommended to coordinate education

PEDESTRIAN CHANNELIZATION

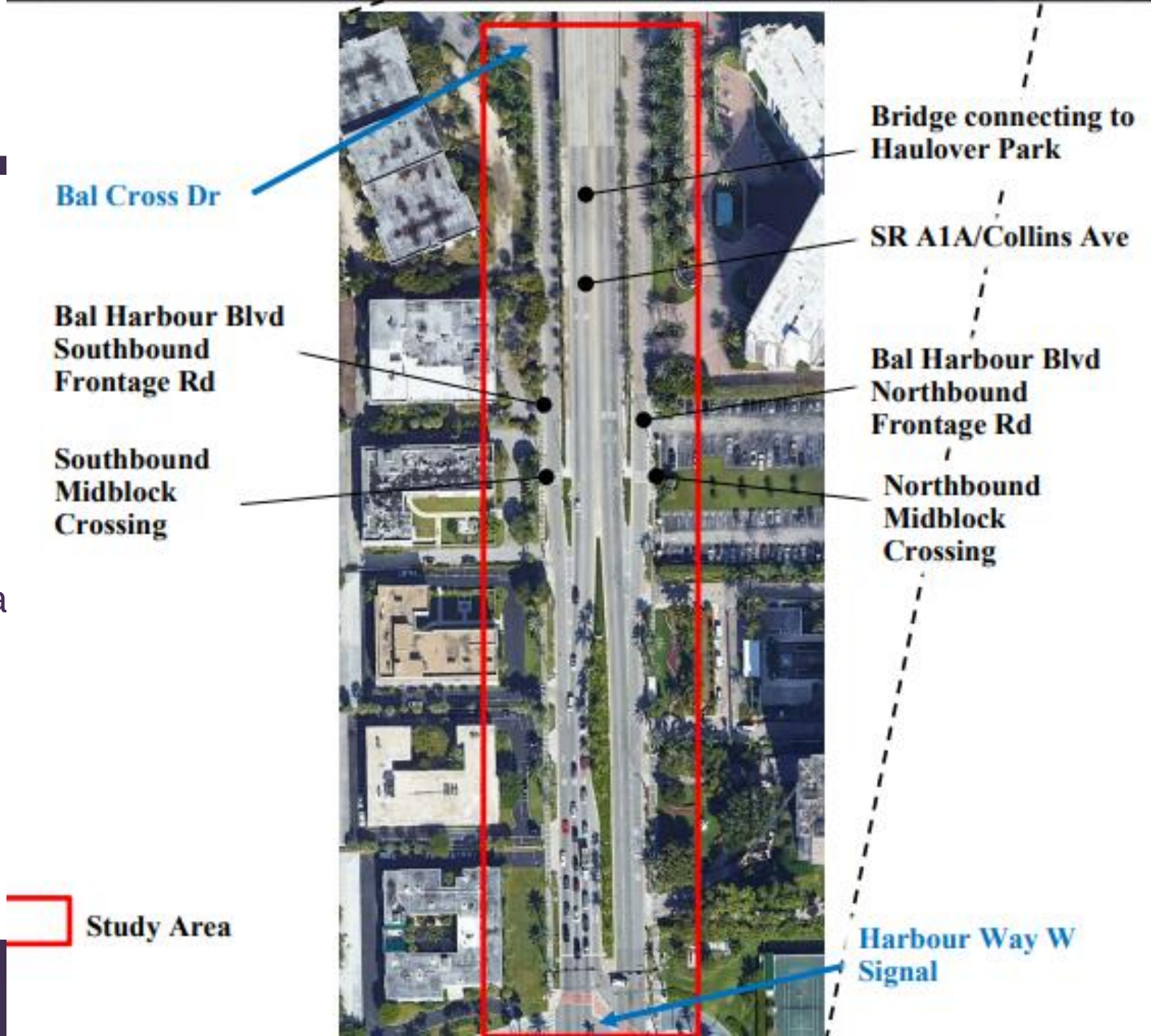


RAISED CROSSWALKS

SR A1A/ Collins Ave from Harbour Way to Bal Cross Drive

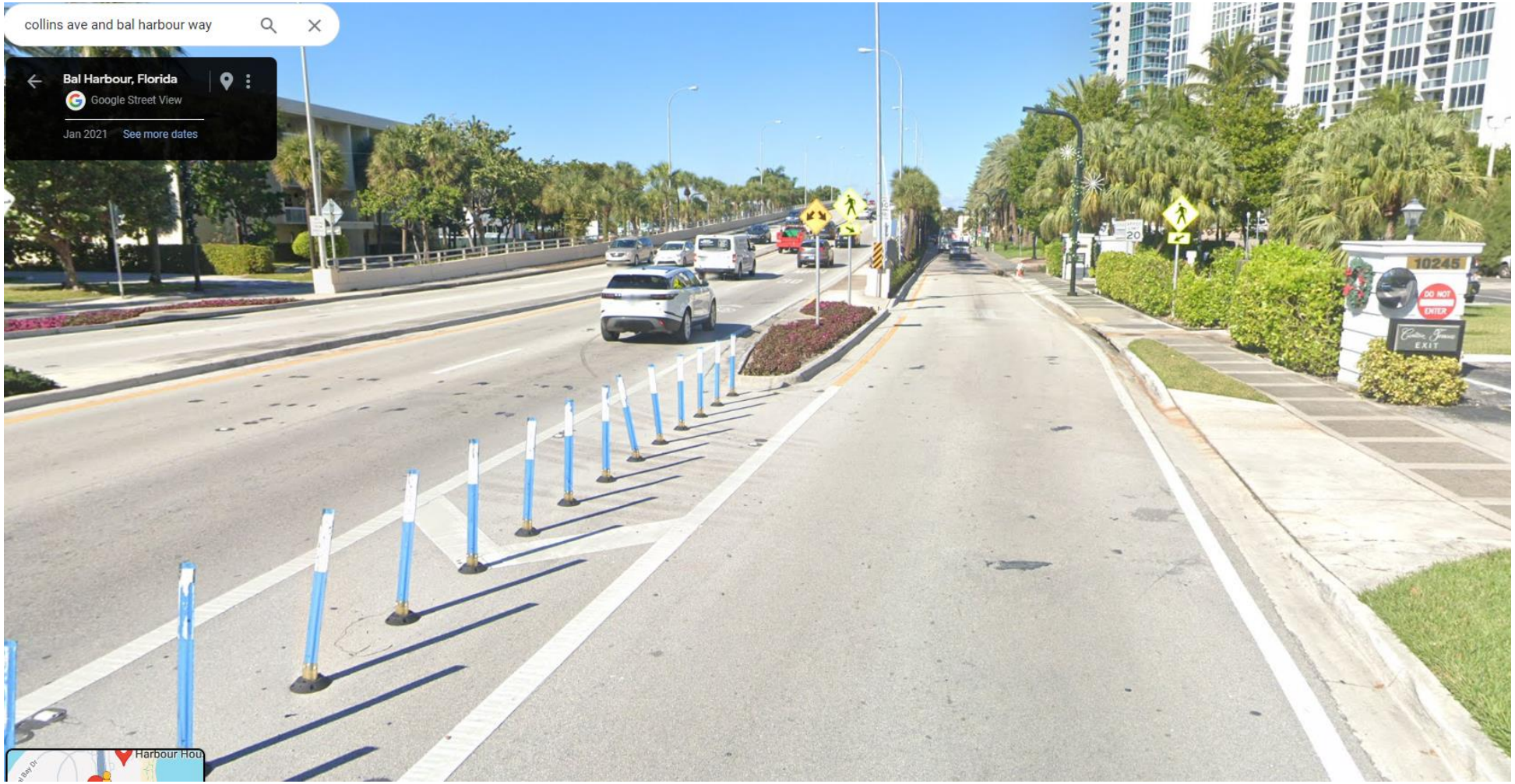
Study was initiated from a review of a bicycle fatality

Bicyclist was crossing at the crosswalk from east to west and was struck by a vehicle traveling northbound on the frontage road



RAISED CROSSWALKS

SR A1A/ Collins Ave from Harbour Way to Bal Cross Drive



RAISED CROSSWALKS

SR A1A/ Collins Ave from Harbour Way to Bal Cross Drive

- Collins Ave is a six-lane divided roadway. Posted speed is 30 mph
- Outside through lane becomes a frontage road.
- Frontage Road posted speed is 20 mph
- Context Class is C4 Urban General Mix
- Sharrows

RAISED CROSSWALKS

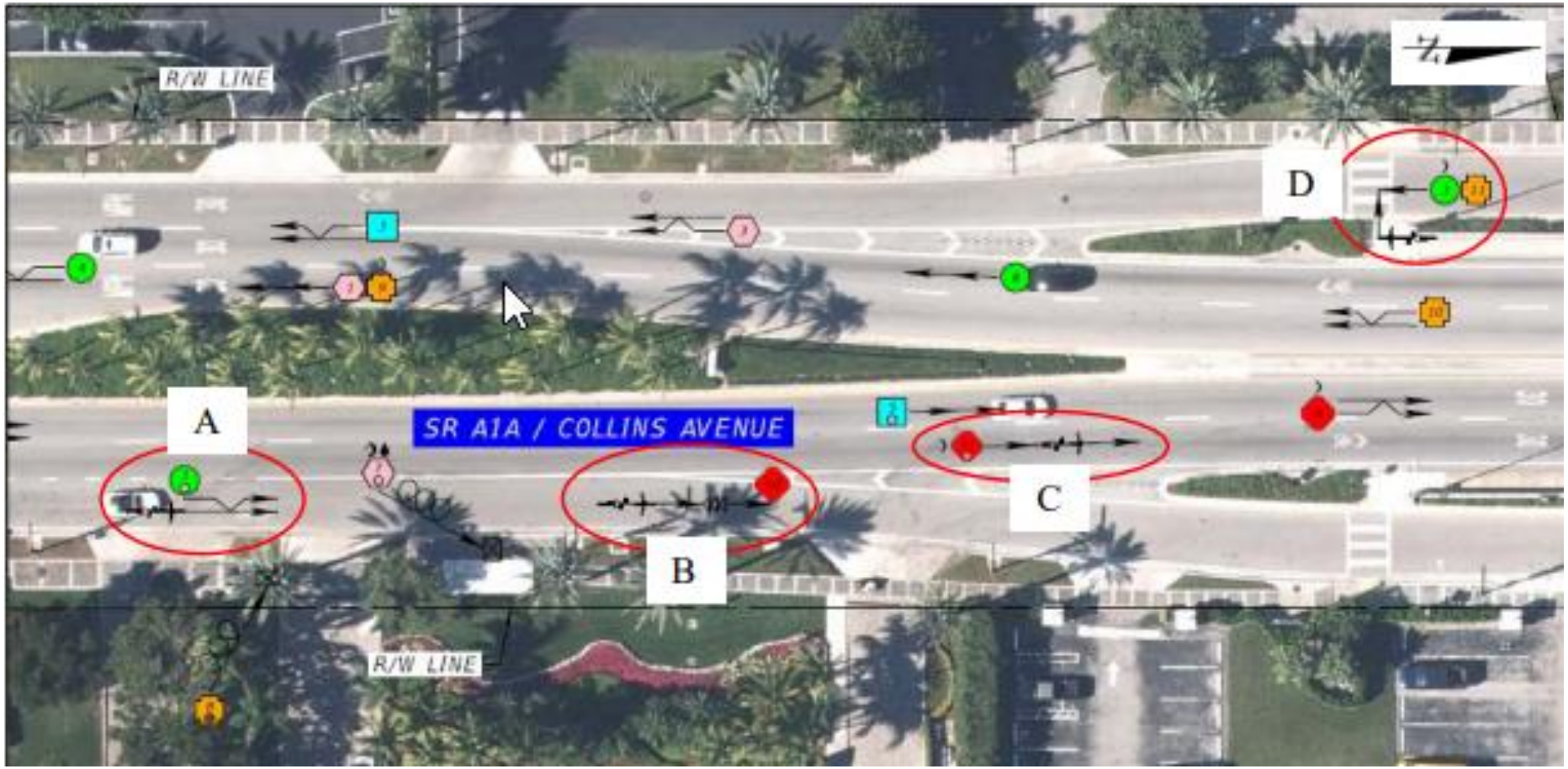
Crash Analysis

- 7 bicycle crashes reported in 5 years
- 3 bicycle crashes occurred on northbound approach
- Bicycle fatality occurred on northbound approach

SR A1A/Collins Avenue Study Segment Segment/Spot with No Expected Values Available		Number of Crashes Year 2014	2015	2016	2017	2018	5 Year Total Crashes	Mean Crashes Per Year	%
CRASH TYPE	Rear End	4	4	5	4	5	22	4.40	44.0%
	Head On	0	0	0	0	0	0	0.00	0.0%
	Angle	0	0	0	0	1	1	0.20	2.0%
	Left Turn	0	0	0	0	1	1	0.20	2.0%
	Right Turn	0	0	1	0	0	1	0.20	2.0%
	Sideswipe	1	3	2	4	3	13	2.60	26.0%
	Backed Into	0	0	0	0	0	0	0.00	0.0%
	Pedestrian	0	0	0	0	0	0	0.00	0.0%
	Bicycle	0	2	2	1	2	7	1.40	14.0%
	Fixed Object	0	1	1	1	2	5	1.00	10.0%
	Other Non-Collisions	0	0	0	0	0	0	0.00	0.0%
	Overturn/Rollover	0	0	0	0	0	0	0.00	0.0%
	Others	0	0	0	0	0	0	0.00	0.0%
	Total Crashes	**5**	**10**	**11**	**10**	**14**	**50**	**10.00**	**100.0%**
SEVERITY	PDO Crashes	3	8	9	7	11	38	7.60	76.0%
	Fatal Crashes	0	0	0	0	0	0	0.00	0.0%
	Injury Crashes	2	2	2	3	3	12	2.40	24.0%

RAISED CROSSWALKS

Collision Diagram



RAISED CROSSWALKS

Speed Study

- Study confirmed speeding along mainline on Collins Ave and along frontage roads

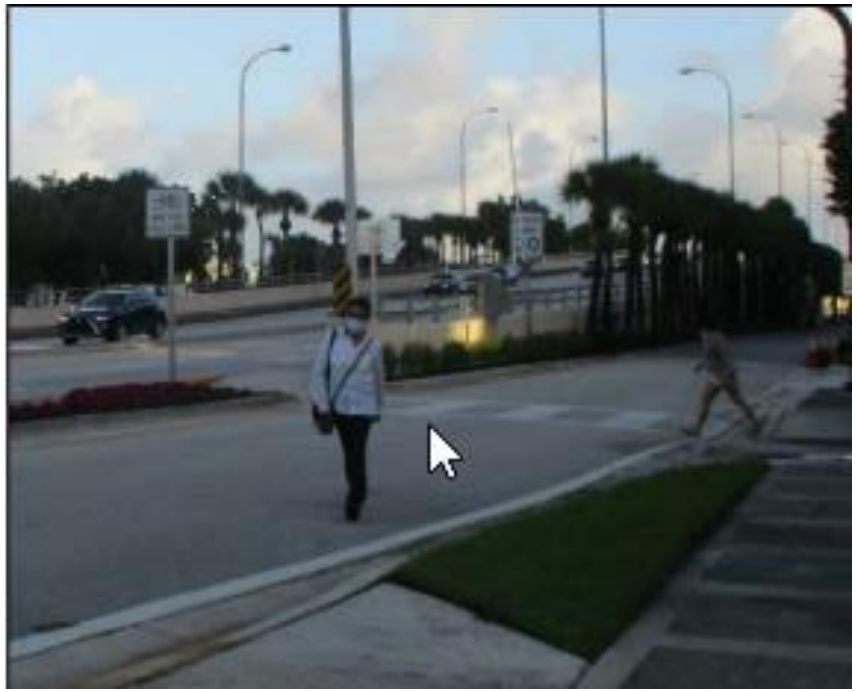
Pedestrians and Bicyclists Activity

- 214, 178, and 281 bicyclists crossed at the midblock crossing
- 90 senior pedestrians used the midblock crossing

RAISED CROSSWALKS

Field Reviews

- Motorist did not slow down or stopped for pedestrians at midblock crossings



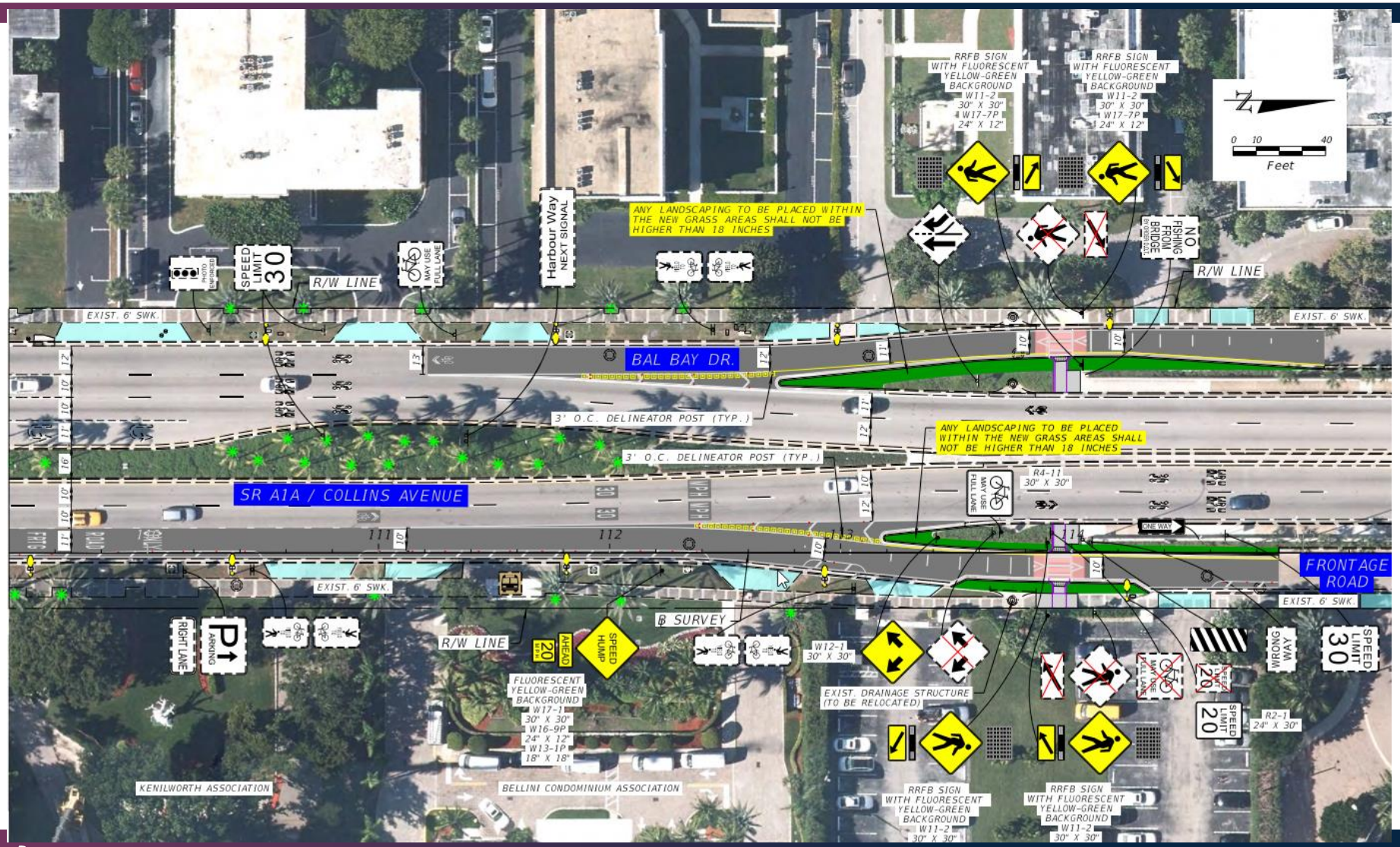
RAISED CROSSWALKS

Proposed Improvements

- Reduce the lane widths for northbound and southbound frontage roads
- Extend gore area of the frontage road
- Install additional delineators in the gore area
- Provide a raised crosswalk controlled with a rectangular rapid flashing beacon (RRFB)
- Provide 20 mph and 30 mph pavement markings
- Provide transverse speed lines pavement markings across frontage roads approaching midblock crossings

RAISED CROSSWALKS

Proposed Improvements

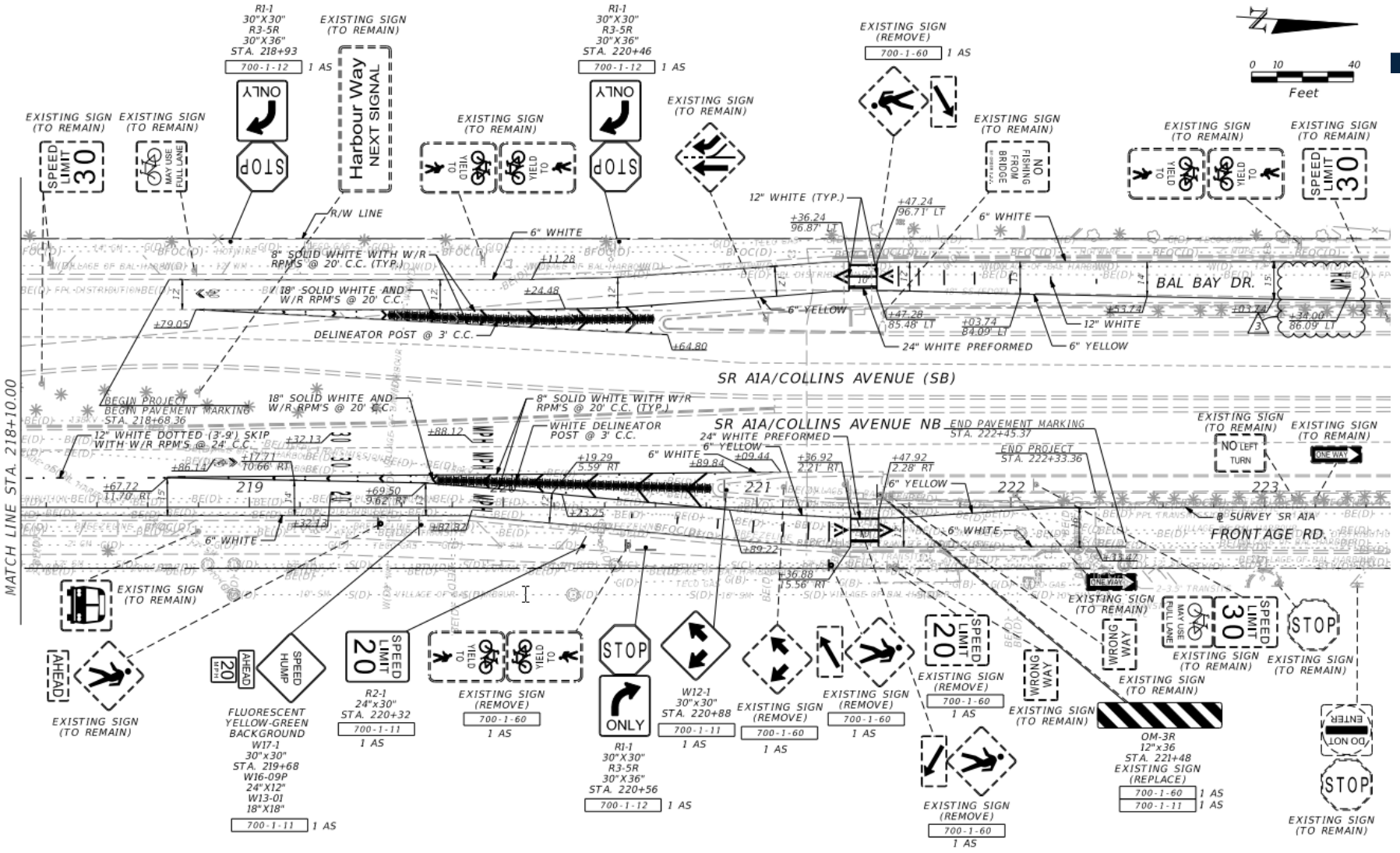


FDOT

TARGET ZERO FATALITIES & SERIOUS INJURIES

RAISED CROSSWALKS

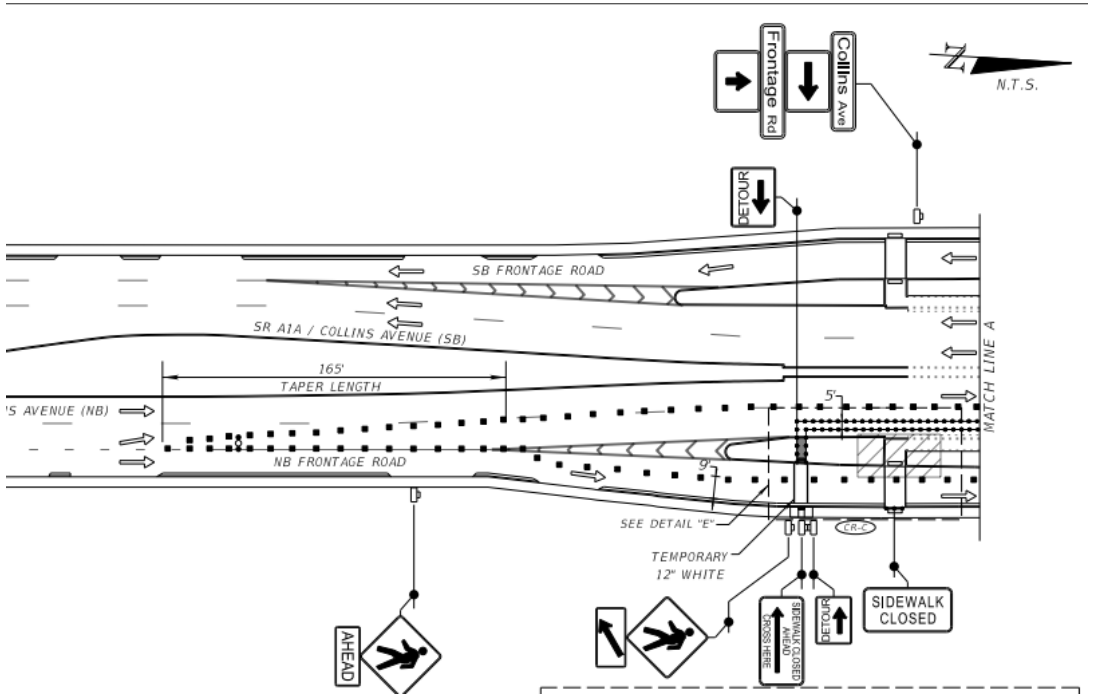
Project Number 448906-1-52-01_ Plans

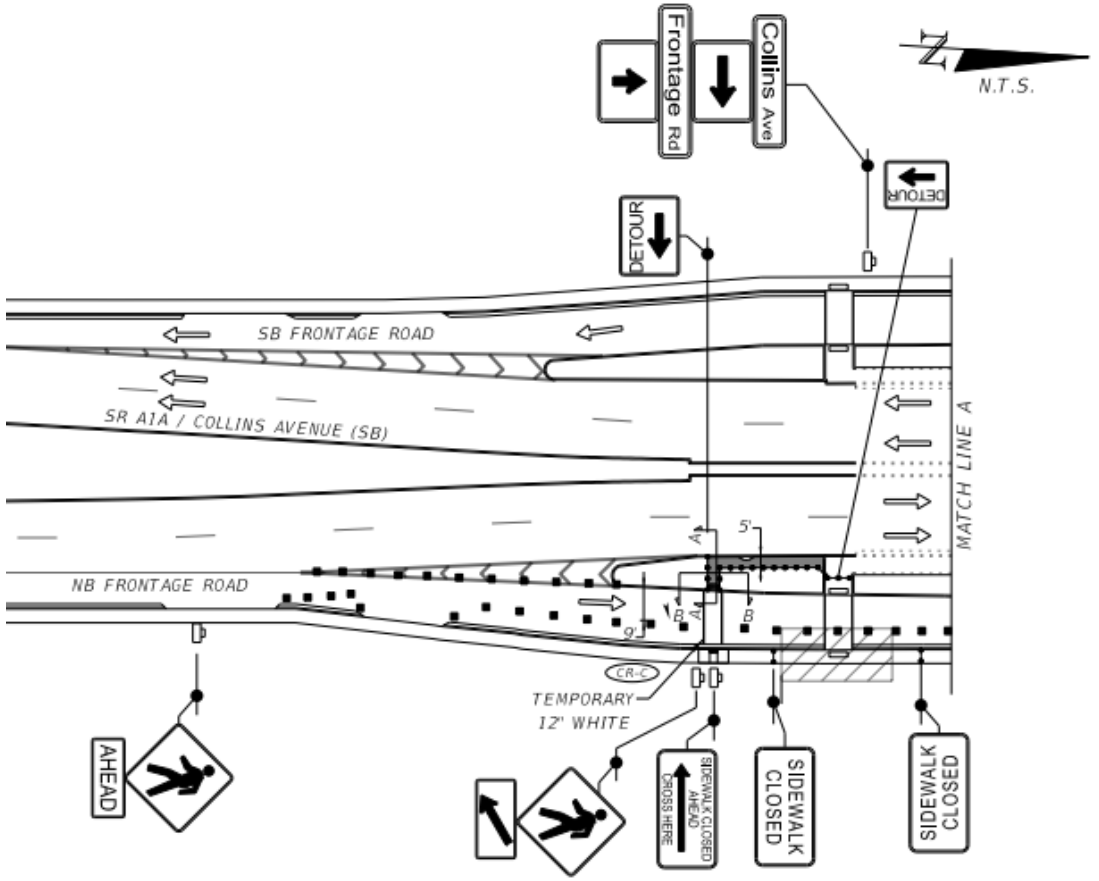


RAISED CROSSWALKS

Challenges

- Project Number 448906-1-52-01_ MOT Plans





- Bus transit
- Emergency vehicles route

Thank You!

Safety Through Speed Management

Naziru Isaac, P.E.
District Roadway Design Engineer
FDOT District 5

TRANSPORTATION SYMPOSIUM

Safety Through Speed Management

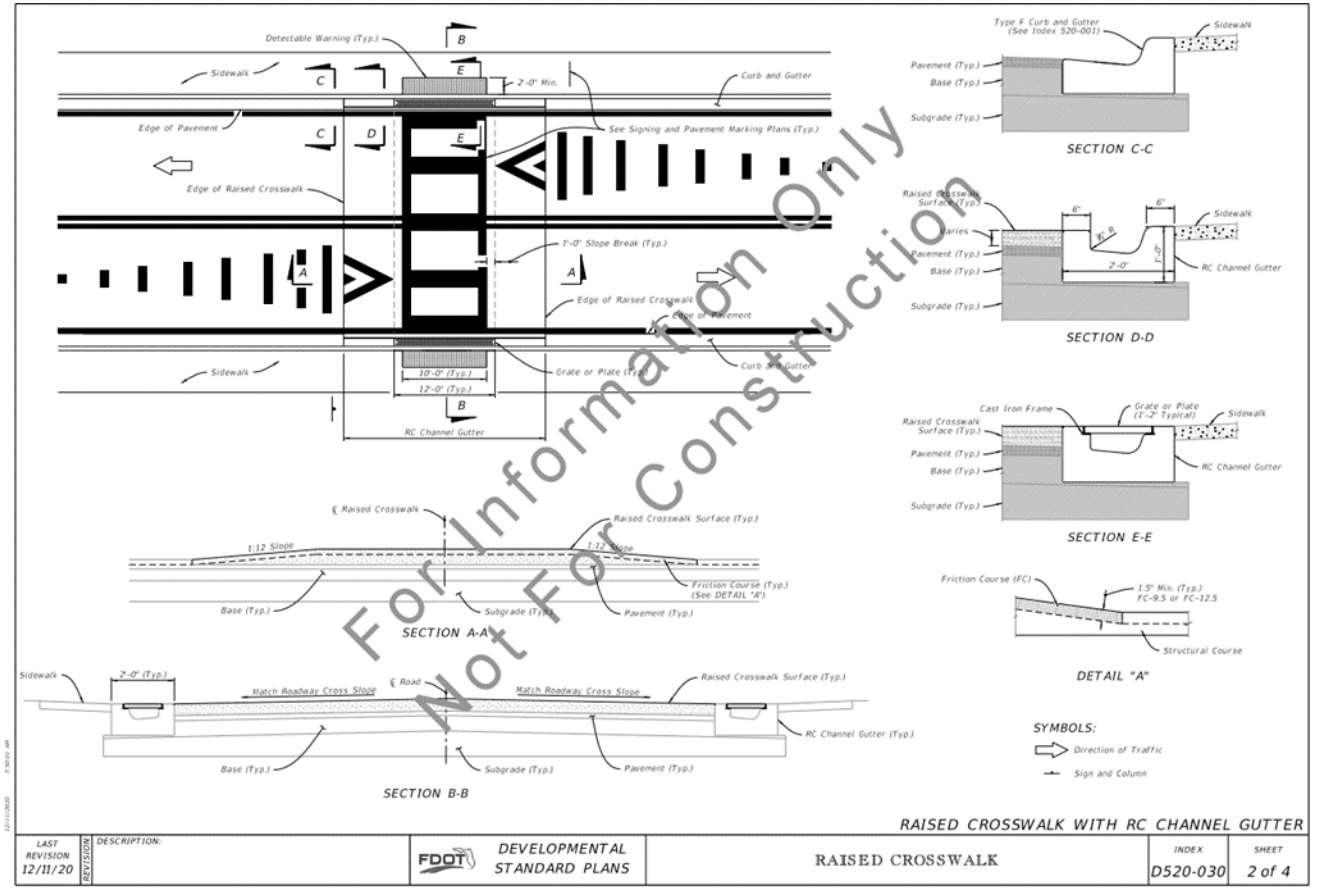
- FDM 202: Speed Management
  - Engagement – Enclosure – Deflection
  - 18 Strategies
  - Varying Levels of Implementation

- Project-Specific Justification
  - Design Speed
  - Corridor Context
  - Corridor Needs

Lane Repurposing	Raised Intersections
Roundabouts	Raised Crosswalks
On-Street Parking	Speed Feedback Sign
Chicanes	Pedestrian Refuge Islands
Lane Narrowing	Bulb-Outs
Horizontal Deflections	RRFBs
Street Trees	PHBs
Short Blocks	Terminated Vistas
Speed Tables	Islands in Curved Sections

Raised Crosswalks

- Developmental Standard
- Very Low Speed
- Stand-alone or Supplemented Installations



Design Advantages and Challenges

- Challenges
  - Drainage
  - Design Vehicle (e.g. Freight, Transit)
  - Public Engagement and Support
  - Constructability
  - Future Maintenance

Design Advantages and Challenges

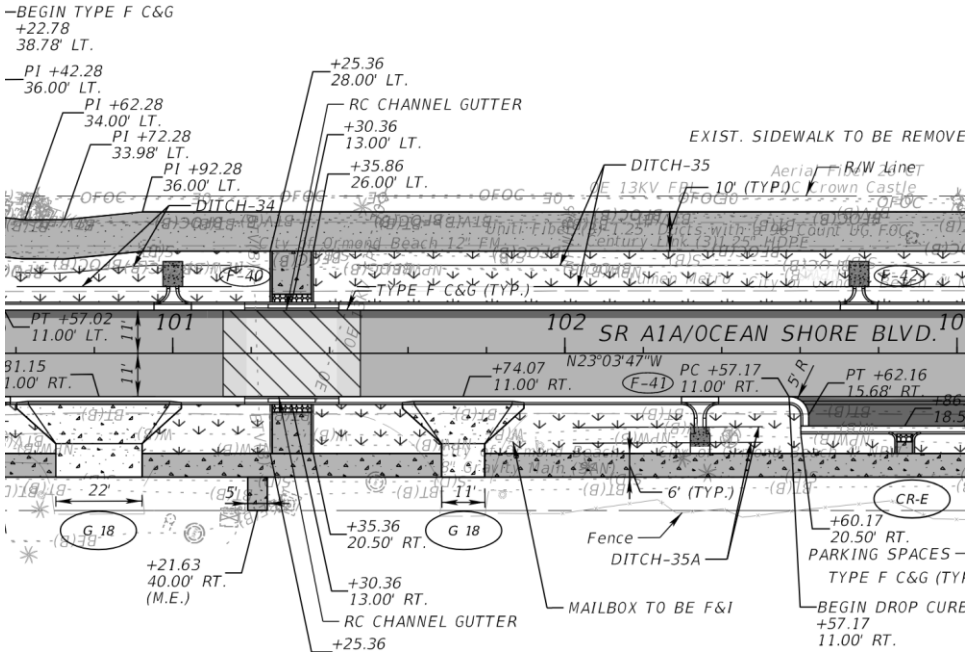
- Challenges
  - Drainage
  - Design Vehicle (e.g. Freight, Transit)
  - Public Engagement and Support
  - Constructability
  - Future Maintenance
- Advantages
  - Increased Pedestrian Mobility
  - Enhanced Pedestrian Visibility
  - Reduced Vehicle Speeds
  - Increased Conspicuity to the Crosswalk

District 5 Implementation

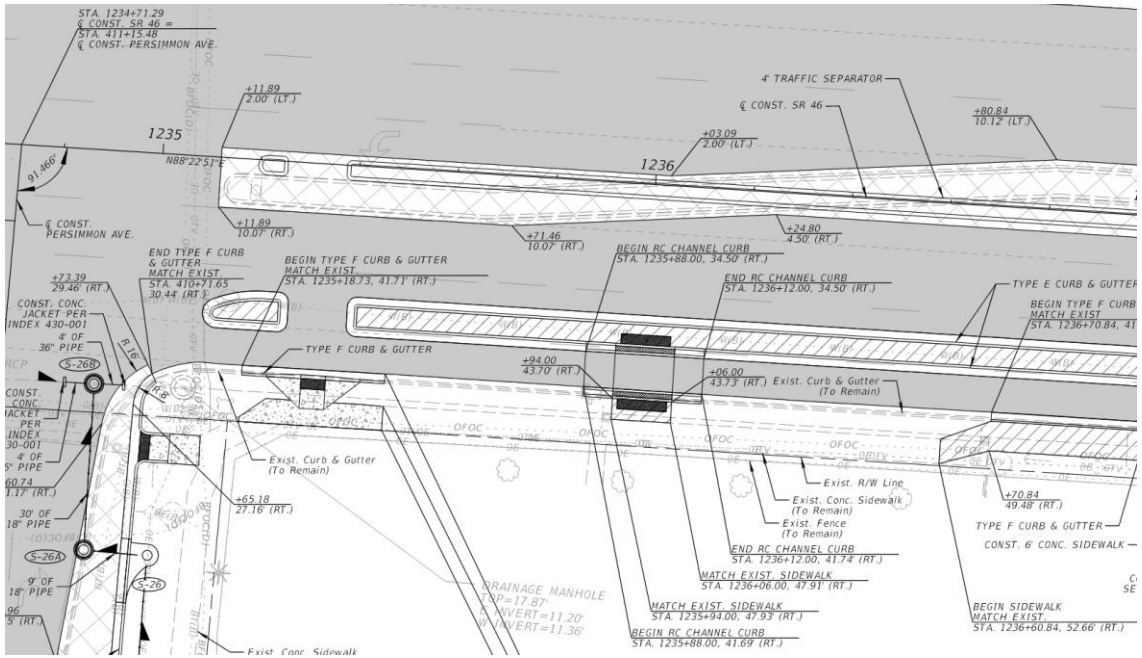
Raised Crosswalks by the Numbers

10 FDOT District 5 Projects

- 31 Raised Crosswalks



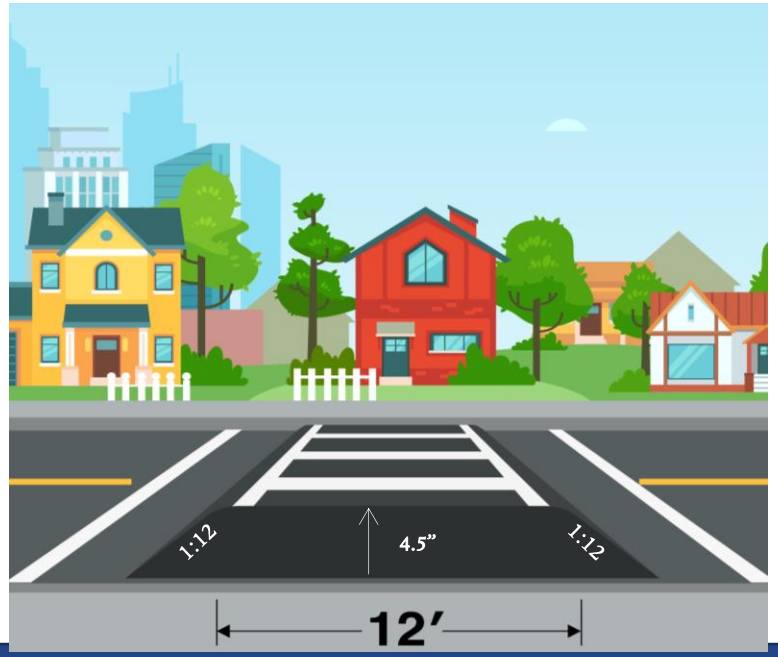
- 4 Raised Bike Lanes (B&A Areas)

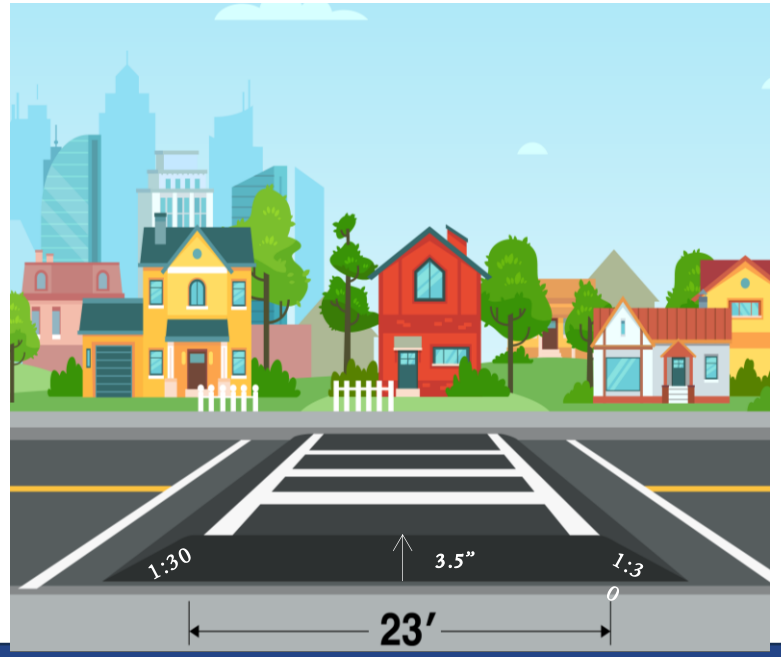


TRANSPORTATION SYMPOSIUM

SR 500 / US 441 – Orlando

- C4 Context Class
- 6-lane Divided
- 30 mph Target Speed
- Heavy Bike/Ped/Transit Corridor





- Raised Crosswalks
- PHBs
- Pedestrian Refuge Islands
- Lane Narrowing
- Speed Feedback Sign
- In-Road Lighting
- Pedestrian Channelization Barrier

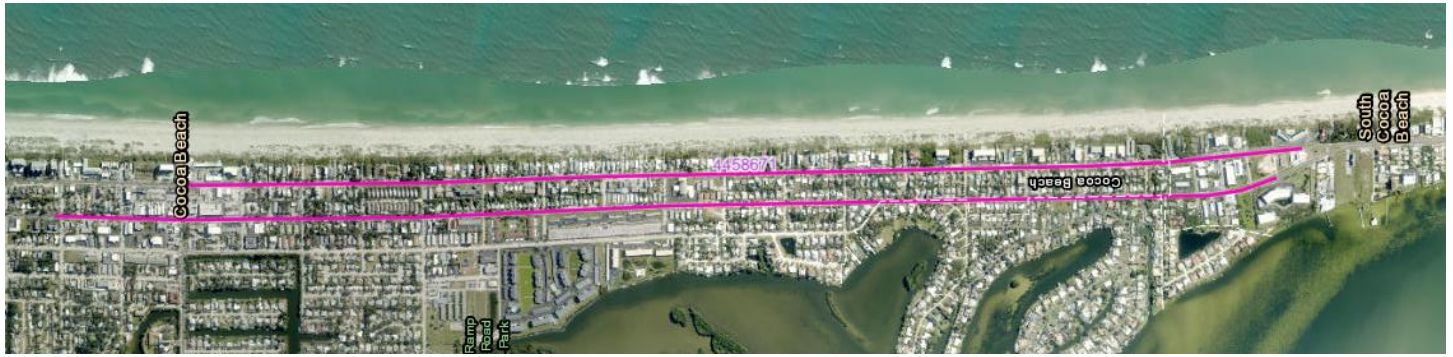
TRANSPORTATION SYMPOSIUM

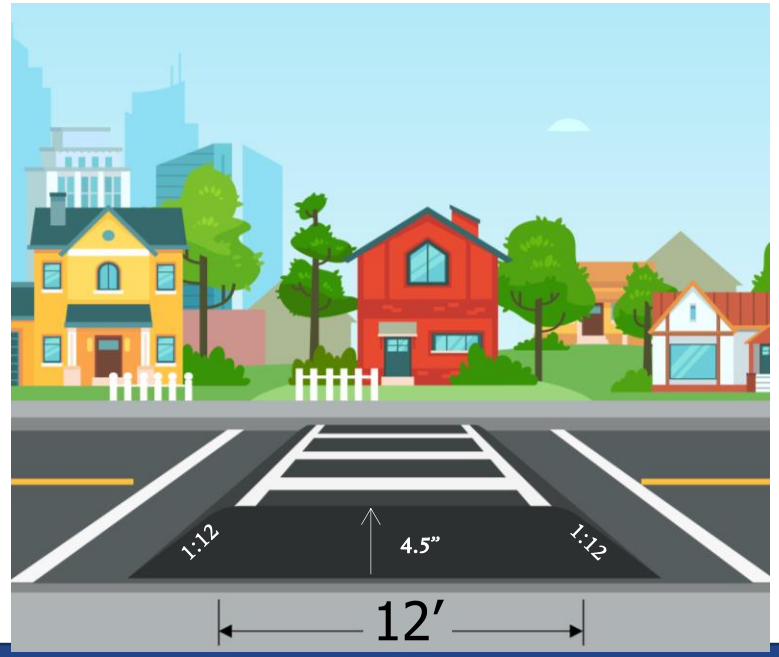
SR 500 / US 441 – Orlando

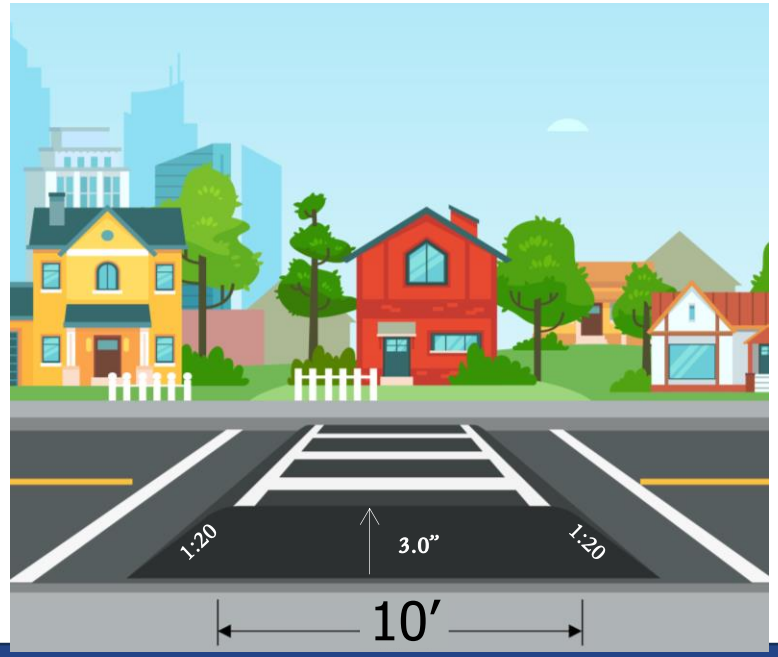
- Raised Crosswalks
- PHBs
- Pedestrian Refuge Islands
- Lane Narrowing
- Speed Feedback Sign
- In-Road Lighting
- Pedestrian Channelization Barrier

SR A1A – Cocoa Beach

- C4 Context Class
- Bifurcated 4-lane
- 35 mph Target Speed







- Raised Crosswalks
- Lane Narrowing
- In-Road Lighting

TRANSPORTATION SYMPOSIUM

District 5 Lessons Learned

- TTCP Phasing
  - Initial Opening to Traffic
    - Operating Speeds
    - Signing and Marking Installations
    - Public Engagement – Informing the Public
  - Pavement Drop-Offs

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- TTCP Phasing
  - Initial Opening to Traffic
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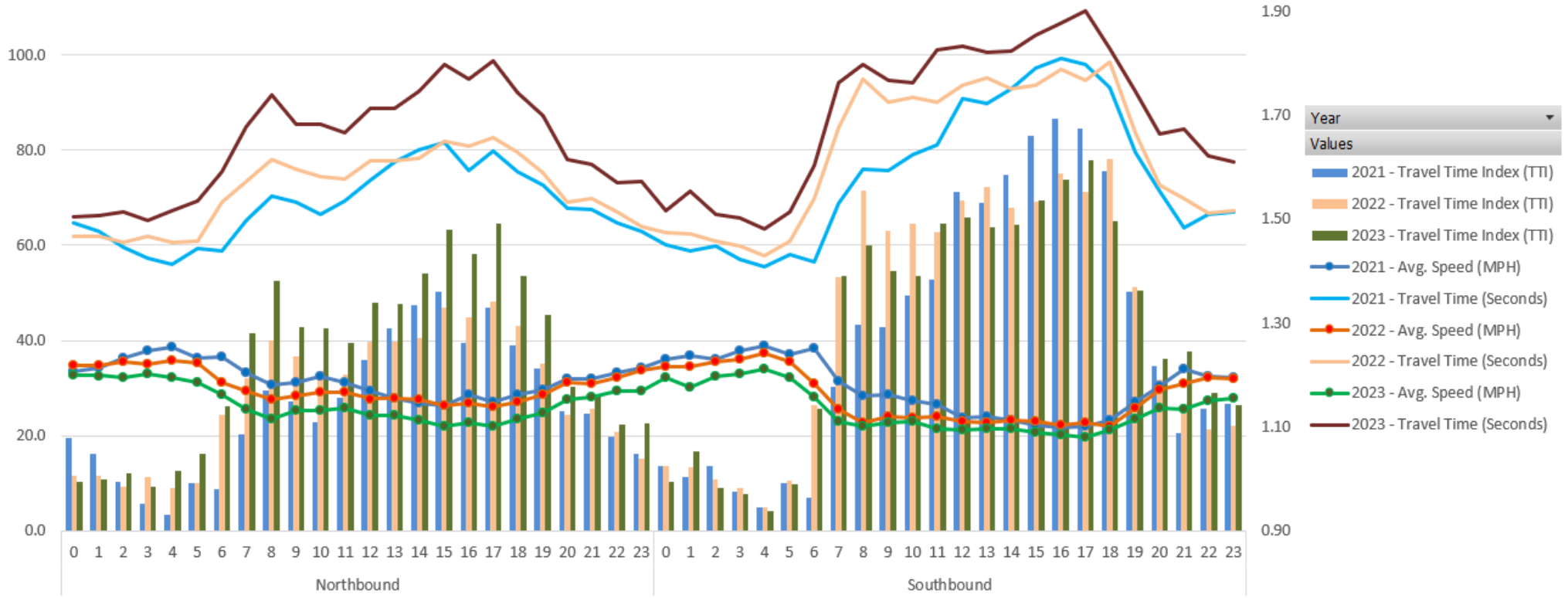
- Constructability
  - Asphalt Paving Operations – Hand Work
  - RC Channel Gutter Grates – Procurement & Securement
  - Material Selection

Results of Implementation

- SR 500 / US 441 – Orlando
  - Corridor Speed Reductions

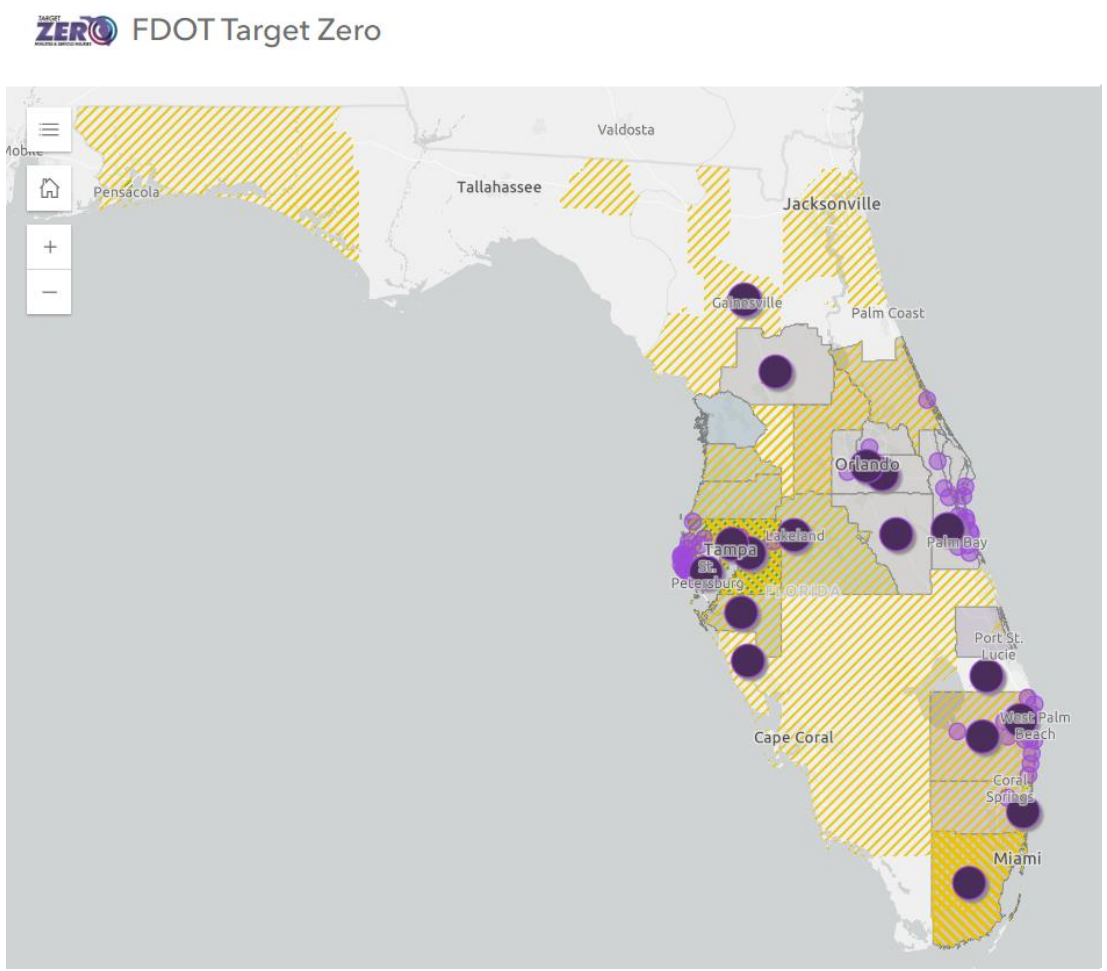


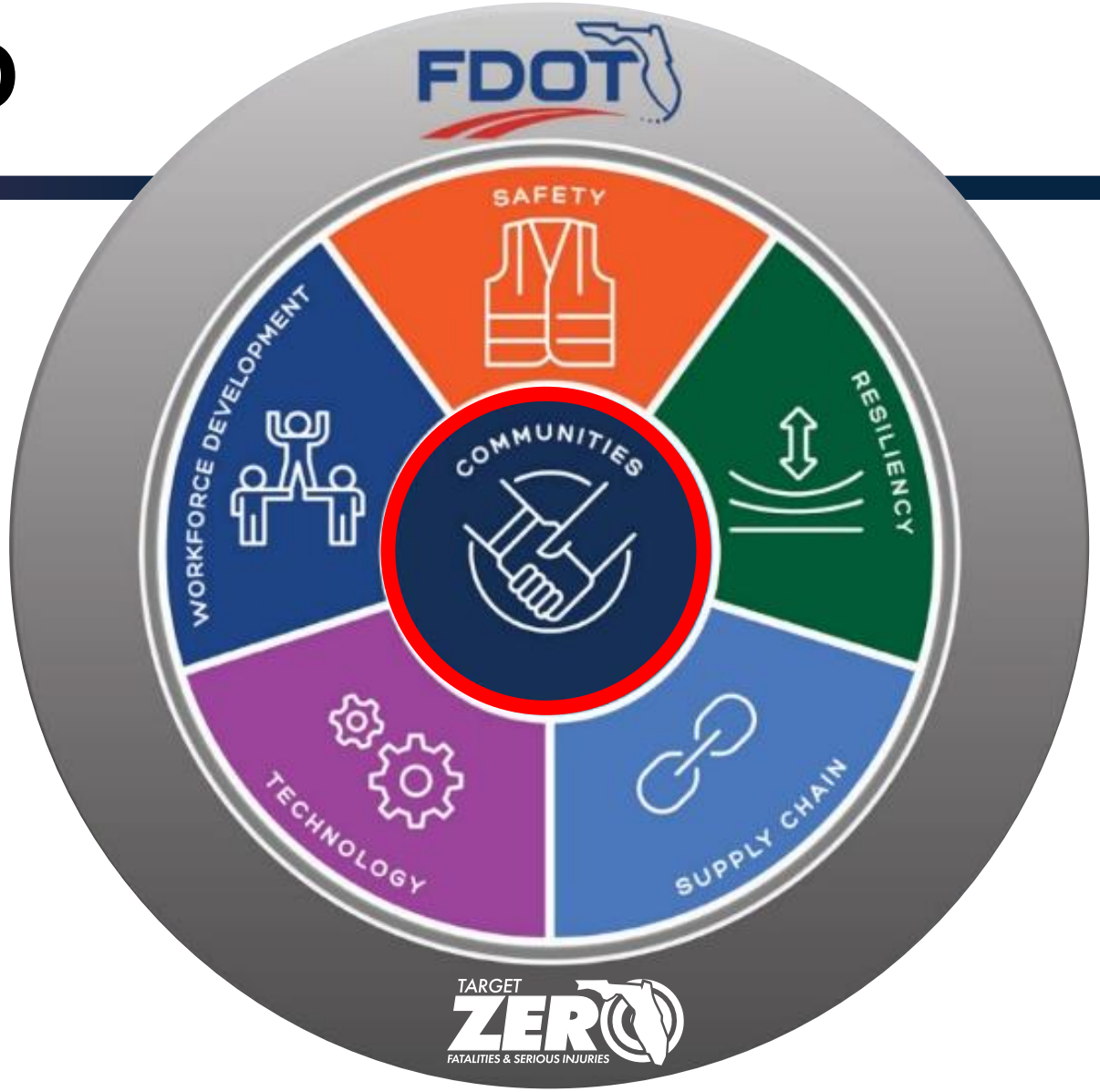
Results of Implementation

- SR 500 / US 441 – Orlando
  - Corridor Speed Reductions
  - Post-Construction Crash Data Collection On-Going

Orange Blossom Trail Drone Video

Together Toward ZERO





Top Counties for Lane Departure, Intersection, Pedestrian and Bicyclist Fatalities and Serious Injuries + **Partner Agencies with 'Zero' Resolutions and/or Action Plans** + **Partners Awarded with 'Safe Streets for All' Federal Grants** = TARGET ZERO FATALITIES & SERIOUS INJURIES

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