Evaluation of Pavement Markings within the Dynamic Envelope

Sponsored by the FRA Office of Research & Development

Train Control & Communications Division

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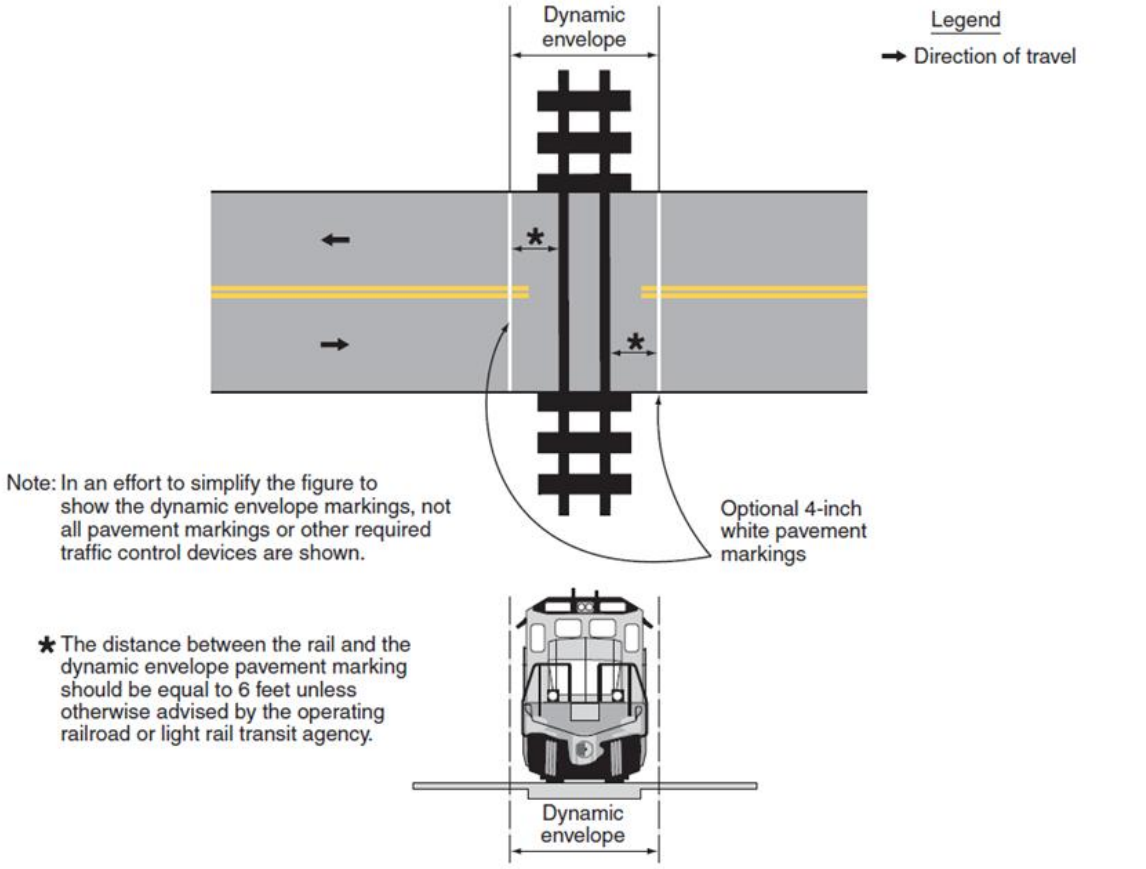
U.S. Department of Transportation
Research and Innovative Technology Administration
John A. Volpe National Transportation Systems Center

Dynamic Envelope

Dynamic Envelope is the clearance required for the train and its cargo overhang due to any combination of loading, lateral motion, or suspension failure.

Figure 8B-8. Example of Dynamic Envelope Pavement Markings at Grade Crossings



December 2009

Sect. 8B.28 to 8B.29

2009 MUTCD

Dynamic Envelope Pavement Markings

Commercial Blvd, Ft Lauderdale, FL

Project Description:

- Evaluate effectiveness of pavement markings in reducing instances of stopped vehicles within the grade crossing dynamic envelope zone.
- Select pavement markings pattern and test location. Field-test, driver behavior data collection (pre/post), and document results.
  - Pattern and test location pre-selected by FL DOT
- Follow-on research funds for large-scale implementation and evaluation.

Project Partners:

U.S. Department of Transportation
Federal Railroad Administration

STATE OF FLORIDA • DEPARTMENT OF TRANSPORTATION

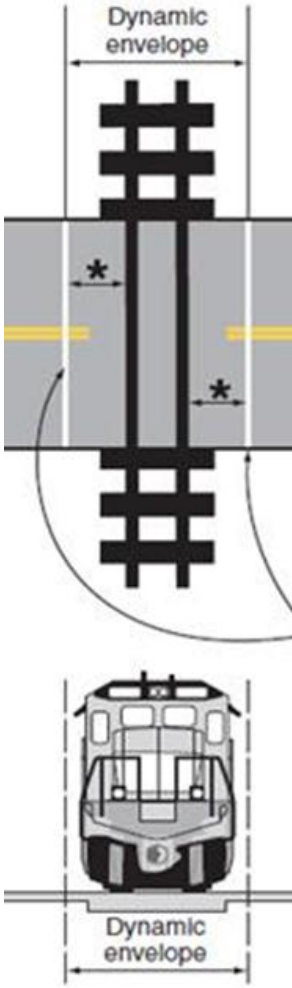
Commercial Boulevard, Ft Lauderdale

- Annual Average Daily Traffic (AADT) of 69,000
- Grade crossing (ID# 628186E) is across a multi-lane east-west roadway
  - Eastbound: 5 lanes including on-ramp to southbound I95, Traffic Signal (150').
  - Westbound: 4 lanes including the off-ramp from I95 just 26-feet before the tracks. Traffic signal approximately 800-feet from the crossing.

Commercial Boulevard, Ft Lauderdale

- Double-tracked
- About 60 trains per day
- CSX, Amtrak, TriRail (commuter rail)
- Rail corridor and roadway owned by FDOT

- Accident History
  - 11/6/2011 (vehicle stopped on the tracks)
  - 10/26/2010 (vehicle turned onto the tracks)
  - 11/19/2009 (vehicle stopped beyond the crossing arm as it was lowering; backed up; and then proceeded to cross the tracks. - 2 fatalities and 1 injury)
  - 8/25/2009 (vehicle on the tracks clipped by train)
  - 11/21/2005 (pick up truck on the tracks)
  - 12/7/2005 (vehicle stalled on the tracks)



Dynamic Envelope is the clearance required for the train and its cargo overhang due to any combination of loading, lateral motion, or suspension failure. (2009 MUTCD)

Traffic Backed Up Over Tracks

Commercial Boulevard, Ft Lauderdale, FL

Vehicle Stopped within Crossing

Commercial Boulevard, Ft Lauderdale, FL

Vehicle Turning into Right of Way

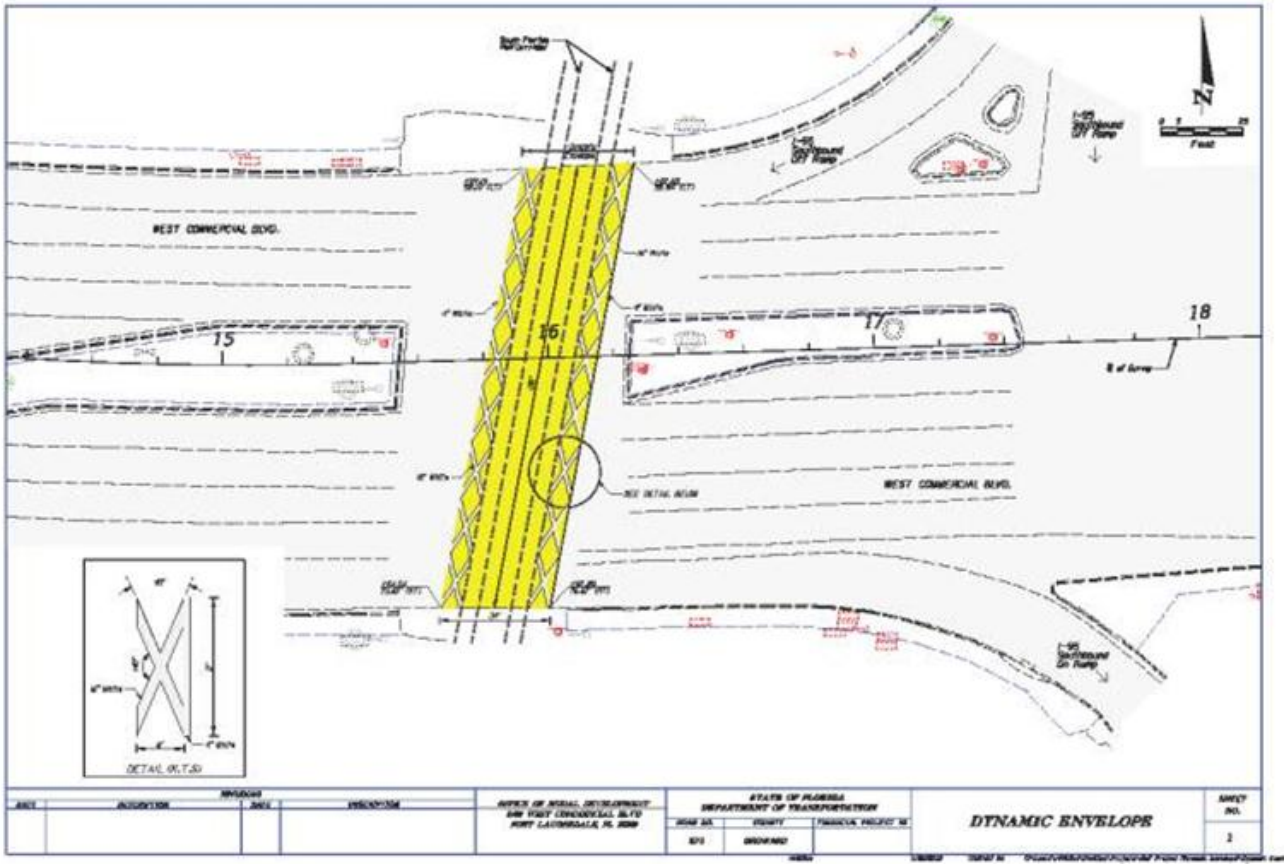
Commercial Boulevard, Ft Lauderdale, FL

Examples

Commercial Boulevard, Ft Lauderdale, FL

Dynamic Envelope Pavement Markings

Pattern and test location pre-selected by FDOT

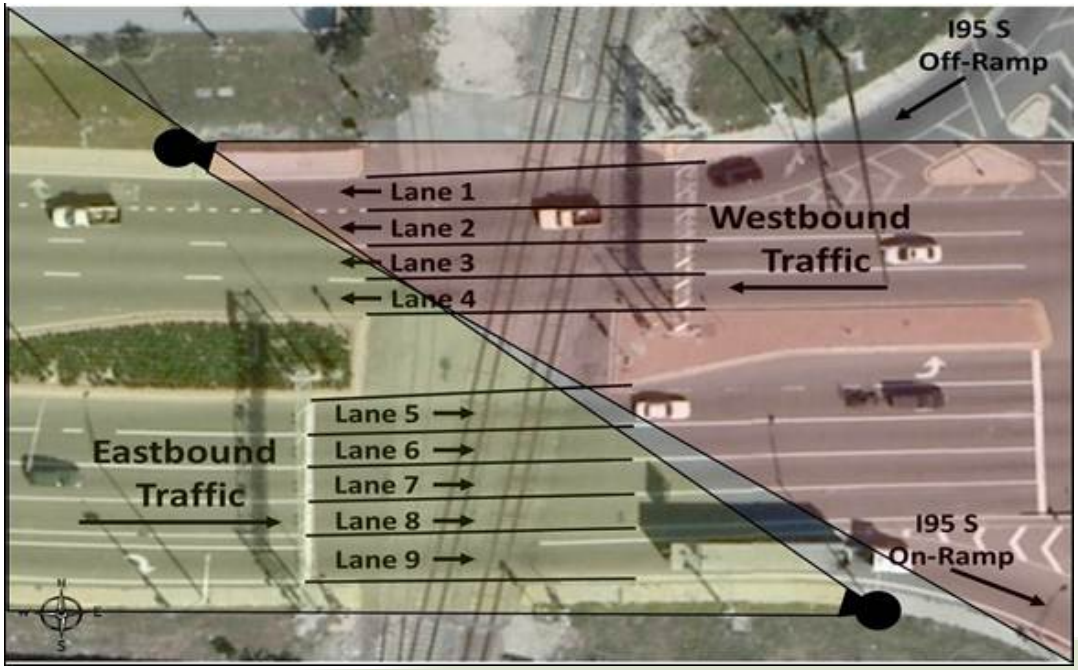


Commercial Boulevard, Ft Lauderdale

- Pre-installation data May 23-June 5, 2012
- Markings Installed week of December 9, 2012
- Post-Installation data Jan 6-19, 2013

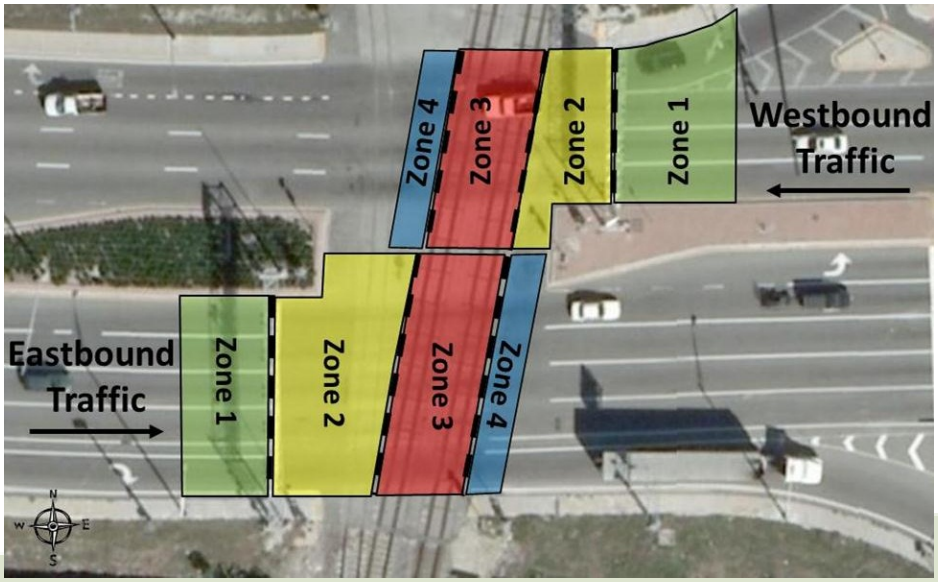
Data Collection

- Data collected in 2-hour time frames from
- 7:30-9:30am, 11:00am-1:00pm, and 4:00-6:00pm each day for the daytime condition and
- 10:00pm-12:00am for the nighttime condition.
- Recorded 112 hours of data for analysis during each phase (pre- and post-test). Both directions, eastbound and westbound, were recorded and analyzed separately.
- Allowed for 3-week novelty effect before collecting post-installation data

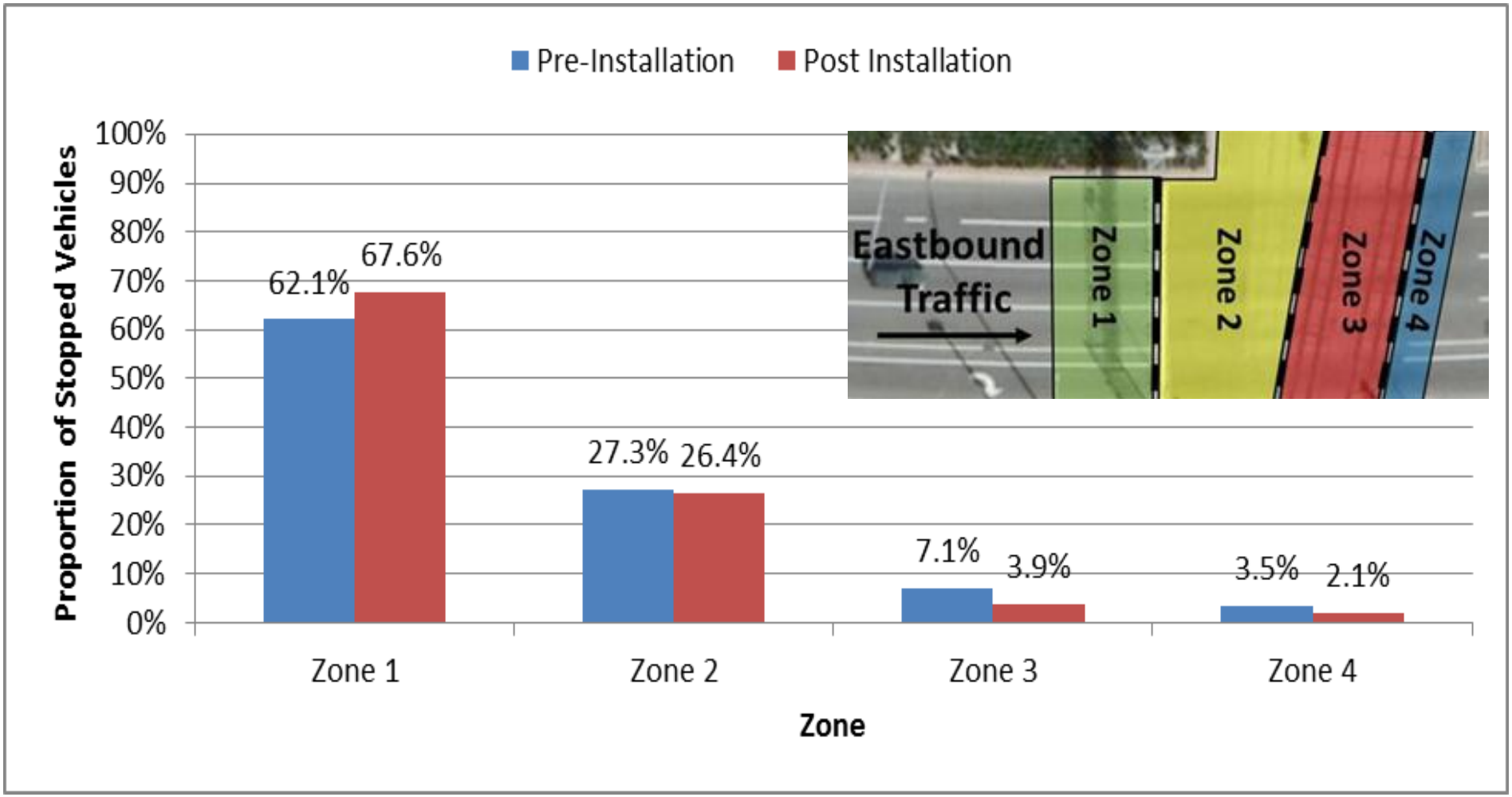


Data Analysis

	Eastbound Traffic		Westbound Traffic	
Zone Stopped	**Pre-Install**	**Post-Install**	**Pre-Install**	**Post-Install**
Zone 1	1,890 (62.1%)	2,244 (67.6%)	1,926 (60.4%)	2,209 (64.2%)
Zone 2	832 (27.3%)	875 (26.4%)	749 (23.5%)	784 (22.8%)
Zone 3	216 (7.1%)	130 (3.9%)	400 (12.6%)	369 (10.7%)
Zone 4	105 (3.5%)	70 (2.1%)	112 (3.5%)	78 (2.3%)
Total	**3,043**	**3,319**	**3,187**	**3,440**

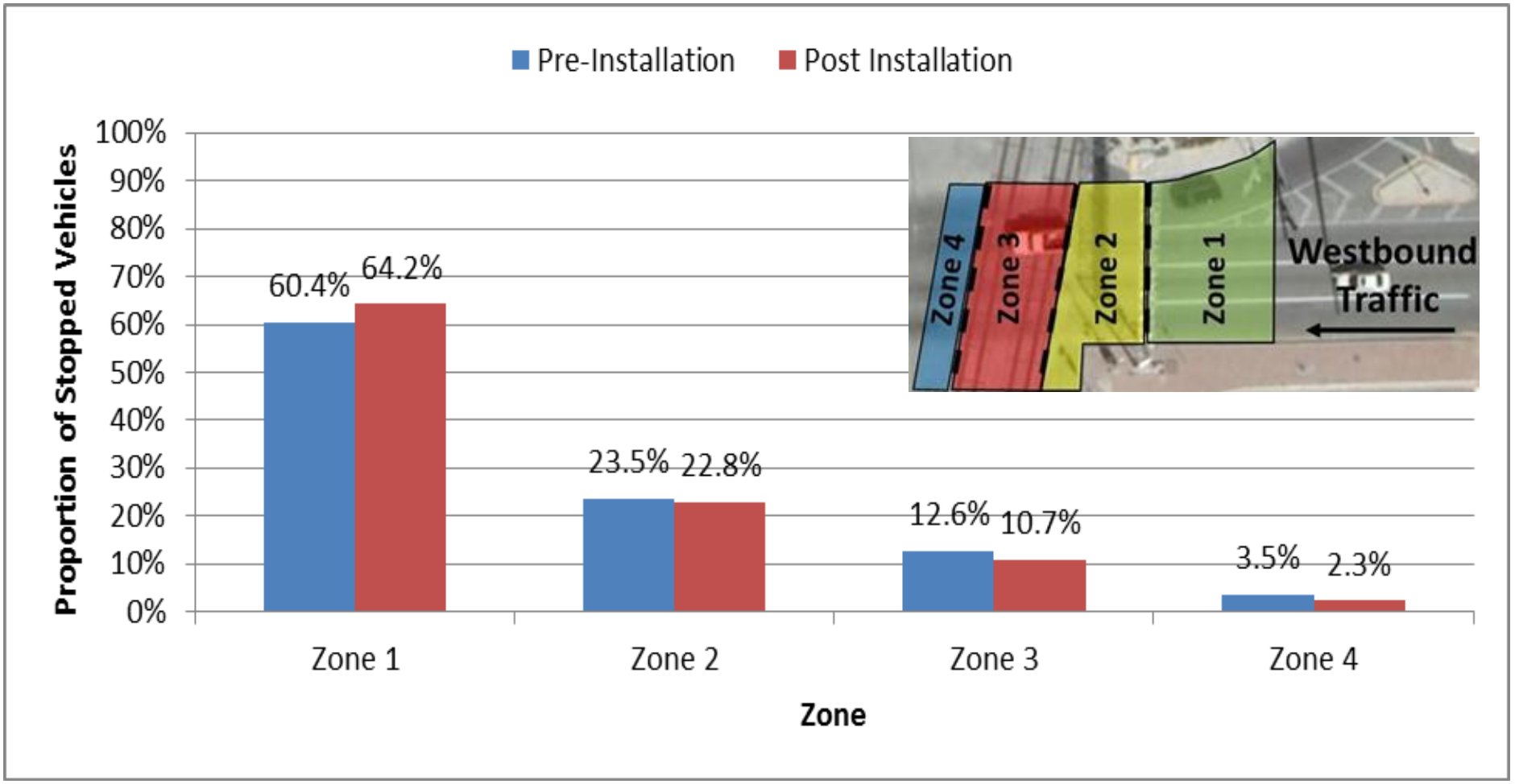


Proportion of Eastbound Vehicles Stopped by Zone



* Chi-square test of independence showed a significant difference between the pre- and post-install conditions ($p \leq 0.01$)

Proportion of Westbound Vehicles Stopped by Zone



* Chi-square test of independence showed a significant difference between the pre- and post-install conditions ($p \leq 0.01$)

Vehicles Stopped within Crossing after Pavement Markings Installation

Commercial Boulevard, Ft Lauderdale, FL

Vehicle Stopped within Crossing after Pavement Markings Installation

Commercial Boulevard, Ft Lauderdale, FL

Findings

- A 45% reduction in the number of vehicles stopped in Zone 3 (on tracks) eastbound and 15% reduction for westbound after installation
- An increase in vehicles stopping in Zone 1 (behind the stop line) after installation
- A reduction in the number of gate violations (both descending and horizontal) after installation

Next Steps

- Draft Report under FRA review
- Continue collaboration with FDOT and NJDOT on additional pilot installations
  - Additional crossings under consideration in FL
  - One crossing under consideration in NJ

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