Preliminary Analysis of LED Enhanced Signs at a Passive Rural Level Crossing

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Introduction

- Research sponsored by the US DOT Federal Railroad Administration Office of Research and Development
- Research Objective: Measure the effect of flashing LED signs on motor vehicle speed profiles at a level crossing approach

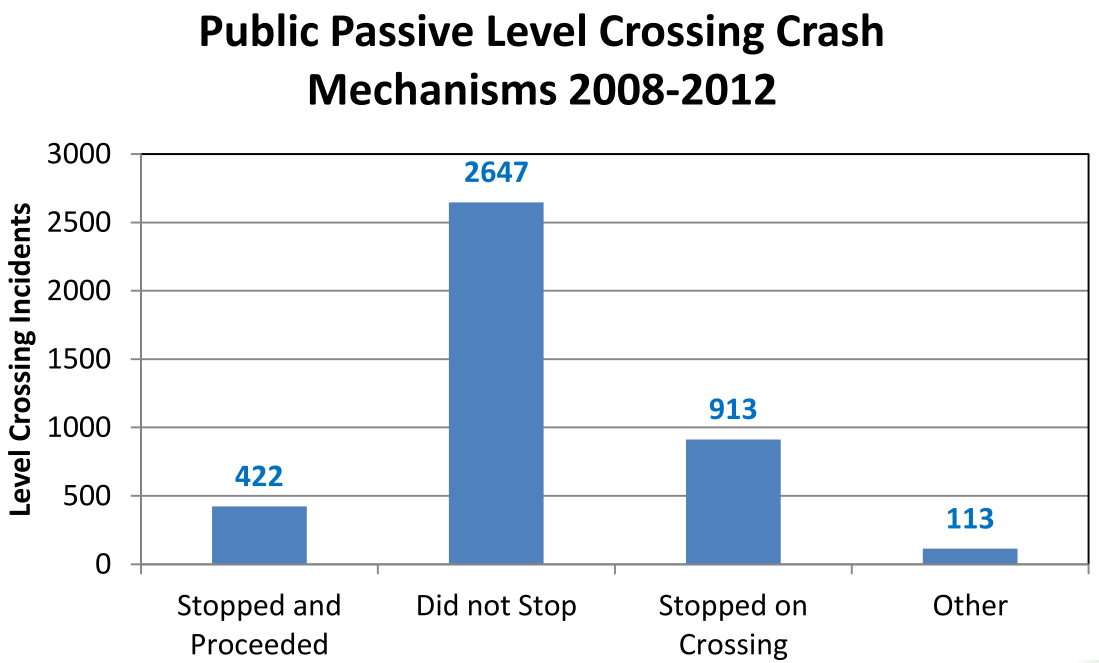
Background

- Almost one-half of public level crossings in the US are passive
- Approximately 35%-40% of all incidents, injuries, and fatalities occur at these crossings
- However 90% of rail-highway traffic is found at active level crossings

Public Level Crossing Incident and Casualty Statistics 2008-2012				
	Number of Crossings	Incidents	Injuries	Fatalities
Active	67,036	969	500	85
Passive	62,527	596	277	59
Totals	129,563	1,565	777	144

Passive Level Crossing Crash Mechanisms

- Why are drivers not stopping at passive level crossings when trains arrive?
- Would enhanced signage at these crossing reduce the number?



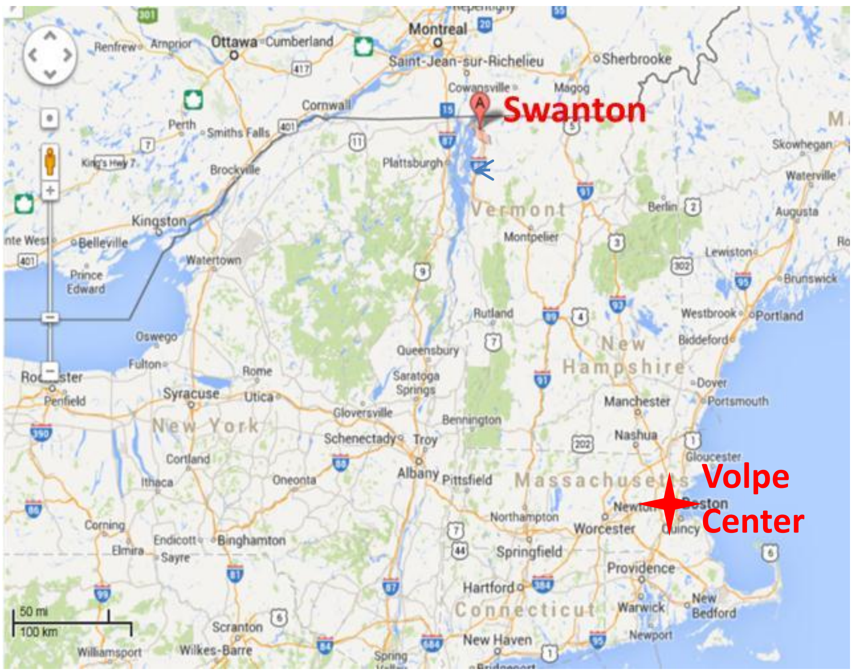
LED Sign Technology Study

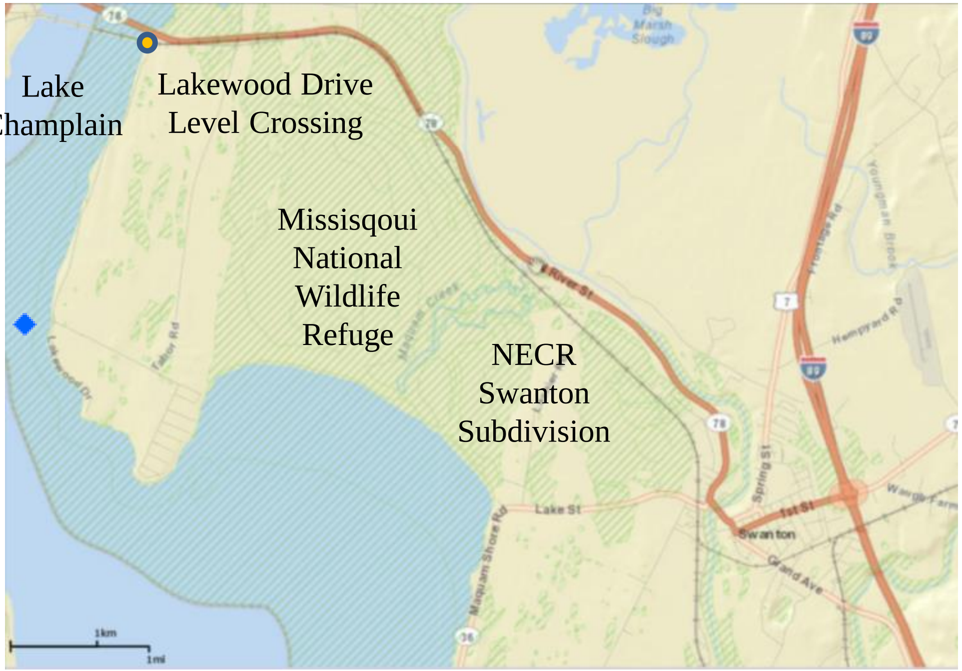
- **Research Objective:** Measure the effect of flashing LED signs on motor vehicle speeds at a level crossing approach
- **Location Criteria:**
  - Passive level crossing
  - No STOP sign control
  - No nearby highway intersection
- **Approach:** *Before/After* analysis
  - Phase 1 - Baseline
  - Phase 2 - LED Crossbuck
  - Phase 3 - LED Crossbuck and Advance Warning

R15-1

W10-1

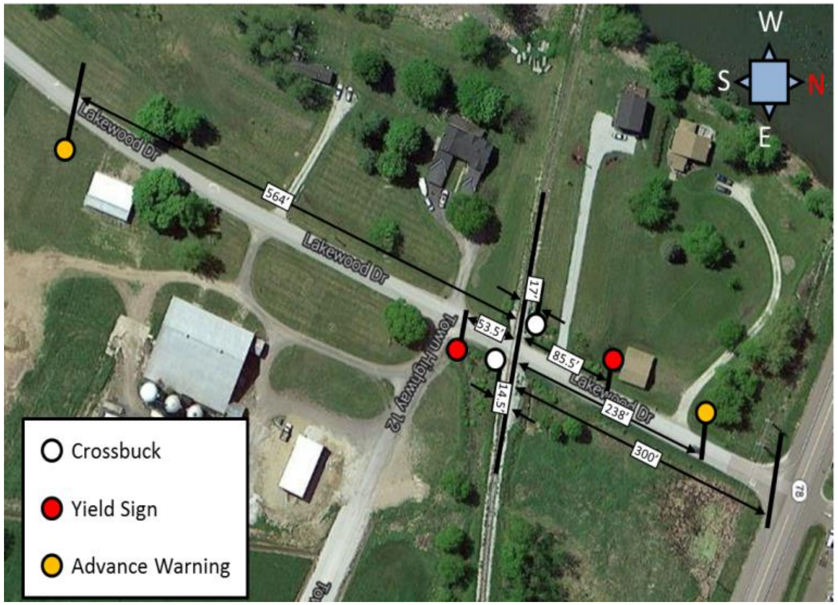
Study Location: Swanton, Vermont





Level Crossing Vicinity

Distance from Xing (ft.)	Sign		
	Crossbuck	YIELD	Advance Warning
Northbound Approach	14.5	53.5	564
Southbound Approach	17	85.5	238



Aerial View of Crossing Locale

Northbound Approach Prior to Sign Installation

Test Schedule

Phase 1 (Baseline)			
	Start Date	End Date	Total Days
Novelty Period	6/24/2013	7/26/2013	33
Data Collection	7/27/2013	8/28/2013	33
Phase 2 (Crossbuck)			
	Start Date	End Date	Total Days
Novelty Period	8/29/2013	9/25/2013	28
Data Collection	9/26/2013	10/8/2013	13
Phase 3 (Crossbuck and AWS)			
	Start Date	End Date	Total Days*
Novelty Period	10/9/2013	10/15/2013	7
Data Collection	10/16/2013	10/28/2013	13

*Novelty period less than 4 weeks

FRA Mobile Driver Feedback Device

MDFD Deployment

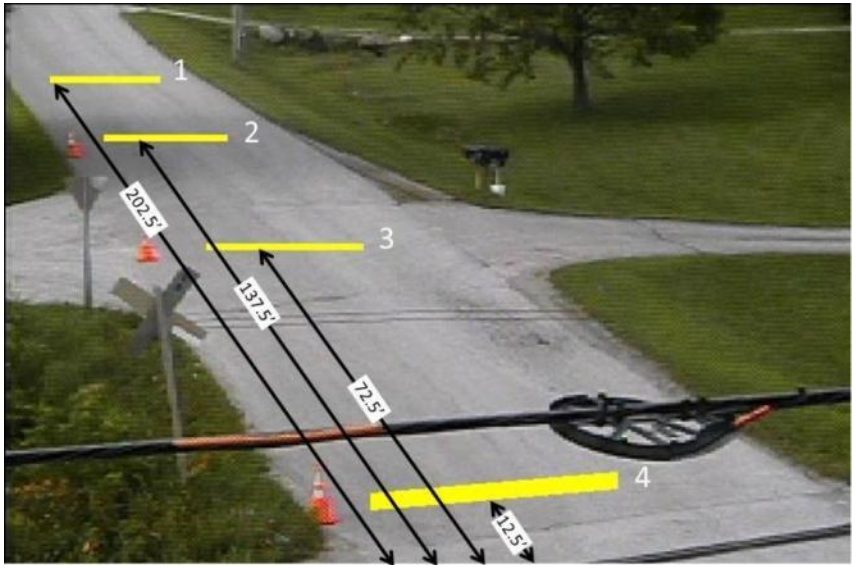
- 82.5 ft. North of Railroad Centerline
- 15 ft. from the Edge of Lakewood Drive

View from Northbound Approach to Crossing

FRA MDFD as Deployed

Detector Configuration

Vehicle Speed Profiles of Northbound Traffic Were Measured



Sign Installation

Crossbuck Signs Activated on 8/29/13

Advance Warning Signs Activated on 10/9/13

Views From Northbound Approach to Level Crossing

Results for LED Crossbuck Signs

Baseline (n=1486) and LED Crossubck (n=527) Comparison - Daytime							
Detector Name	Distance from Crossing (feet)	Baseline Mean Speed (mph)	LED XBuck Mean Speed (mph)	$\overline{x}_{BL} - \overline{x}_{CB}$	*t*-value	*p*-value	Significant*
Detector 1	202.5	31.45	31.92	-0.47	-1.596	> 0.10	NO
Detector 2	137.5	28.45	28.87	-0.42	-1.390	> 0.15	NO
Detector 3	72.5	25.42	25.32	0.10	0.285	> 0.40	NO
Detector 4	12.5	23.05	22.64	0.41	1.202	> 0.20	NO

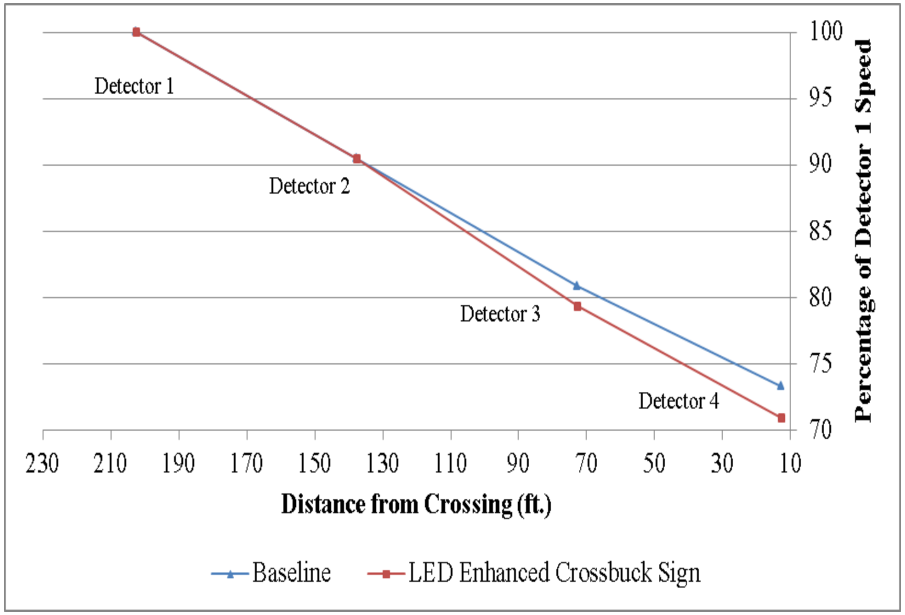
*Significant at 95% Confidence Level

Baseline (n=282) and LED Crossbuck (n=132) Comparison - Nighttime							
Detector Name	Distance from Crossing (feet)	Baseline Mean Speed (mph)	Phase LED Xbuck Mean Speed (mph)	$\overline{x}_{BL} - \overline{x}_{CB}$	*t*-value	*p*-value	Significant*
Detector 1	202.5	32.97	30.02	2.95	3.651	< 0.001	YES
Detector 2	137.5	30.55	27.46	3.09	4.003	< 0.001	YES
Detector 3	72.5	27.56	24.24	3.32	4.242	< 0.001	YES
Detector 4	12.5	24.92	22.03	2.89	3.786	< 0.001	YES

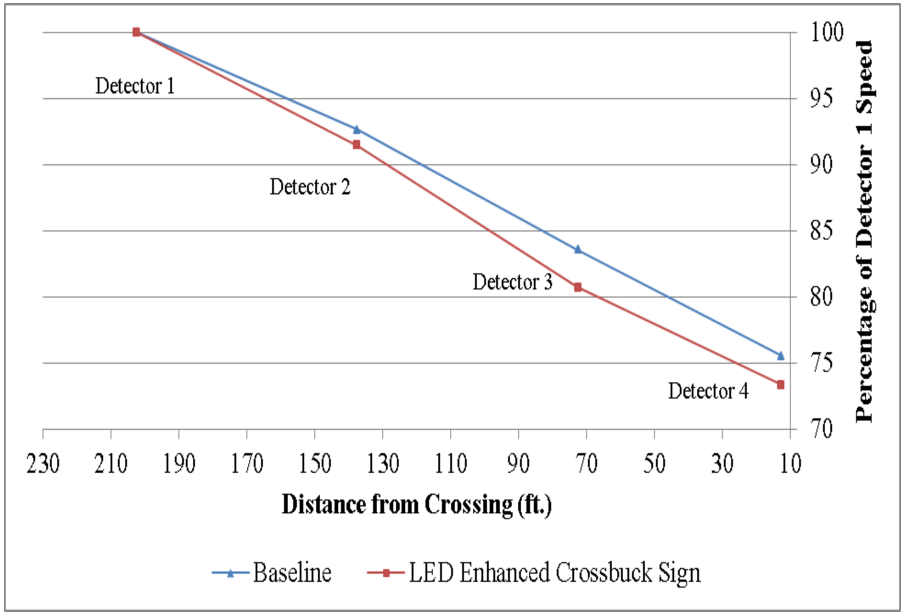
*Significant at 95% Confidence Level

Rate of Mean Speed Decrease Across Detection Zone

Daytime



Nighttime



Steeper Rate of Decrease for Phases 2 and 3

Vehicle Class Speed Study

- Used to normalize for seasonal changes in the vehicle composition
- Baseline: 7/27/13 – 8/28/13
- LED Crossbuck: 9/26/13-9/30/13
- One Saturday, Sunday, and Monday were selected from each phase

Class	A (%)	B (%)	C (%)	D (%)	E (%)	F (%)	G (%)	H (%)
Baseline (n = 701)	90.73	6.42	0.57	0.57	0.29	0.14	1.14	0.14
LED Crossbuck (n = 501)	89.22	8.38	0.80	0.60	0.00	0.00	0.80	0.20

A – Light Vehicle
B – Light Vehicle with Trailer
C – Commercial Vehicle
D – Commercial Vehicle with Trailer
E – Bus
F – Recreational Vehicles
G – Motorcycles
H – Other

Challenges – Changes to Experimental Conditions

October 1, 2013 – Swanton Highway Department Painted a Double Yellow Line on Lakewood Drive

July 18, 2013

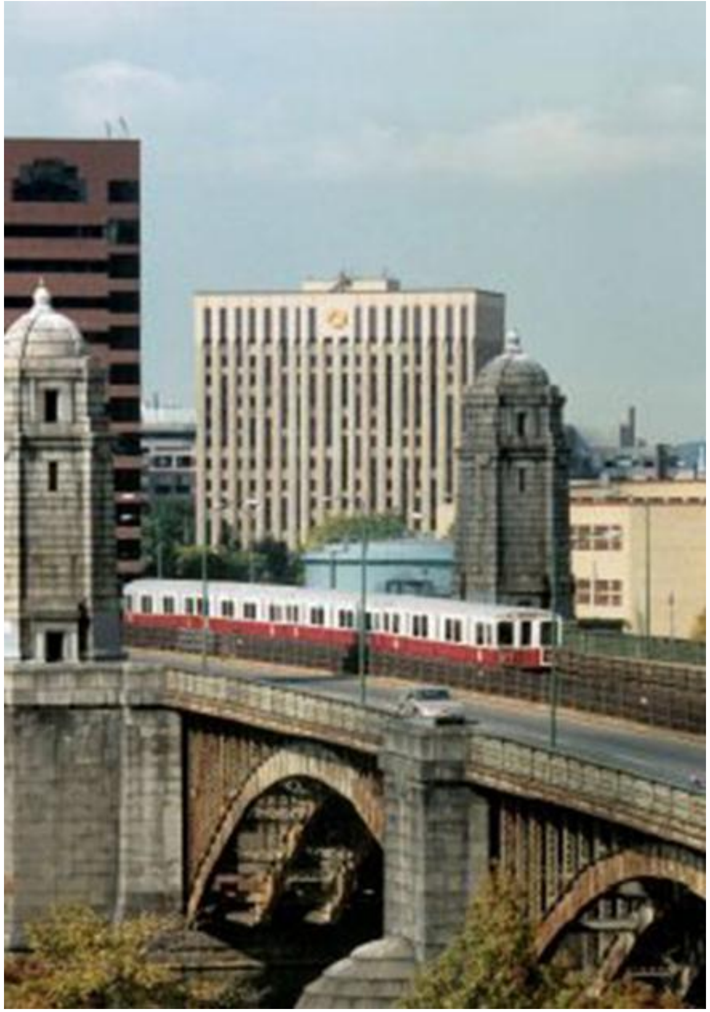
October 9, 2013

Significant Effect at Night of 2.13-2.79 MPH!

Comparison of Phase 2 mean speeds before and after the addition of centerline line markings – Nighttime (n=128)					
Detector Number	Mean speed before (mph)	Mean speed after (mph)	Δ Speed (mph)	t_{stat}	Significant $\alpha = 0.05$
1	29.84	31.97	2.13	-2.076	YES
2	27.36	29.38	2.02	-2.073	YES
3	24.18	26.62	2.44	-2.456	YES
4	22.00	24.79	2.79	-2.921	YES

Major Findings

- A statistically significant decrease in mean vehicle speed of 1.5-2 mph was observed between Phases 1 and 2 nighttime data samples.
- Little change in mean vehicle speed was observed between the other data samples
  - Phases 1 and 2 daytime (slight decrease in speed)
  - Phases 1 and 3 daytime and nighttime (slight increase in speed during the day)
- There was a statistically significant increase in the number of vehicles moving < 12 mph within ~75 ft. of the level crossing
- Rate of mean vehicle speed decrease across detection zone increased for Phases 2 and 3
- The addition of the highway centerline lane markings may have resulted in an increase in mean vehicle speeds.



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