



United States Department of Transportation Federal Railroad Administration Grade Crossing Research Program

Presented by:

Starr Kidda, PhD

Francesco Bedini Jacobini

Federal Railroad Administration (FRA)

FRA's Mission:

- *To enable the safe, reliable, and efficient movement of people and goods for a strong America, now and in the future*

We accomplish our mission of grade crossing safety by:

- Issuing and enforcing safety regulations
- Investing in rail corridors
- Conducting research and developing technology



Image source: <https://www.aar.org/railroad-101>

U.S. Grade Crossing and Trespassing Trends

The U.S. Railroad System

775
Railroads

140,000
Route Miles of Track

209,000
At-Grade Railroad Crossings

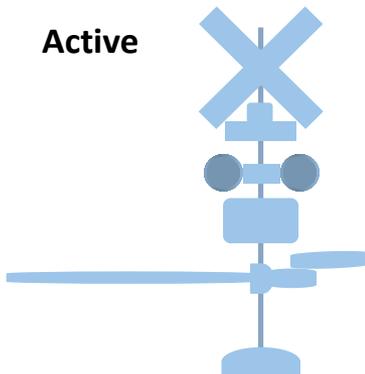


Crossings in the U.S.

54%

(with gates,
bells, and/or
flashing lights)

Active



46%

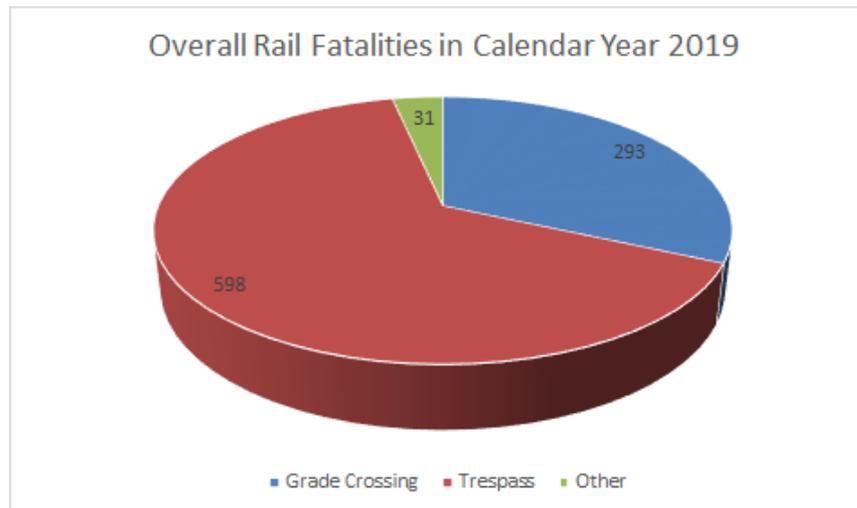
(with signs and
markings, but not
active warning devices)

Passive



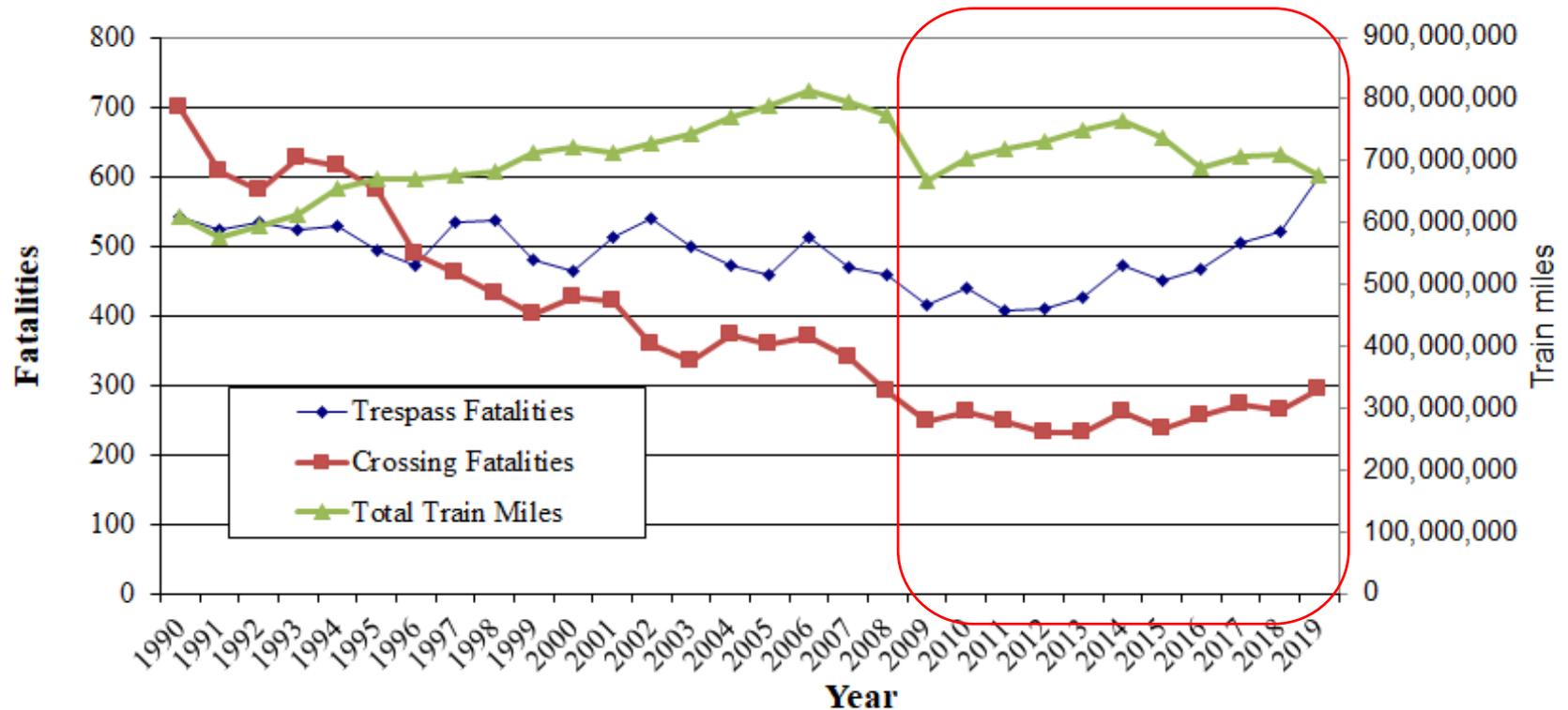
Grade Crossing Accident/Incident Data

- 2019 Accident/Incident Data: 2,226 incidents
 - Highway-Rail Grade Crossings: 1,098 casualties (293 fatal, up 10.2% from 2018)
 - Rail Trespassing: 1,128 casualties (598 fatal, up 13% from 2018)
 - Highway-rail and trespassing incidents account for 96.52% of all railroad fatalities.



<http://safetydata.fra.dot.gov>

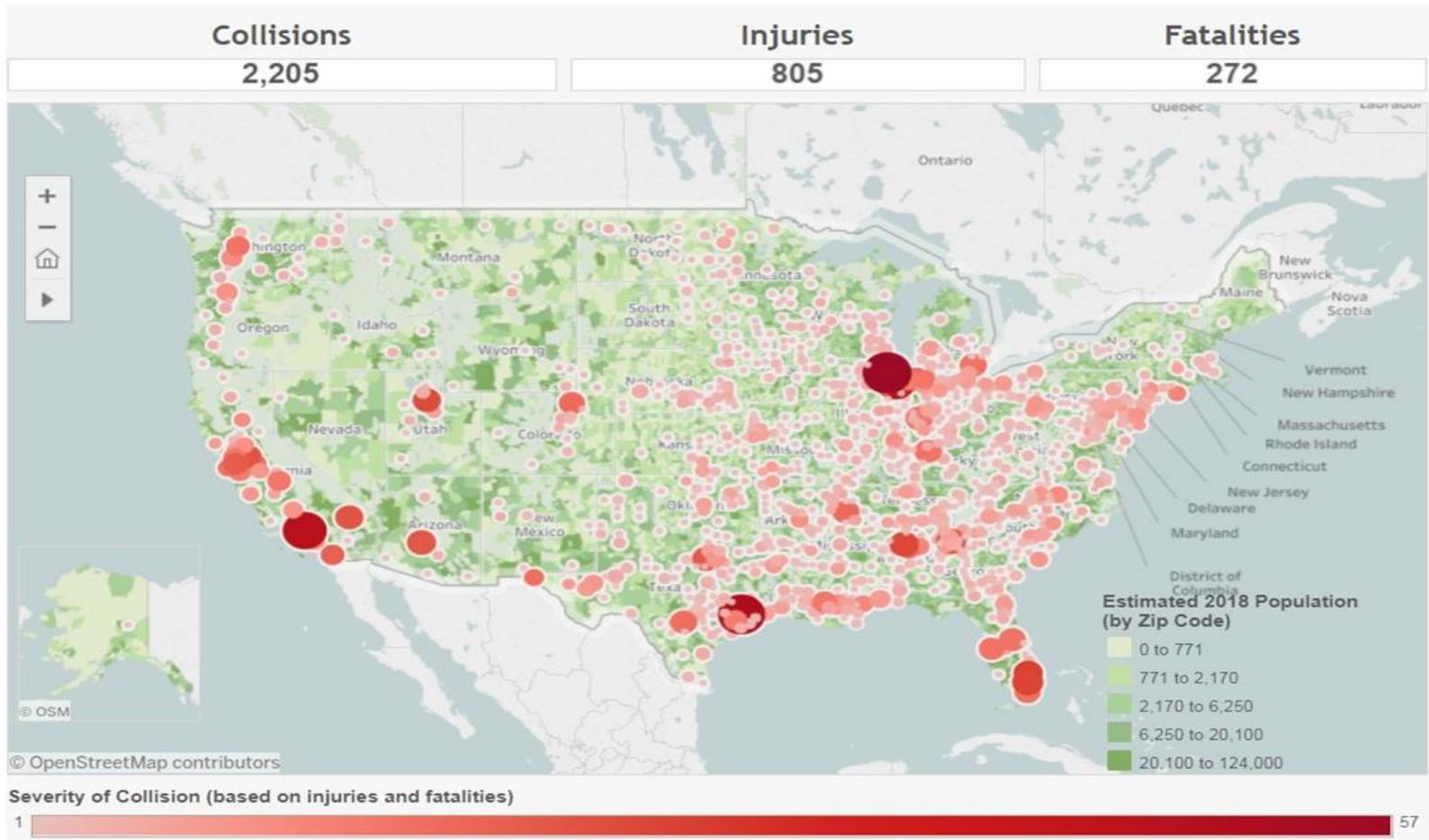
Grade Crossing and Trespass Safety Trend



<http://safetydata.fra.dot.gov>

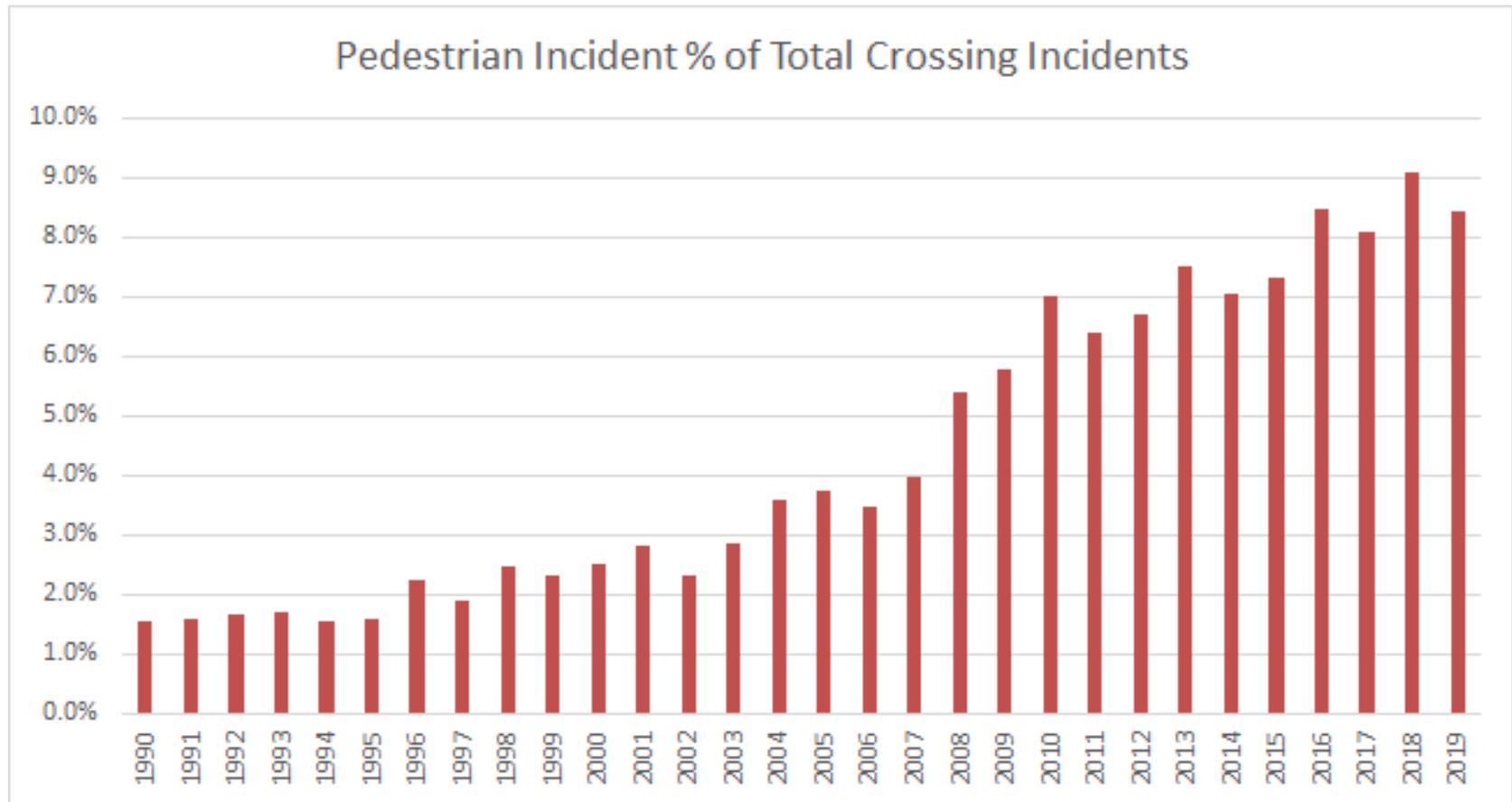
Grade Crossing Accidents and Severity

Highway-Rail Crossing Collisions (2018)



<http://fra.dot.gov/gxdash>

Pedestrian Incident % of Total Crossing Incidents



<http://safetydata.fra.dot.gov>

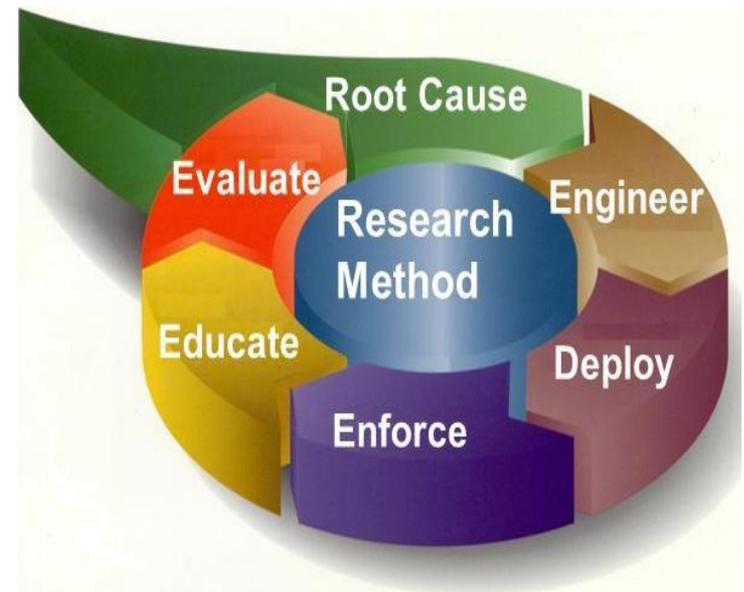
Grade Crossing Safety and Trespass Prevention Research Program

Goal

- Analyze **impact causation** and **develop safety countermeasures, programs, and guidance** to reduce the number of causalities at grade crossings and along railroad rights-of-way

Research Methods

- Research the root cause of incidents and fatalities
- Identify corrective actions
 - Engineering, Enforcement, Education
- Engage stakeholders
- Deploy and evaluate solutions



Current Research Program Partners



Sample of Current Research Topics

Grade Crossing Safety Research

- ❑ Evaluate Low Cost Treatments
- ❑ New Technologies for Blocked Crossings
- ❑ FRA Grade Crossing Database Enhancement
- ❑ FRA GradeDec Online Tool Enhancement



Vehicle Right-of-Way (ROW) Incursion Prevention

W. Jefferson St – ID 622187R



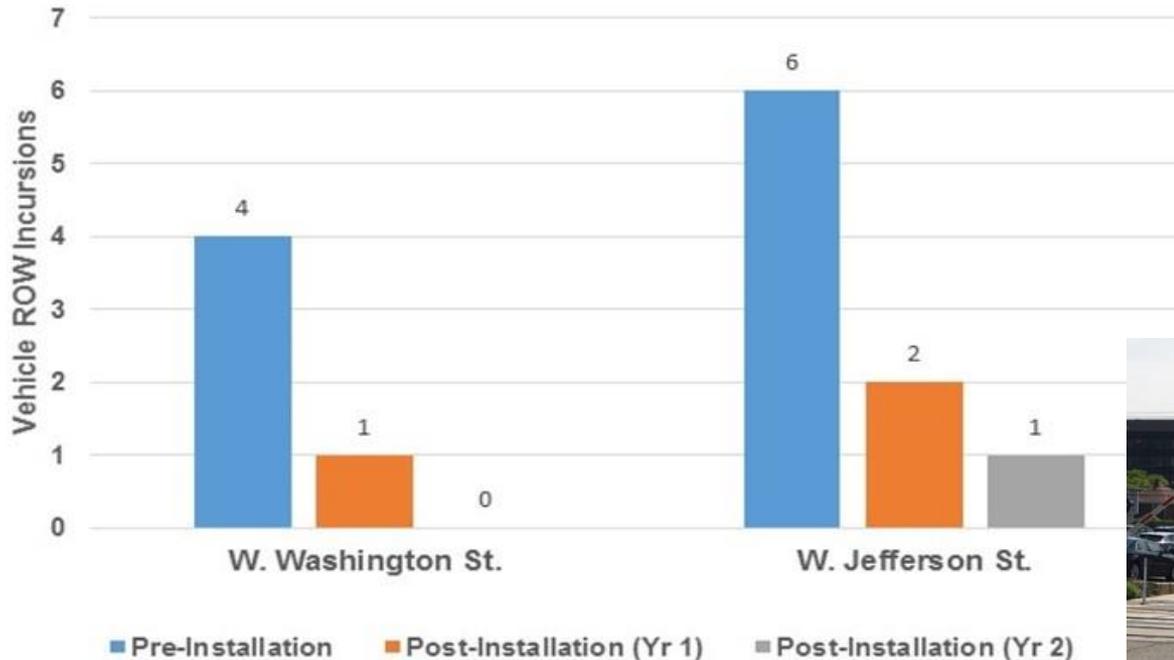
W. Washington St – ID 622188X



- Partnered with SunRail and Orlando, Florida to develop engineering treatments to prevent vehicle ROW incursion:
 - Extended pavement markings (yellow centerline and white edge lines) through the crossing
 - Added reflective markers and flexible delineators on both sides and in-between the tracks
- Evaluated the effectiveness to deter vehicles from turning onto the rail ROW

Vehicle ROW Incursion Prevention

Results



<https://rosap.ntl.bts.gov/view/dot/37006>

U.S. Department of Transportation
Federal Railroad Administration
RR 15-13 | August 2018

RESEARCH RESULTS
Published in Research, Development & Technology

RAILROAD RIGHT-OF-WAY VEHICLE INCURSION PREVENTION RESEARCH

SUMMARY
The Federal Railroad Administration's (FRA) Office of Research, Development and Technology (RD&T) sponsored research conducted by the John A. Volpe National Transportation Systems Center (Volpe Center) to evaluate the effectiveness of engineering treatments to deter vehicles from turning onto the rail right-of-way (ROW) at highway/rail grade crossings. The goal of the treatments is to reduce the number of vehicles that mistakenly enter the ROW, thus reducing the possibility of an incident with a train.

The Volpe Center partnered with SunRail (the commuter rail system in the Orlando area) and the City of Orlando, FL, to develop vehicle ROW incursion prevention engineering treatments, identify suitable grade crossings for implementation, collect before and after data, and evaluate the results.

Treatments were installed at two crossings in the City of Orlando, FL, and evaluated through December 2016 to December 2017 after installation. The locations selected for this study were the grade crossings at W. Washington St. (Crossing ID 622188X) and W. Jefferson St. (Crossing ID 622187R) within the city. Volpe research staff developed the treatments for the

significantly at both crossings, down 75 percent at the W. Washington St. crossing and 67 percent at the W. Jefferson St. crossing over the 2-year evaluation period.

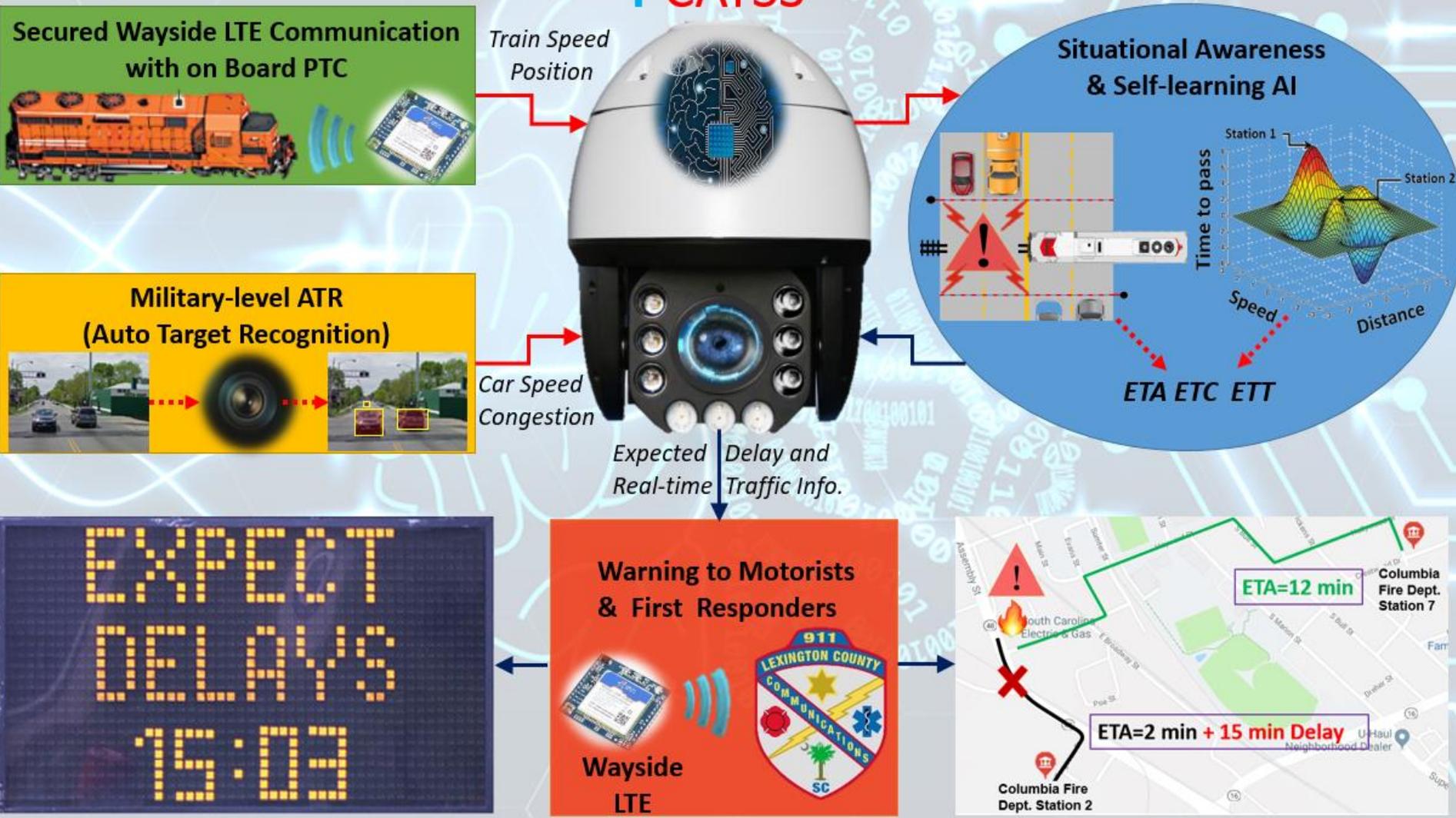
Figure 1. ROW Incursion Treatments installed at the W. Washington St. Crossing in Orlando, FL.

BACKGROUND
Vehicles turning onto the railroad ROW are a significant problem. There have been several high-profile incidents involving vehicles mistakenly turning into the railroad ROW at grade crossings. One of these recent incidents occurred in Orland, CA, on February 14, 2015. The incident involved a pickup pulling a trailer that turned onto the ROW and was struck by a



Intelligent Crossing Assessment and Traffic Sharing System

i-CATSS

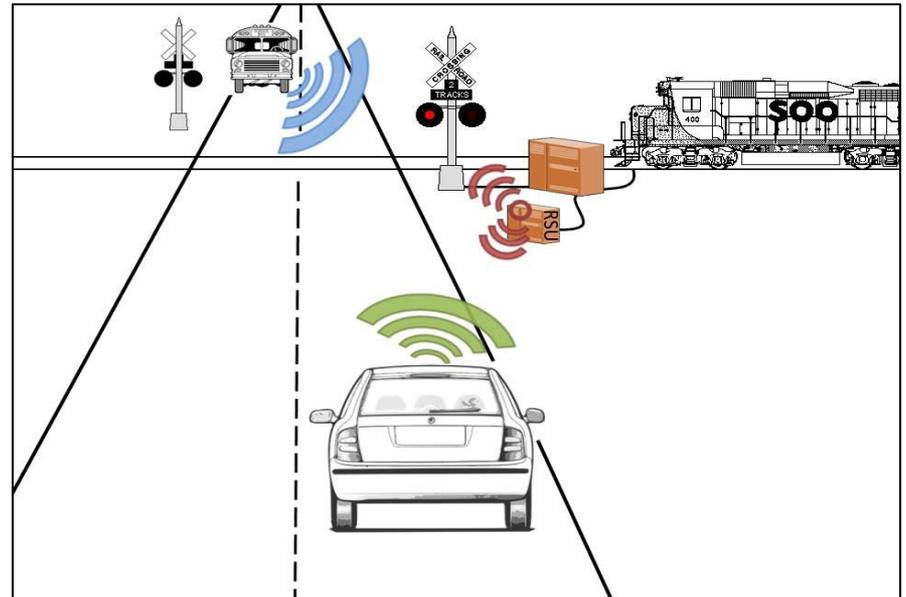


Assessing Safety Benefits of Real-time Railroad Crossing Information System for Emergency Responders



Rail Crossing Violation Warning (RCVW) Phase I Overview

- Leveraged real-time connected vehicle (CV) capabilities to design, test, and evaluate a prototype RCVW application.
- RCVW would be another onboard connected vehicle safety application (similar to lane departure, rear end collision avoidance) to warn drivers of imminent violation of a rail crossing protection system.
- Successfully demonstrated the technology and proof of concept.



LiDAR-Based Grade Crossing Survey System

- FRA developed a LiDAR system that captures scans of grade crossings to automatically identify hazardous conditions, visibility, and hump condition.
- Data will be used to:
 - Update FRA *National Grade Crossing Inventory* database with LiDAR point cloud of crossings.
 - Provide stakeholders with accurate 3D data for follow-up research activities.
- LiDAR system was installed on DOTX 220 (May 2019) and DOTX 304 Hi-Rail vehicle (October 2019) to survey crossings.
 - System designed to capture topography at speeds up to 70 MPH.



FRA LiDAR Grade Crossing Survey System



LiDAR Surveying System to be installed on the Hi-Rail "R4" research vehicle.

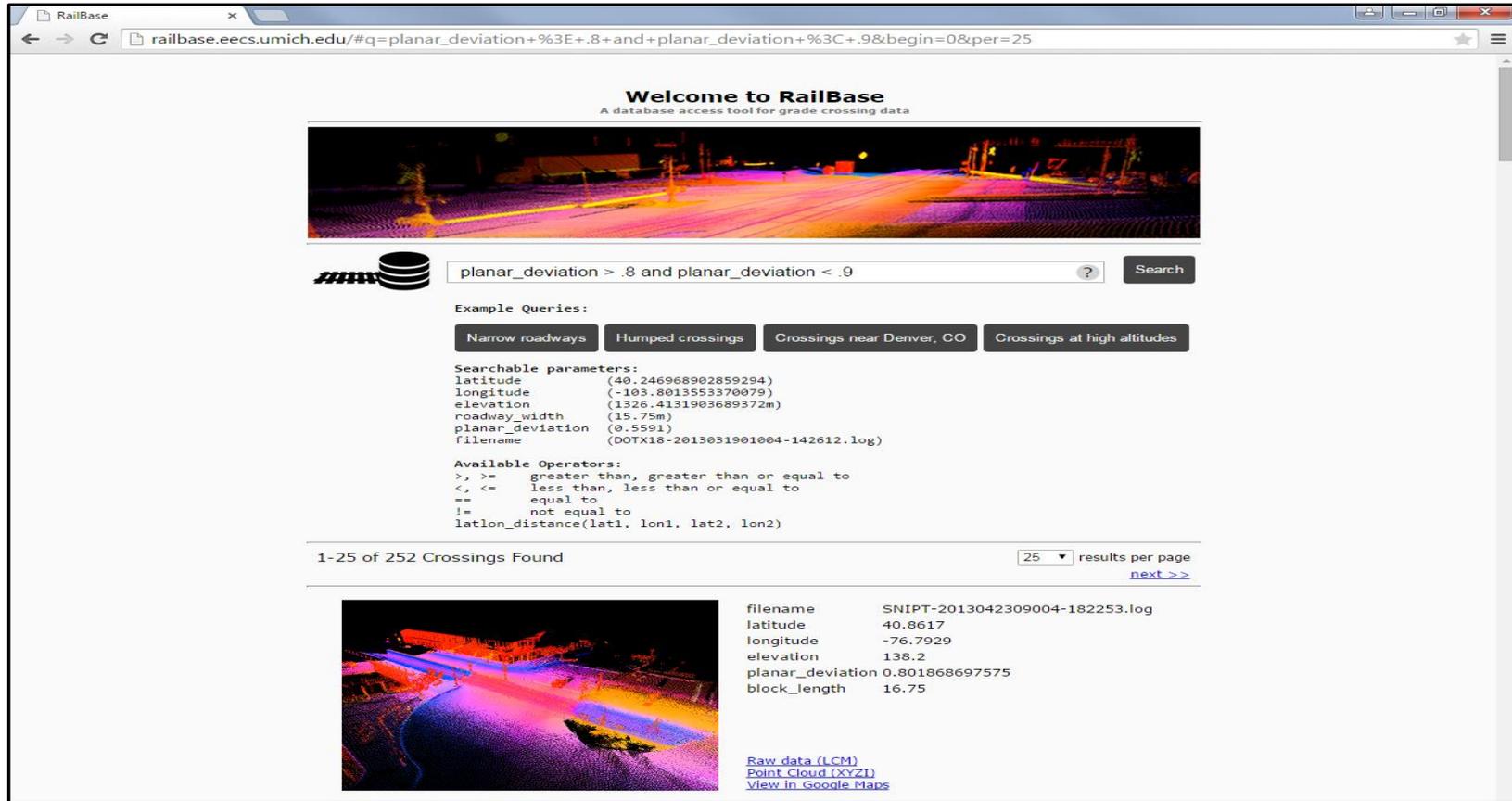
FRA has explored the use of Unmanned Aircraft System (UAS) Technology with LiDAR and Photogrammetry.



<https://railroads.dot.gov/elibrary/using-unmanned-aerial-vehicle-produce-accurate-grade-crossing-profile-data>

FRA LiDAR Grade Crossing Survey System

FRA developed a website to provide access to grade crossing survey data. <https://railbase.eecs.umich.edu/>



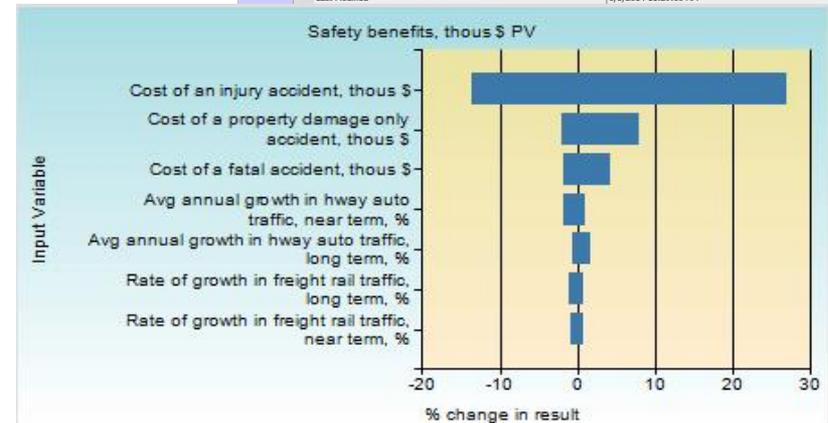
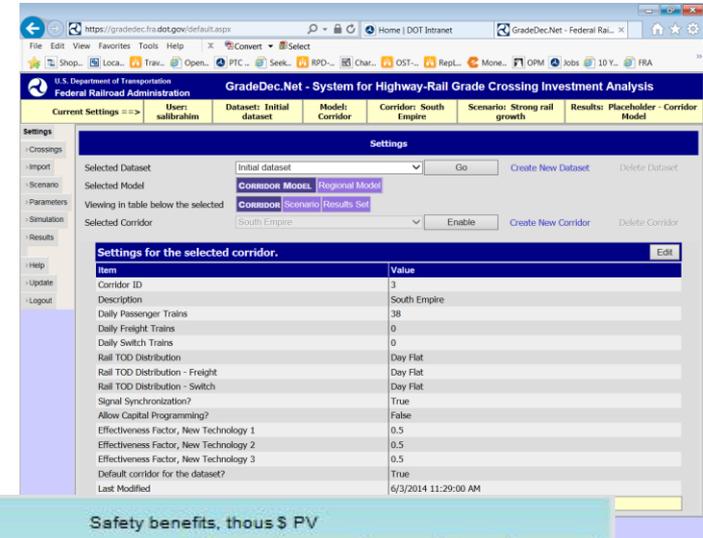
The screenshot shows the RailBase website interface. At the top, it says "Welcome to RailBase" and "A database access tool for grade crossing data". Below this is a large image of a grade crossing at night with LiDAR data overlaid. A search bar contains the query "planar_deviation > .8 and planar_deviation < .9". Below the search bar are "Example Queries" buttons: "Narrow roadways", "Humped crossings", "Crossings near Denver, CO", and "Crossings at high altitudes". A section titled "Searchable parameters:" lists: latitude (40.246968902859294), longitude (-103.8013553370079), elevation (1326.4131903689372m), roadway_width (15.75m), planar_deviation (0.5591), and filename (DOTX18-2013031901004-142612.log). A section titled "Available Operators:" lists: >, >= greater than, greater than or equal to; <, <= less than, less than or equal to; == equal to; != not equal to; and latlon_distance(lat1, lon1, lat2, lon2). Below this, it says "1-25 of 252 Crossings Found" and "25 results per page" with a "next >>" link. A table shows details for a specific crossing:

filename	SNIPT-2013042309004-182253.log
latitude	40.8617
longitude	-76.7929
elevation	138.2
planar_deviation	0.801868697575
block_length	16.75

Below the table are links: "Raw data (LCM)", "Point Cloud (XYZI)", and "View in Google Maps".

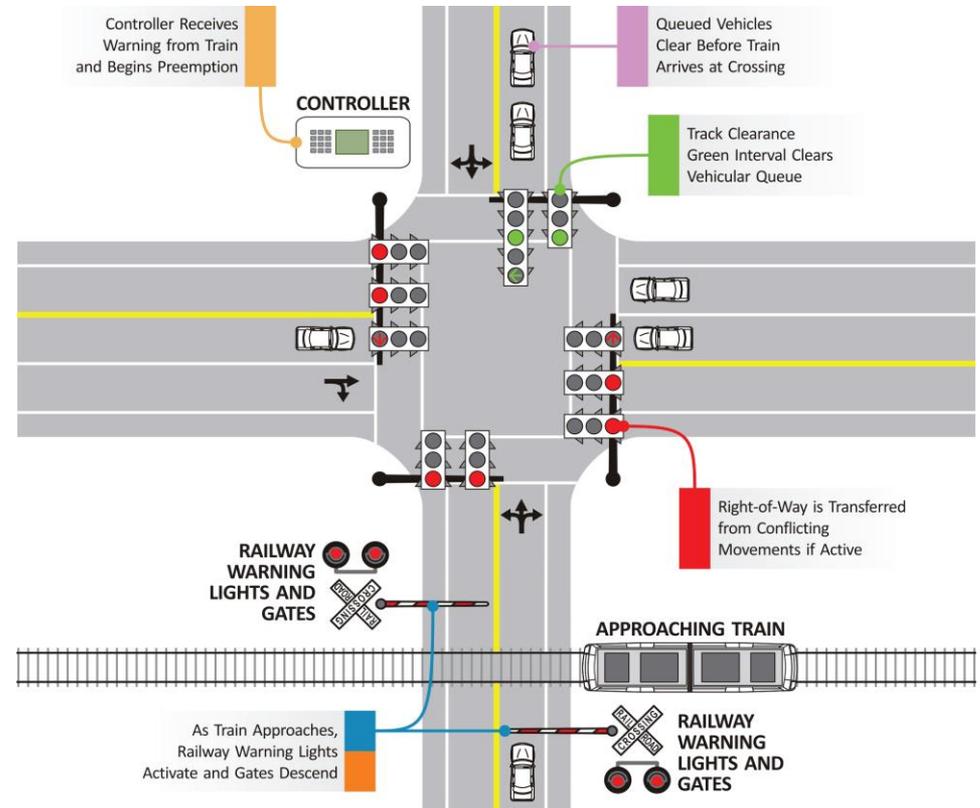
GradeDec.Net

- **GradeDec** is a web-based benefit cost analysis tool.
 - Identifies the riskiest crossings within a geographic area or along a rail corridor and conducts a benefit cost analysis for up to 40 years (investment life cycle).
 - Used to maximize grade crossing investments and offer cost effective alternatives to reduce risk and improve traffic flow.
- Features include:
 - Grade Separation
 - Closure
 - Four-quad gates
 - Time-of-day one way traffic lanes



GradeDec Next Enhancements

- Improve vehicle queuing model to support new advanced highway traffic control systems upstream of grade crossings.
- Improve the accident prediction model to include additional risk factors specific to the location.



2017 Grade Crossing Research Needs Workshop

Final Report
May 2018

Effect of Photo Enforcement Based Education on Vehicle Driver Behavior at a Highway-Rail Grade Crossing

Final Report
April 2018

Effect of Grade Separation on Pedestrian Railroad Trespass Activity at Shuttleworth Drive in Collegeville, AL

Final Report
May 2018

Long-Term Effect of Photo Enforcement-Based Education on Vehicle Driver Behavior at a Highway-Rail Grade Crossing

Final Report
May 2018

Effects of In-Pavement Lights on Driver Compliance with Grade Crossing Safety Equipment

Final Report
May 2018

RAILROAD RIGHT-OF-WAY INCURSION PREVENTION

2017 GRADE CROSSING RESEARCH NEEDS WORKSHOP

DEVELOPMENT OF RAILROAD TRESPASS AND GRADE CROSSING TRAINING AIDS RESEARCH

Final Report
May 2018

U.S. Department of Transportation Federal Railroad Administration

Search

Home

Document Type > eLibrary Search

Year

Month

Subjects

Attention eLibrary Visitors! The eLibrary is currently undergoing reconstruction. If you are unable to locate the document you are searching for and need assistance, please contact the FRA Web Team at fraweb@dot.gov.

Your Selections:

The FRA eLibrary contains all the documents that are found throughout the FRA Public Website. Multiple pages on the website may link to the same eLibrary item based on its set of metadata.

Can I find All FRA Documents in the Library?

Some "documents" may not appear here for the following reasons:

- Document resides on an external site for the record of source, links to the document are provided in context but not in the library as FRA does not maintain this record. This document lives on another website.
- Document has not yet been assigned keywords.
- Document is historical and has been removed from library to avoid confusion with current publications.
- Document is public affairs & policy related, such as press releases, speeches, testimony, or fact sheet. These press-related documents can now be found in the FRA Newroom.
- Document is related to rules and notices. This information can now be found on the Rulemakings search and the Notices search, respectively.

U.S. Department of Transportation Federal Railroad Administration

Search FRA site

FEATURED STORIES

TRESPASSER & GRADE CROSSING FATALITY PREVENTION SUMMIT Tuesday, October 30, 2018

Report to Congress: National Strategy to Prevent Trespassing on Railroad Property

Click Here to Watch the FRA Trespasser & Grade Crossing Fatality Prevention Summit

Positive Train Control Progress Report

FRA ELIBRARY

- Accidents & Fatalities
- Compliance
- Conferences & Presentations
- Emergency & Safety
- Enforcement & Litigation
- Publications & Policy
- Reports
- Rules & Regulations
- Other

Click on Reports

Refine Your Search

To search an exact document title or key phrase, place quotations around the text. Example: "U.S. Government Grade Crossing Research & Stakeholder Engagement" Entering keywords without quotations will search the eLibrary for all occurrences of the keywords.

An aerial, high-angle photograph of a railway track system, showing multiple parallel tracks receding into the distance. The tracks are flanked by overhead power lines and support structures. The entire image has a blue color cast. In the center, the text 'Q&A' is overlaid in a large, white, sans-serif font.

Q&A



CONTACT US

Federal Railroad Administration
1200 New Jersey Avenue, SE
Washington, DC 20590

For more information visit us at
www.fra.dot.gov



Connect with us **USDOTFRA**

Starr Kidda, PhD

Chief – Human Factors Research
Division

Starr.Kidda@dot.gov
202-493-1300

Francesco Bedini

Program Manager – Grade Crossing
Safety and Trespass Prevention

francesco.bedini@dot.gov
202-493-0800



U.S. Department of Transportation
Federal Railroad Administration