

 Hollywood, FL

 June 13-14, 2024

2024 TRANSPORTATION SYMPOSIUM

Innovations in Safety

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FDOT District 7 Safety Program Engineer



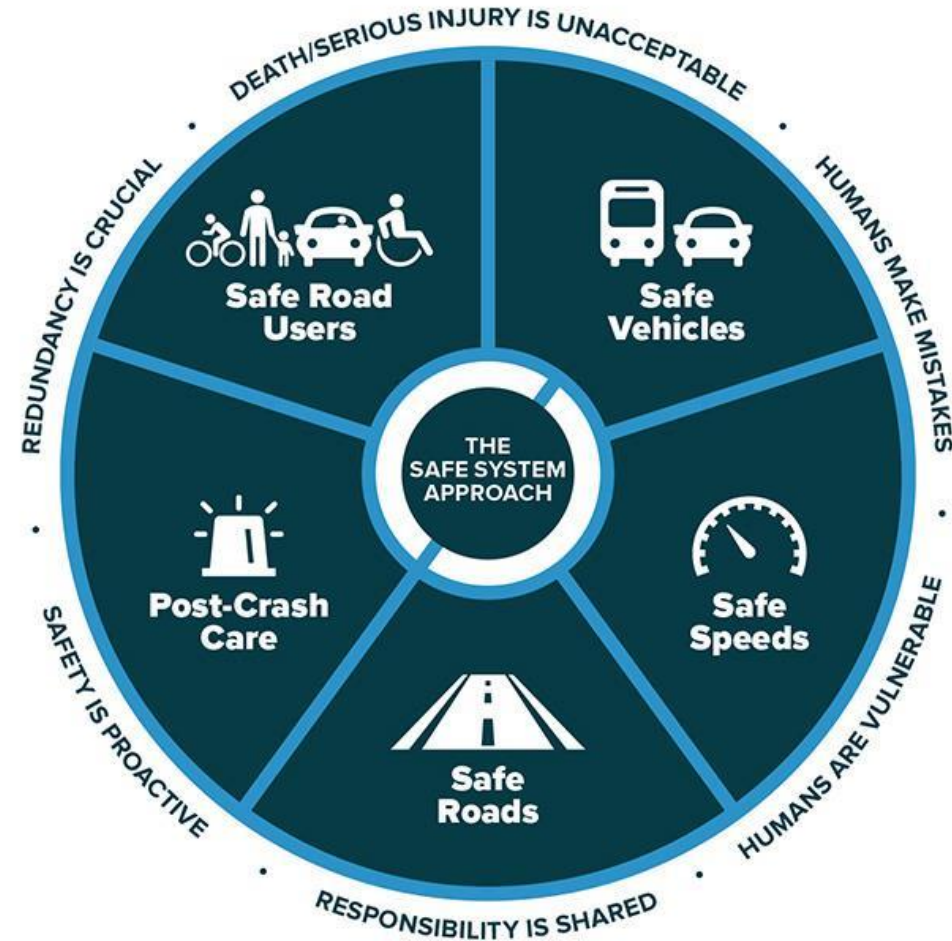
Presentation Outline:

Statewide & D7 Safety Performance

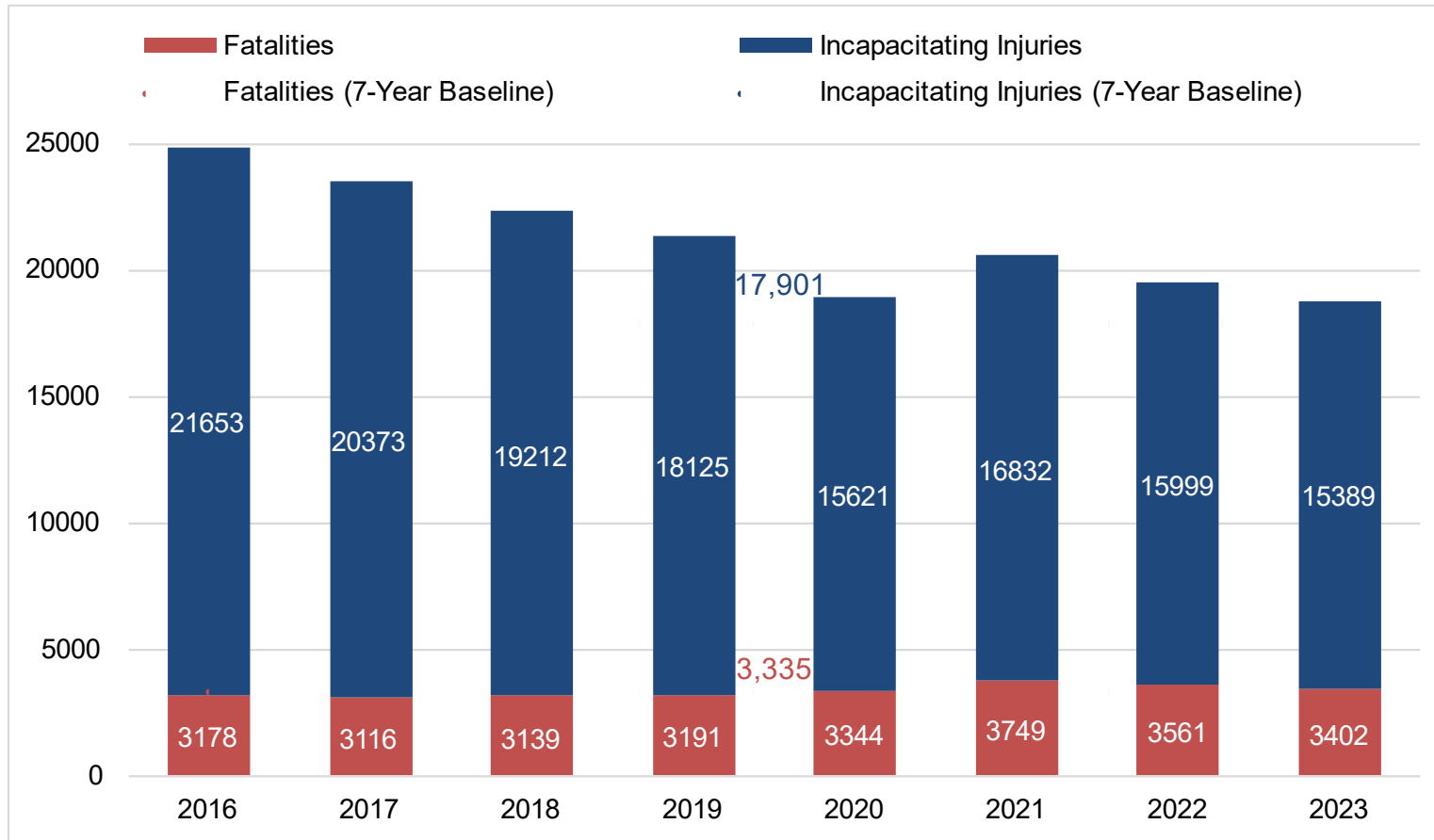
Pavement Friction & Safety

Work Zone Safety

Traffic Safety Initiatives & Innovation

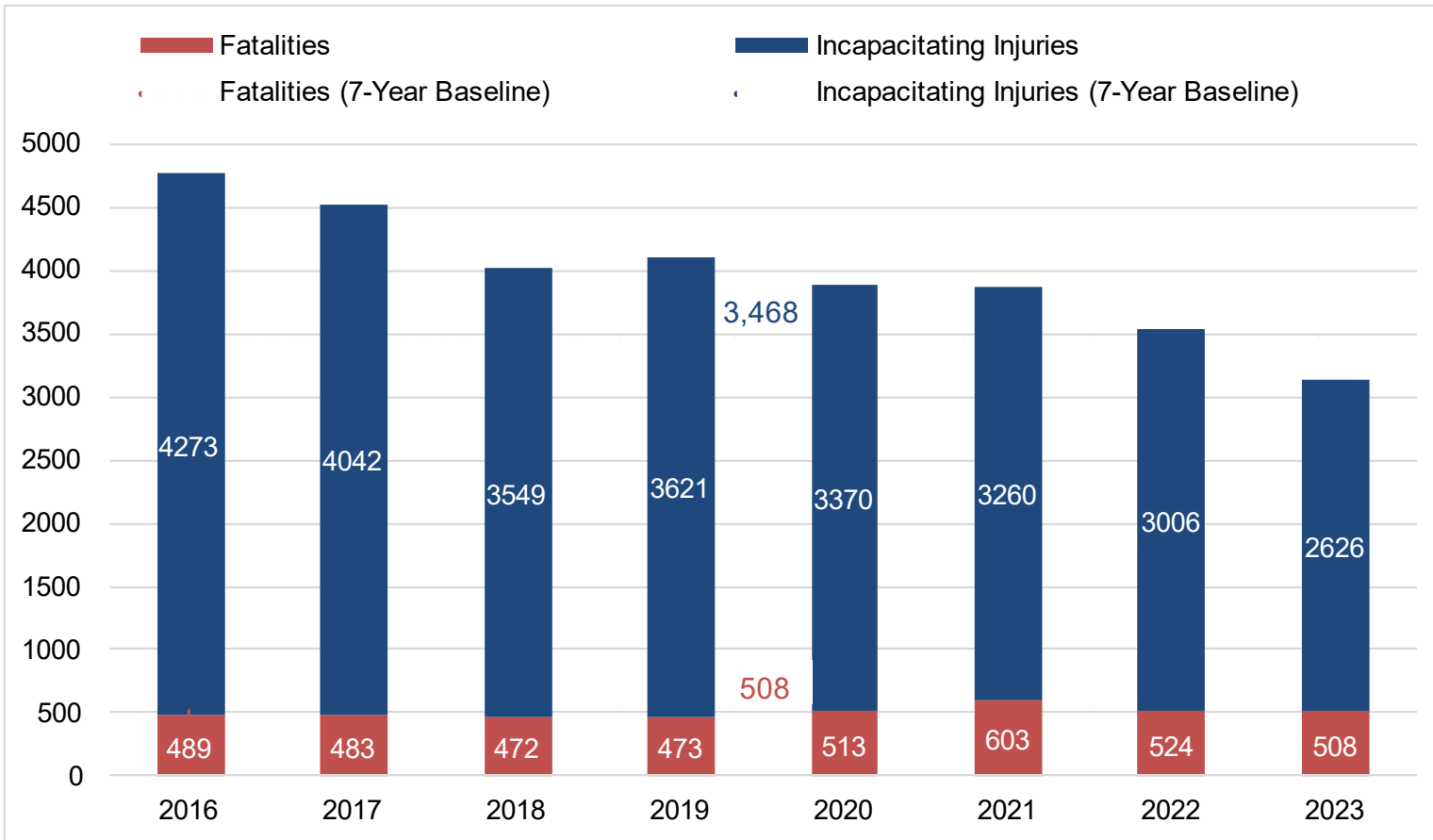


Statewide Safety Performance



- Fatalities are trending down overall compared to the 7-Year baseline after a slight uptick in 2021.
- Fatalities decreased by 4.4% from 2022 to 2023.
- Serious injuries decreased by 3.8% from 2022 to 2023.

District 7 Safety Performance



- Incapacitating Injuries are trending down overall since 2016; Fatalities are trending down overall after an increase in 2021.
- Fatalities decreased by 3.1% from 2022 to 2023.
- Serious injuries decreased by 12.6% from 2022 to 2023.
- Despite the continuous growth in the Tampa Metro Area, overall trends are going the right direction.

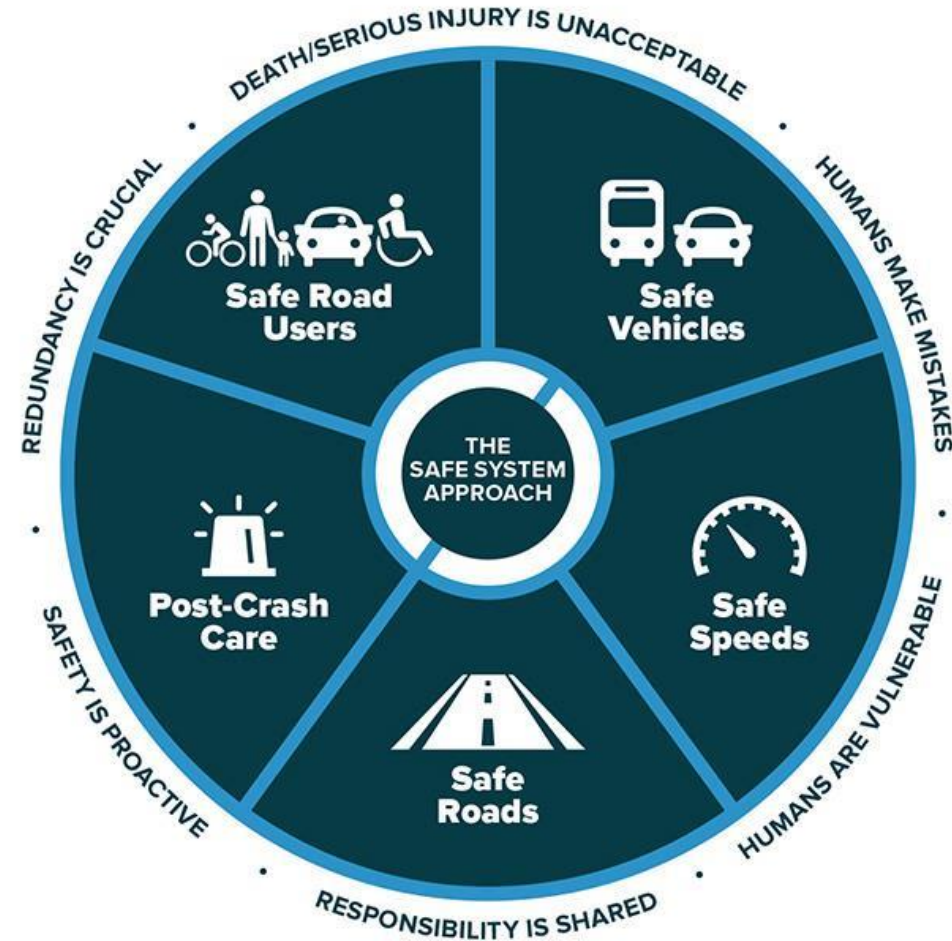
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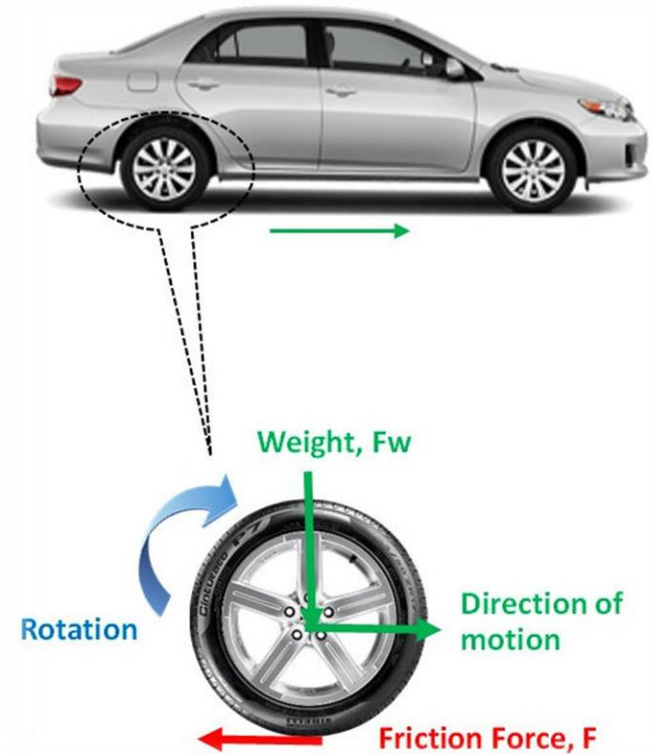
Work Zone Safety

Traffic Safety Initiatives & Innovation



Pavement Friction & Safety?

- Pavement friction is the force that resists the relative motion between a vehicle and a pavement surface.
- Pavement friction is a **significant factor** contributing to traffic crashes
 - Keep safely **in the lanes** when a vehicle changes direction
 - **Shorten braking distance** to avoid potential collisions
 - **Reduce injury severity** even if a collision happens
- High friction demand facilities
 - High-speed roads
 - Curves
 - Intersections
 - Wet surface



Source: DOI: 10.3390/vehicles2010004

Pavement Friction & Safety?

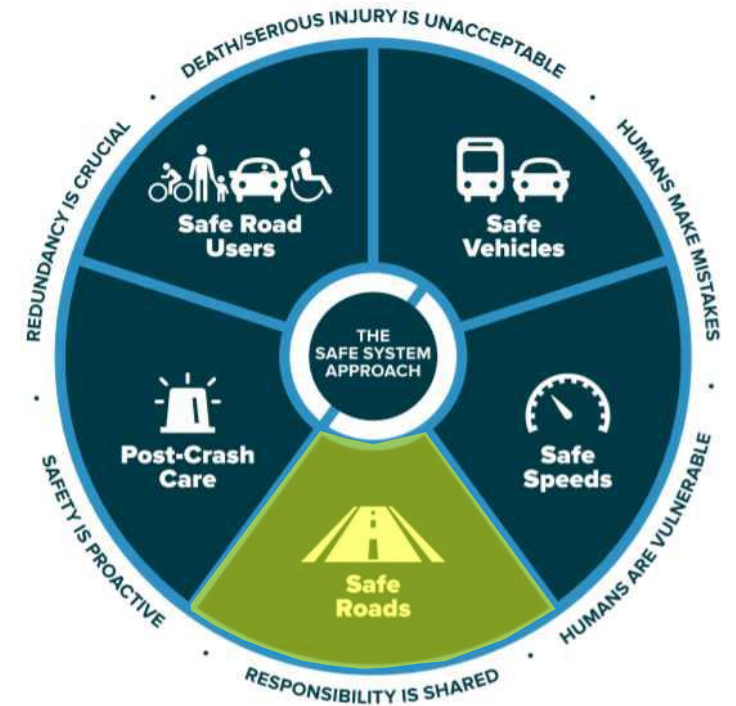
- Pavement friction **deteriorates over time**
- Surface texture polishing by vehicle tires
- Surface material property changes due to traffic and weather loadings
- **Measuring, monitoring, and maintaining pavement friction are vital in pavement and safety management**
- Especially at locations where vehicles are frequently **turning, slowing, and stopping**



Pavement Friction & Safety?

FHWA (SA-21-014):

“Including pavement friction as a parameter in road safety performance modeling, establishing friction performance thresholds based on context, and proactively and systemically managing friction can help your agency achieve its road safety goals to save lives and prevent serious injuries.”

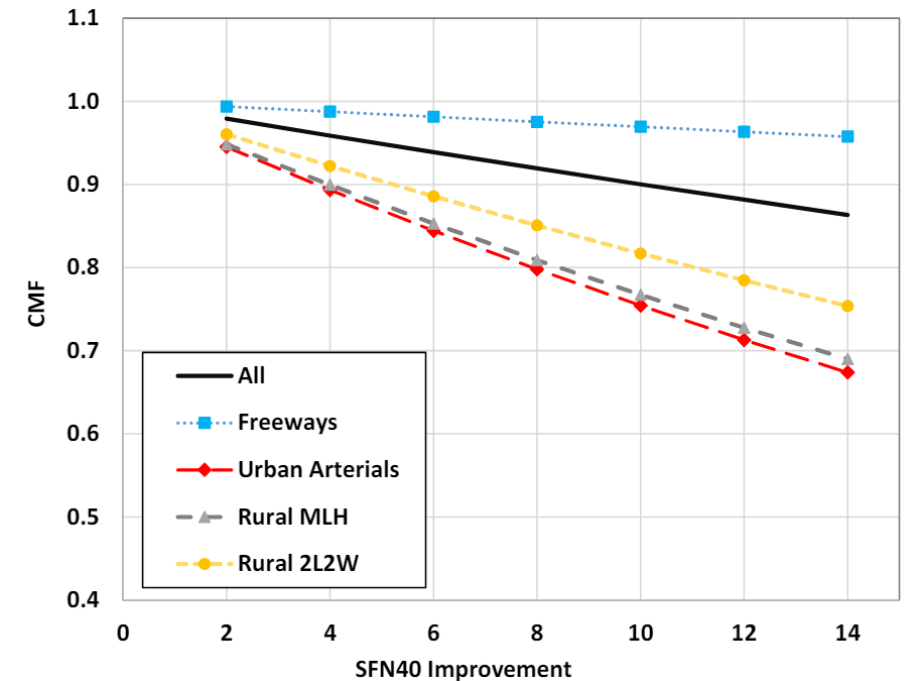


If Safe System is the implementation mechanism for Vision Zero, then **continuous pavement friction measurement is how we get there**

Pavement Friction & Safety?

CMF and percent crash reduction by surface condition for a 10-unit increase in SFN40

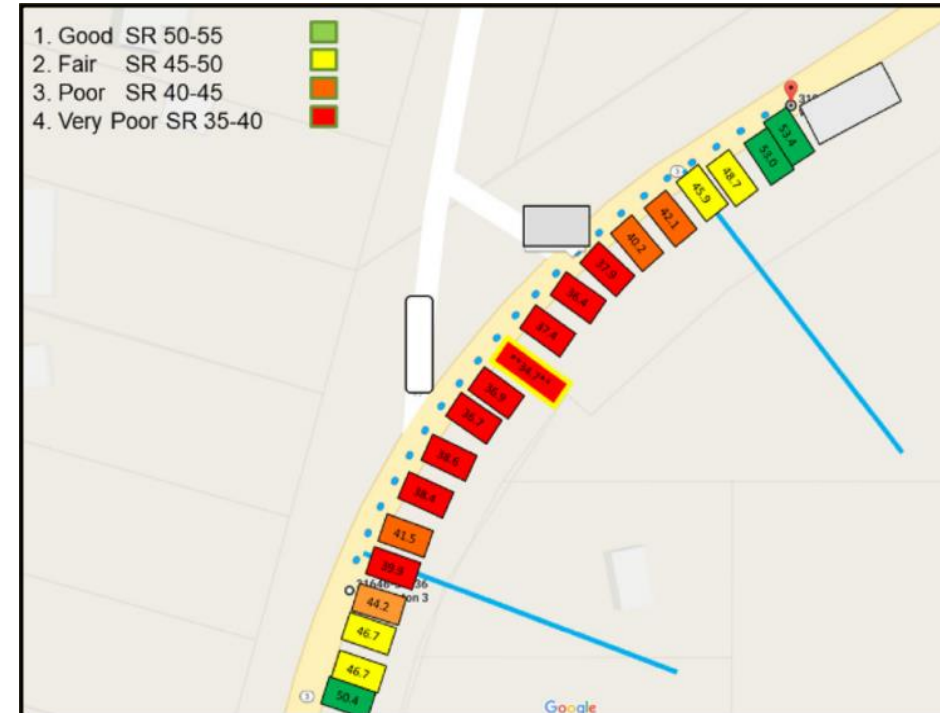
Roadway Facility	Surface Condition	CMF _x regression coefficient (β_1)	CMF for 10-unit SFN40 increase ⁽¹⁾	Standard Error CMF	% Crash reduction
Expressways	Total Wet	-0.0270	0.763	0.0109	23.7
	Total Dry	-0.0135	0.873	0.0078	12.6
Freeways	Total Wet	-0.0088	0.916	0.0152	8.4
	Total Dry	-0.0023	0.977	0.0106	2.3
Urban Arterials	Total Wet	-0.0479	0.619	0.0198	38.1
	Total Dry	-0.0348	0.706	0.0150	29.4
Rural Multilane Highways	Total Wet	-0.0251	0.778	0.0179	22.2
	Total Dry	-0.0251	0.778	0.0178	22.2
Rural 2-lane, 2-way Road	Total Wet	-0.0467	0.627	0.0575	37.3
	Total Dry	-0.0354	0.702	0.0343	29.8



Data from Florida, North Dakota, Texas, Virginia, and Washington State

Pavement Friction & Safety?

- Friction Management
 - Recently added to list of proven safety countermeasures
 - Pavement friction can prevent & reduce fatal and serious injury crashes at locations where friction is critical
 - Typical method of measuring friction on roadway networks takes sample data generally not on curves or intersections and result in gaps in the data
 - Best practice for targeting more efficient and effective installations of friction-enhancing treatments



Visualization of CFM data through a curve with an intersection in 30-foot averaged intervals

Source: US Department of Transportation Federal Highway Administration (FHWA)

Traditional Pavement Data Collection

- Traditionally, pavement friction data are measured from the Locked-Wheel Skid Test (LWST)
- LWST friction measurements are intermittent with traffic control, typically only a few measurements (usually 1 to 5) per mile
- The limited LWST samples make describing the pavement friction patterns at the crash location infeasible or inaccurate



Continuous Pavement Friction Measurement

- Continuous Pavement Friction Measurement (CPFM) continuously collects high-resolution pavement friction data
- Very short distance intervals
- Covering tangents, curves, and intersections
- Revolutionize the understanding of the relationship between crash risks and friction patterns



Continuous Measurement Method - SCRIM

- SCRIM (Sideway-force Coefficient Routine Investigation Machine)
- Continuously collected ~2,100 miles of GPS-linked friction and texture data, geometry (curve, grade, crossfall), and video in 14 days.
- Can travel 15mph to 55mph for a range of 45-150 miles in one tank of water. No traffic control needed.

↓30%

On wet roads



↓40%

Fatalities

↓20%

On dry roads

BCR ~ 13:1 to 35:1



**TRANSPORTATION
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SCRIM Data Collected

Category	Date Item	Description
Pavement Friction	SCRIM Reading (SR)	Raw SCRIM pavement friction coefficients
	SCRIM Coefficient (SC)	Speed and temperature-corrected SR
Macrotexture	Mean Profile Depth (MPD)	ISO 2019 standard calculation in millimeters and inches
Roughness	IRI	International Roughness Index, inches/mile
Geometry	Curve	Radius in feet ($1/\text{curvature} * 3.281$)
	Grade	%, positive grade is uphill, negative grade is downhill
Measurement	Date/Time	Survey year-month-day hour/minute/second
	Location	GPS longitude, latitude

SCRIM Data Applications

SCRIM Usage Nationwide

NCDOT – Has been sponsoring several research projects to investigate the trends of pavement friction and texture changes over time and appropriate threshold values

KYTC – Has developed robust Safety Performance Functions specific to Kentucky that will predict crashes and will use Empirical Bayes to determine expected crash rates

FHWA – Has published CMFs and investigatory thresholds to use for decision-making and projections for improving friction on roadways

VTTI – Has analyzed the Continuous Friction Measurement data to assess crash risk and develop investigatory or intervention levels of frictions for multiple states

WDM – Has worked with states to develop custom Safety Performance Functions and set thresholds that are solution-based

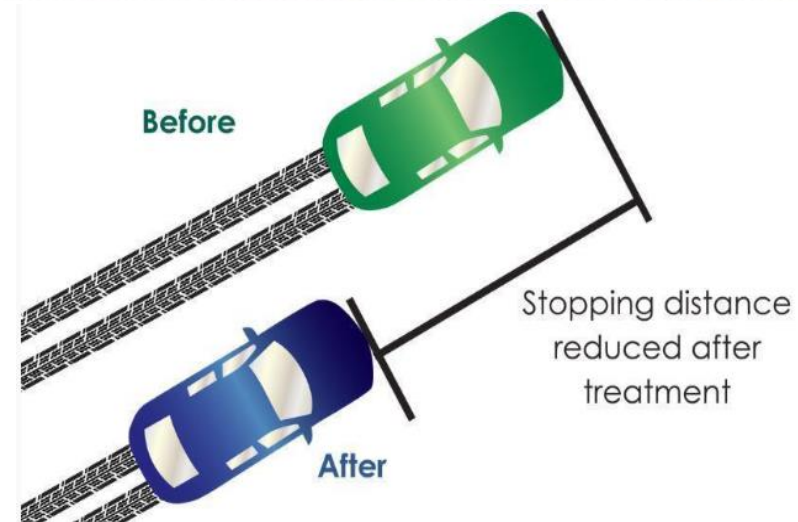
Pilot SCRIM Data Applications in D7

- District 7 linked crash data with continuous friction measurements and road safety assessments to select intersections for High Friction Surface Treatment (HFST)



Utilizing SCRIM Data for Targeted HFST

- High Friction Surface Treatment (HFST):
 - The application of very high-quality aggregate to the pavement using a polymer binder to restore and/or maintain pavement friction
 - Helps motorists maintain better control in both dry and wet driving conditions
 - Reduces stopping distance
 - Increase expected stopping behaviors (stop before stop bar)
 - Reduce improper stopping behaviors (occupancy crosswalks)
 - Reduce the risk of vehicle-pedestrian conflicts



District 7 Targeted HFST Projects

HFST projects were then constructed at many intersections and curves through various contracting methods - **Fast Response, Design-Build Pushbutton & Work Program**

Intersections

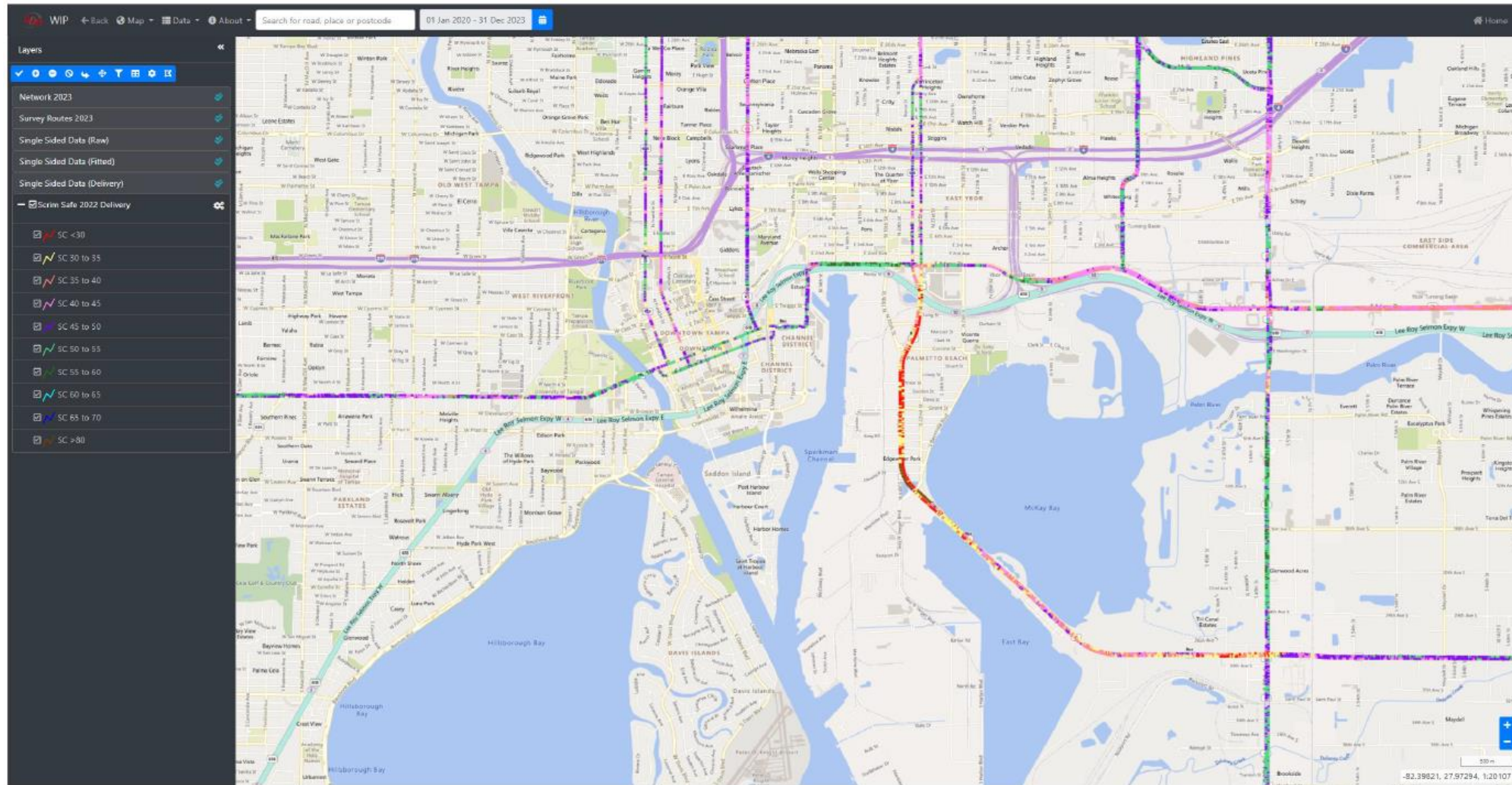
- Hillsborough Avenue at Central Avenue (2020)
- Hillsborough Avenue at Sheldon Street (2020)
- Hillsborough Avenue at Lagoon Street (2020)
- Hillsborough Avenue at George Road (2022)
- US 301 at Stacy Road (2022)

Curves

- NB SR 589 Off Ramp at Independence Parkway (2021)
- SB SR 589 On Ramp at Independence Parkway (2021)
- US 41 (Tamiami Trail) South of SR 674 (College Avenue) (2022)
- Memorial Highway at Spruce Street (2022)
- USB 41 near Hemlock Street (2022)



D7 Districtwide SCRIM Pilot Project Results

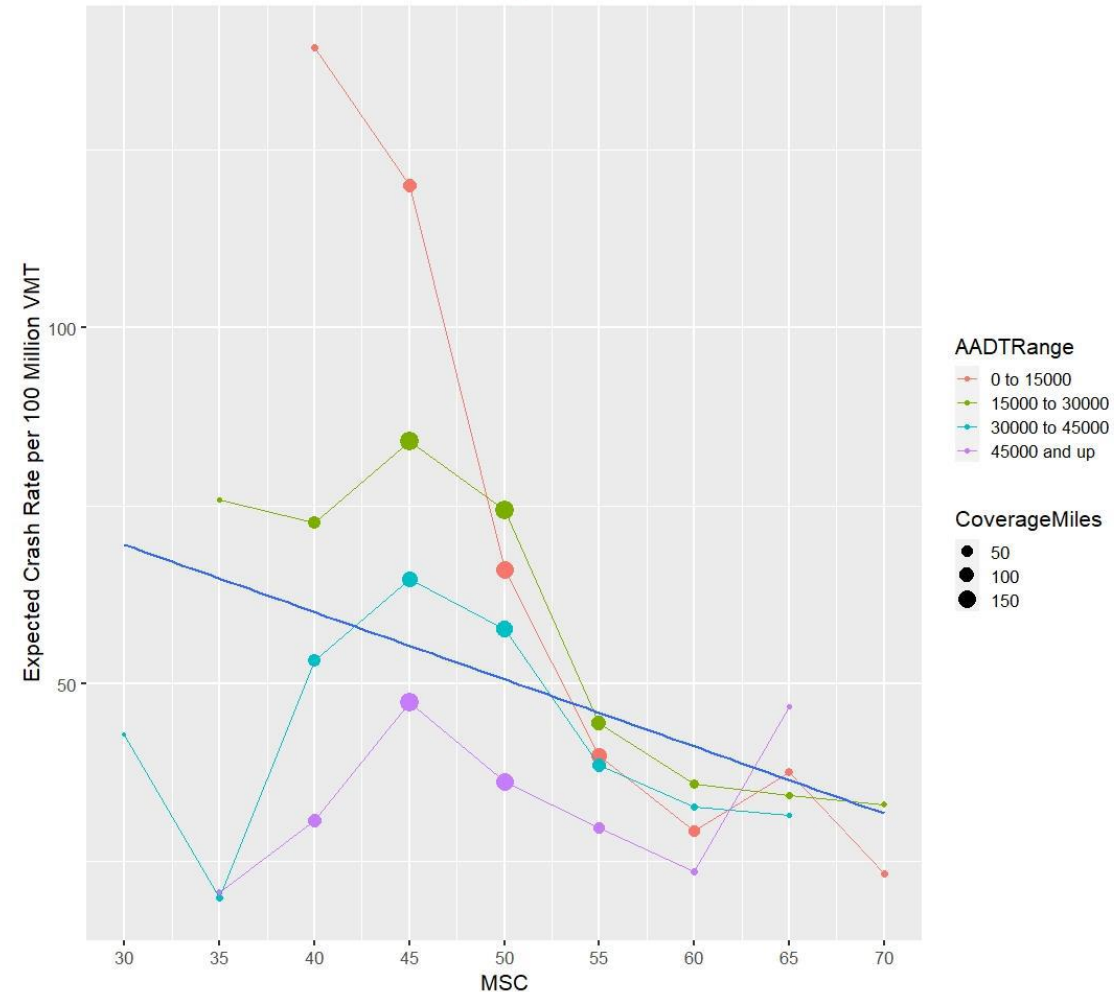


D7 Districtwide SCRIM Pilot Project Results

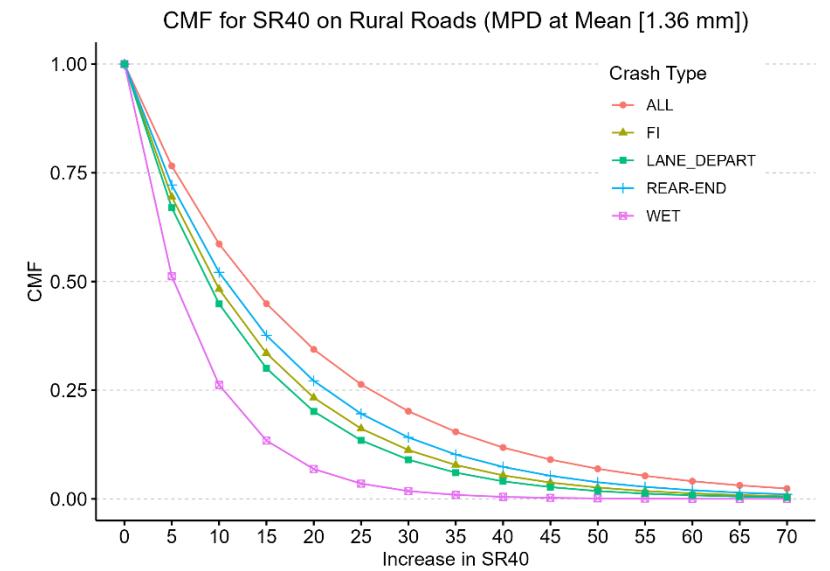
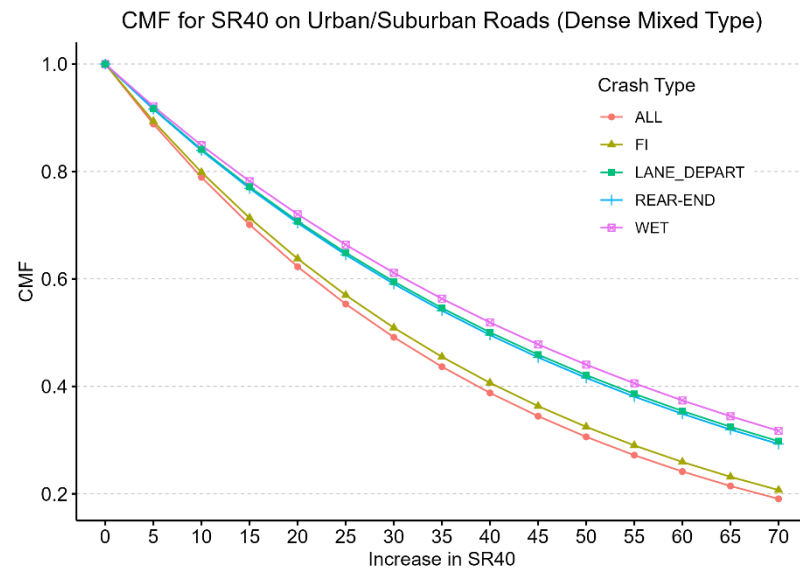
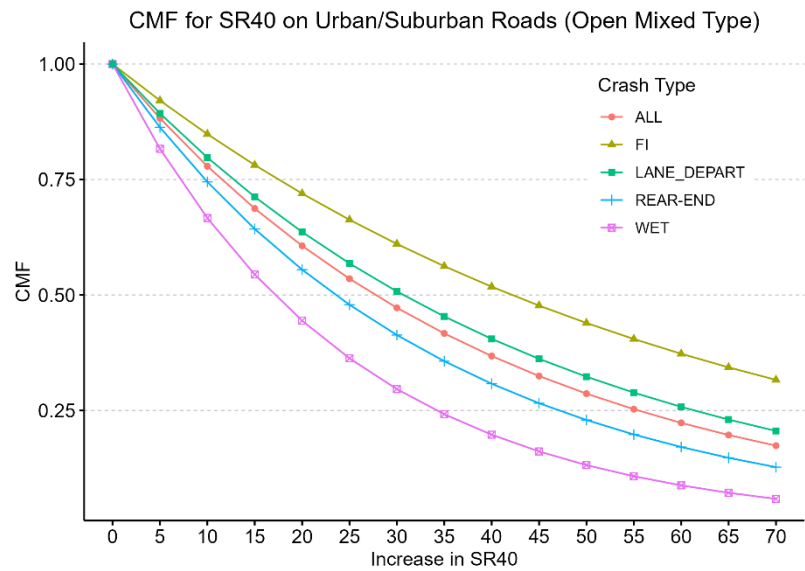
- Low AADT locations have disproportionately high crash rates
- The blue 'line of best fit' for all the data indicates an **inverse relationship between friction and crash rate**
- The majority of this year's SCRIM network coverage recorded friction (MSC) values between 40 and 50
- **Increases in friction (MSC) and mean profile depth (MPD) result in the largest predicted % decrease in crash rate**, due to the large effect these measures have on roads with disproportionately high crash rates
- **Crash rates at or near intersections nearly 3x higher than non-intersections**
- **Crash rates on inclines are slightly lower than flat roads**

Adjusted Crash Rate by AADT Range and MSC

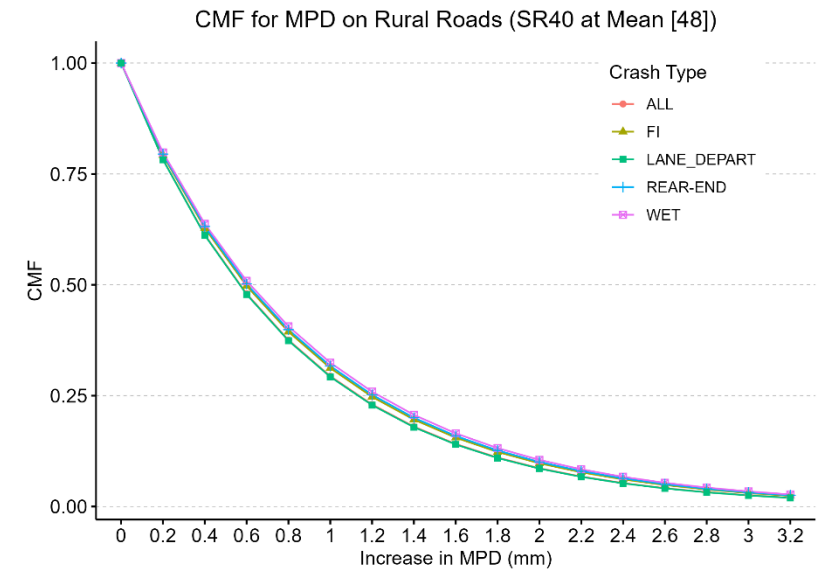
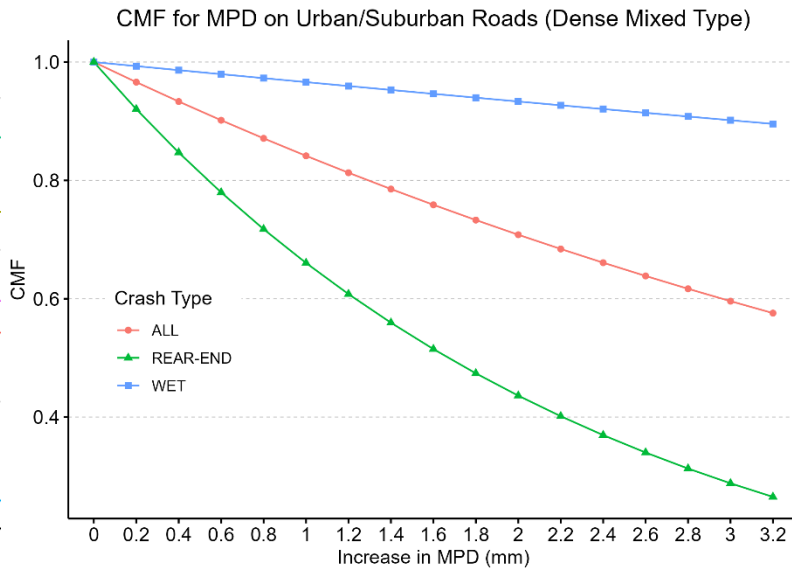
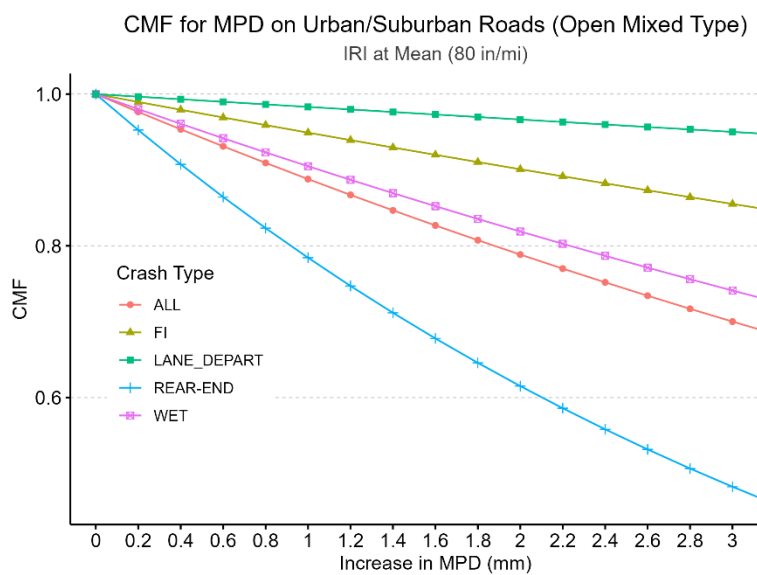
Only SCRIM values with at least 2.5 Coverage Miles per AADT Range are Included



D7 DW SCRIM Pilot Results – Friction CMF



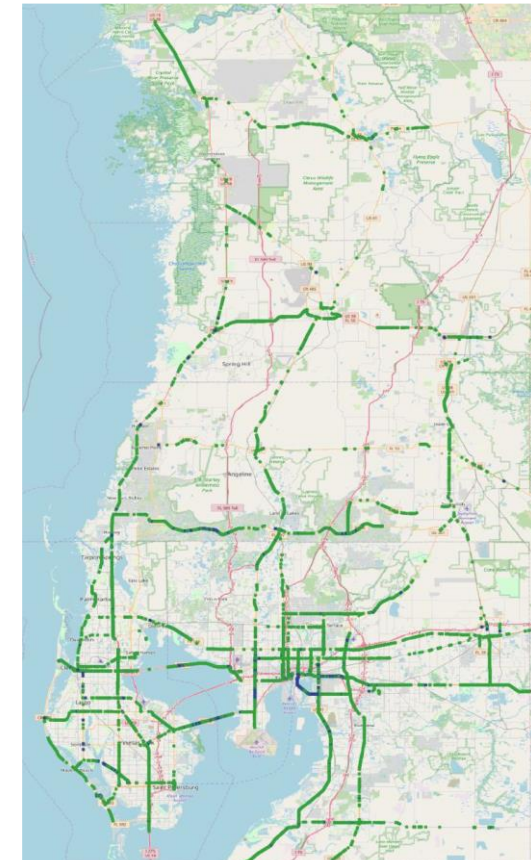
D7 DW SCRIM Pilot Results – Macrotexture CMF



D7 Districtwide SCRIM Pilot Project Results

District 7 is utilizing SCRIM data to:

- Investigate relationships among pavement condition, friction, crashes, and other FDOT big data
- Identify **key locations** (programmed FY26+FY27 resurfacing projects, excessive crash history) with desktop and field road safety assessments (RSAs) for potential safety-focused treatment
- Develop quantitative relationships for skid related crashes, friction, pavement condition, traffic type, facility type, and weather to predict **likelihood of skid related crashes**
- Develop SPFs which can be incorporated into future prioritization processes
- Estimate benefits/costs of pavement friction improvements to inform pavement friction management strategies
- Enhance **resurfacing project selection and prioritization** which currently uses spot pavement measurements (crack, ride, and rut ratings)



Surveyed network where MSC<45
Green lines: MSC 40-45 (poor)
Blue lines: MSC <40 (very poor)

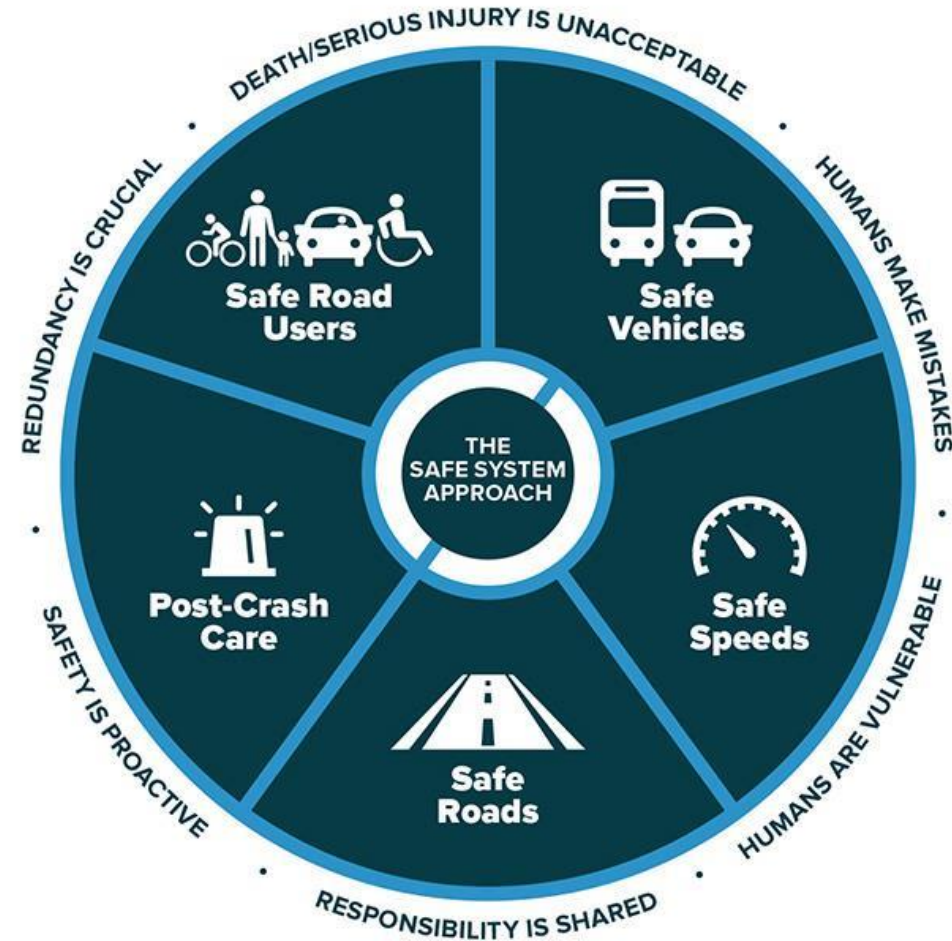
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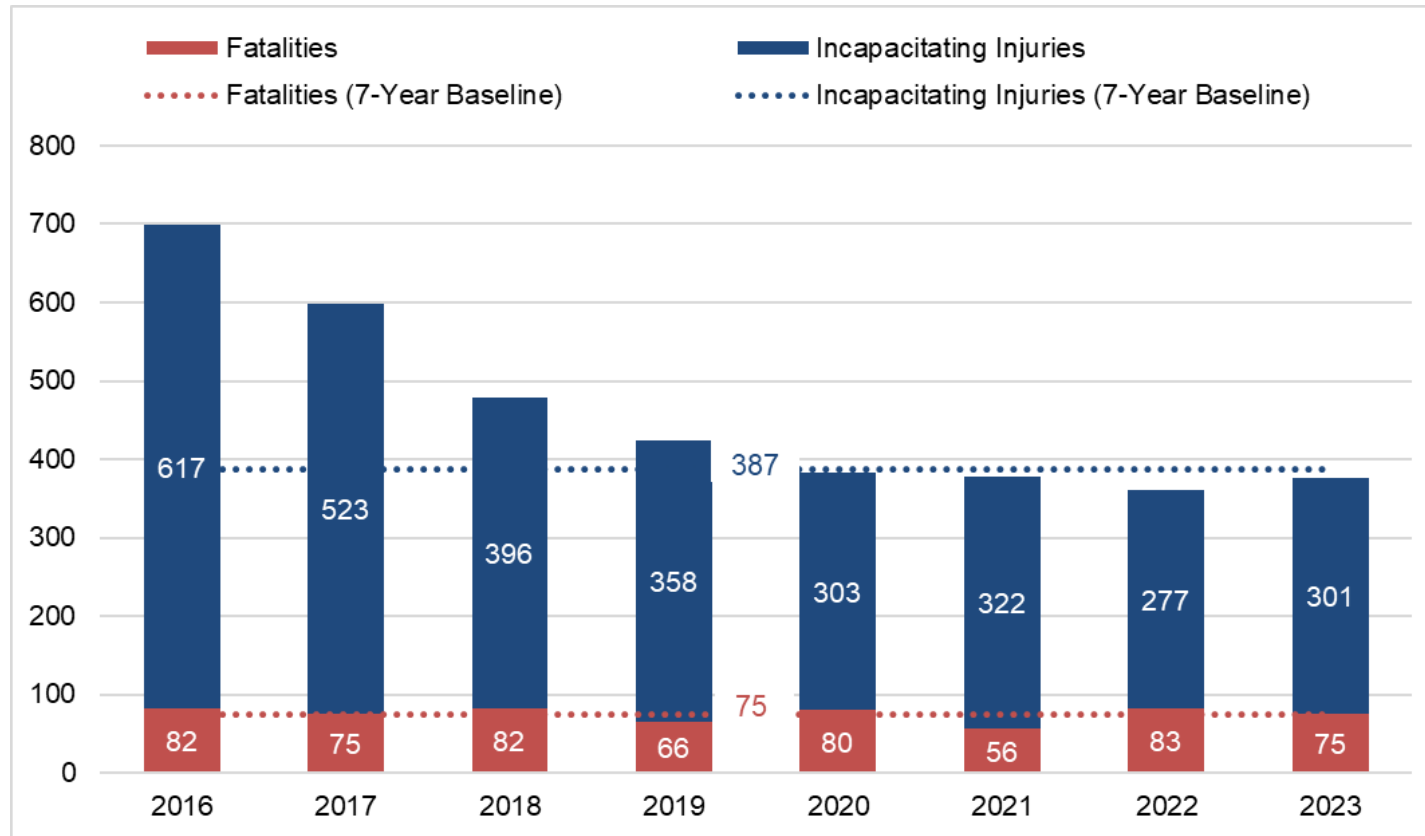
Work Zone Safety

Traffic Safety Initiatives & Innovation



Work Zone Safety Stats

Severe Crash Performance 2016 – 2023 in Florida



Key Takeaways

- Incapacitating Injuries are trending down overall. Fatalities are going down after a jump in 2022.
- Despite a higher overall number of work zone crashes in 2023 (12,143), the total number of fatal/ incapacitating injury crashes is lower
- Despite motorcycles encompassing only 3% of registered vehicles, they are overrepresented with about 30% of WZ fatalities & serious injuries (44 out of 150 total WZ crashes in 2023)
- Commercial vehicles were involved in 12% of work zone crashes and almost 4% of those resulted in a fatality or serious injury.

Work Zone Safety Action Plan

- [Designer, CEI, and Contractor Training Workshops](#)
- Webinars
- [Community Meetings](#)
- Lane Closure Notification System



- [Design Policy Changes](#)
- [Design Safety Prompt List](#)
- Pilot Projects for New Technology
- Smart Work Zones
- [Near-Miss Crash Analysis](#)



- [ELEE Program](#)
- Contract Language Updates
- [Increased TCO presence in Work Zones](#)
- Streamline Communication

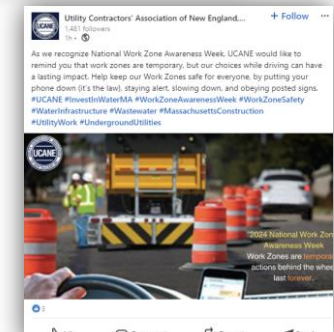
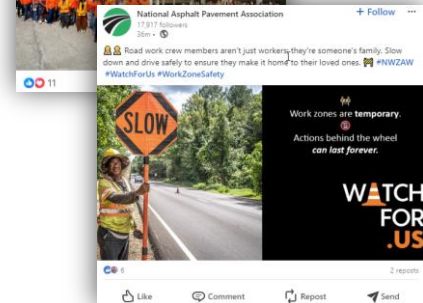
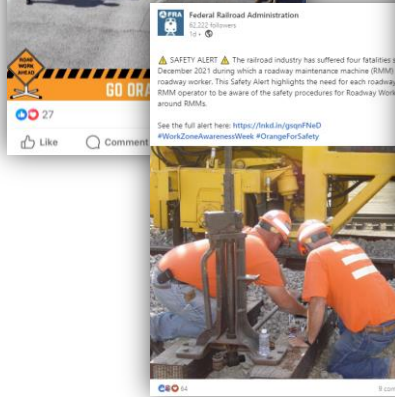


- [WZ RSAs](#)
- Design Phase Reviews
- [Geofencing Surveys](#)
- Before/After Analysis

- [Contractor Safety Technology Incentive Program](#)
- Recognition in D7 Safety Newsletter
- [FDOT Safety Challenge Coin](#)

Work Zone Awareness Week 2024 Recap

- Multiple Contractors held stand-downs for safety
- The Skyway goes Orange!
- Go Orange Day/NWZAW sweeps the country



TRANSPORTATION SYMPOSIUM

D7 Safety Issues

Speeding and dangerous driver behavior within work zones

Enforcement limitations due to design and construction constraints

Impractical bike and pedestrian accommodations leading to non-compliance and unsafe outcomes (e.g. crossing mid-block or entering the work zones)

“Copy and Paste” TTC design plans

Lack of oversight during construction

New design and construction workforce leading to a lack of experience within the industry



Work Zone Safety Partners



Strategies to Improve Work Zone Safety

IF YOU **SEE**
something
SAY
something

Cater Work Zones
to the users

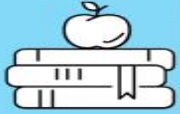
Prioritize
safety over
meeting
minimum
standards

Provide
positive
guidance &
continuous
improvements

Streamline
communication
between partners so
emergent issues can be
solved quickly



Work Zone Education



EDUCATION

Short-Term Strategies

Hosted **4** Work Zone Safety Workshops for all Design employees, consultants and Temporary Traffic Control Designers



Completed a **6** month Education & Engagement period as part of the Work Zone Safety Action Task List

Ongoing coordination between MOT Designers and construction personnel through Open House Sessions

Work Zone Enforcement – Short Term



ENFORCEMENT

Short-Term Strategies

- Increased law enforcement presence at high-risk locations
- Enhanced Law Enforcement Engagement Program (ELEE)
- Provide dedicated team with interdisciplinary support to increase frequency of on-site reviews
- Update policies to provide method to STOP WORK at locations where traffic control is causing a safety issue for workers or the public



Work Zone Enforcement – Long Term



ENFORCEMENT

Long-Term Strategies

Build in safety checklists and requirements to contracts to hold contractors accountable for their safety metrics, including mandatory training for workers

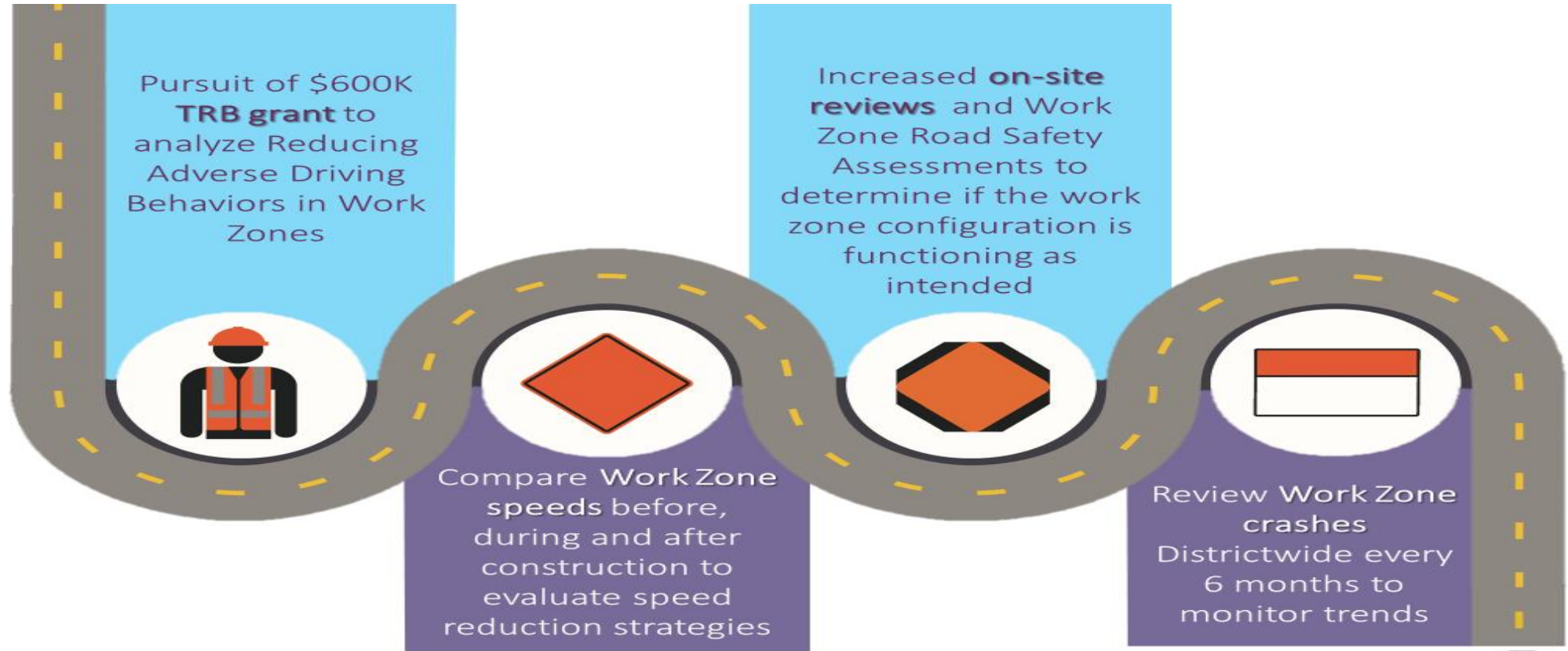
Mandate OSHA record be included during contractor selection and bidding process

On-site pop-in reviews to permit projects that include utility and developer work zones



**TRANSPORTATION
SYMPOSIUM**

Work Zone Evaluation



EVALUATION



Strategies

Smart Work Zones

Smart Work Zones to Improve Work Zone Safety

- Warning systems detect slow and stopped vehicles and automatically posts messages on signs to inform motorists they are approaching a Work Zone in real time
- Information can also be sent to traffic information providers and forwarded to motorists through smart phone apps and on-board navigation systems



Smart Work Zones

Smart Work Zones CASE STUDY

A Before & After Safety Evaluation was conducted to study the Smart Work Zone implemented at I-75 at SR 574 (Martin Luther King Jr. Boulevard)

Results indicated Smart Work Zones work well during rush hours; however, drivers tend to disregard Smart Work Zone speed limits during non-rush hours

TAKEAWAYS

- **Enforcement** is needed to ensure speeds are followed, similar to non-smart work zone applications
- Additional analysis may be needed before implementing on all projects



Addressing Work Zone Challenges

Case Study

N 62nd Street from CSX to Columbus Drive Issues



Segment of 62nd is one-way but does not have one-way arrows in the travel lane and pavement markings have not been adjusted



Plans show this area should be closed but roadway is open to traffic without any signage or channelizing devices

People are able to cross into Work Zone

Addressing Work Zone Challenges

Case Study

N 62nd Street from CSX to Columbus Drive
Issues



Only 1 one-way sign for only 1 direction on a 4-leg intersection with traffic approaching from 3 directions

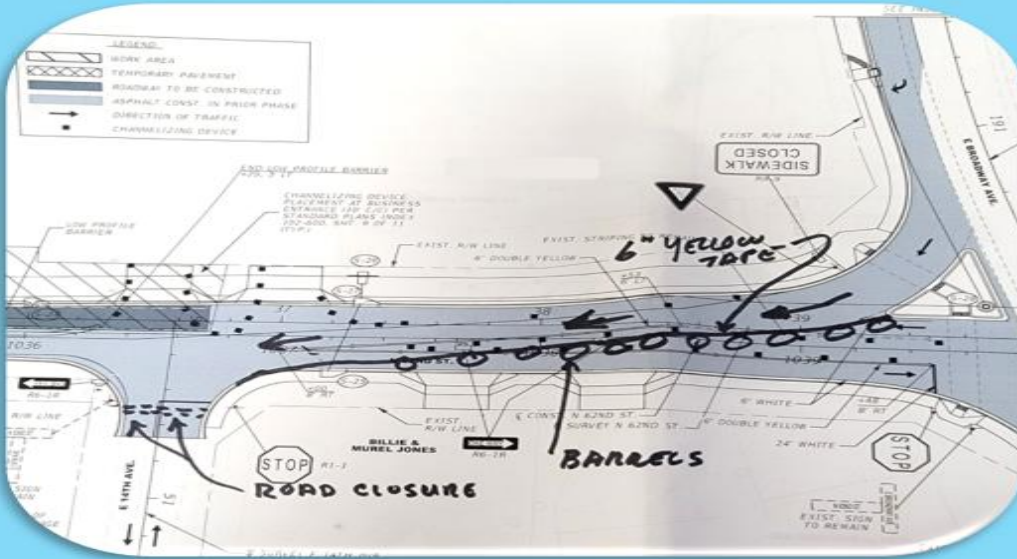


A Portable Changeable Message Sign upstream states this side street is closed and a detour must be used, however, the side street is open and no detour is needed

Addressing Work Zone Challenges

Case Study

N 62nd Street from CSX to Columbus Drive Resolution



- District personnel performed multiple site visits to evaluate the Work Zone

- Job-site inspector placed road closures (Type 3 barricades) where appropriate
- Inspector also added barrels and yellow tape on a taper to better communicate the roadway closure

Addressing Work Zone Challenges

Case Study

N 62nd Street from CSX to Columbus Drive Follow Up



- District personnel were notified of additional issues within the work zone
- Further work and coordination with the contractor will be needed to increase safety and prevent these incidents. Measures would include WWD prevention measures and additional positive guidance for drivers.

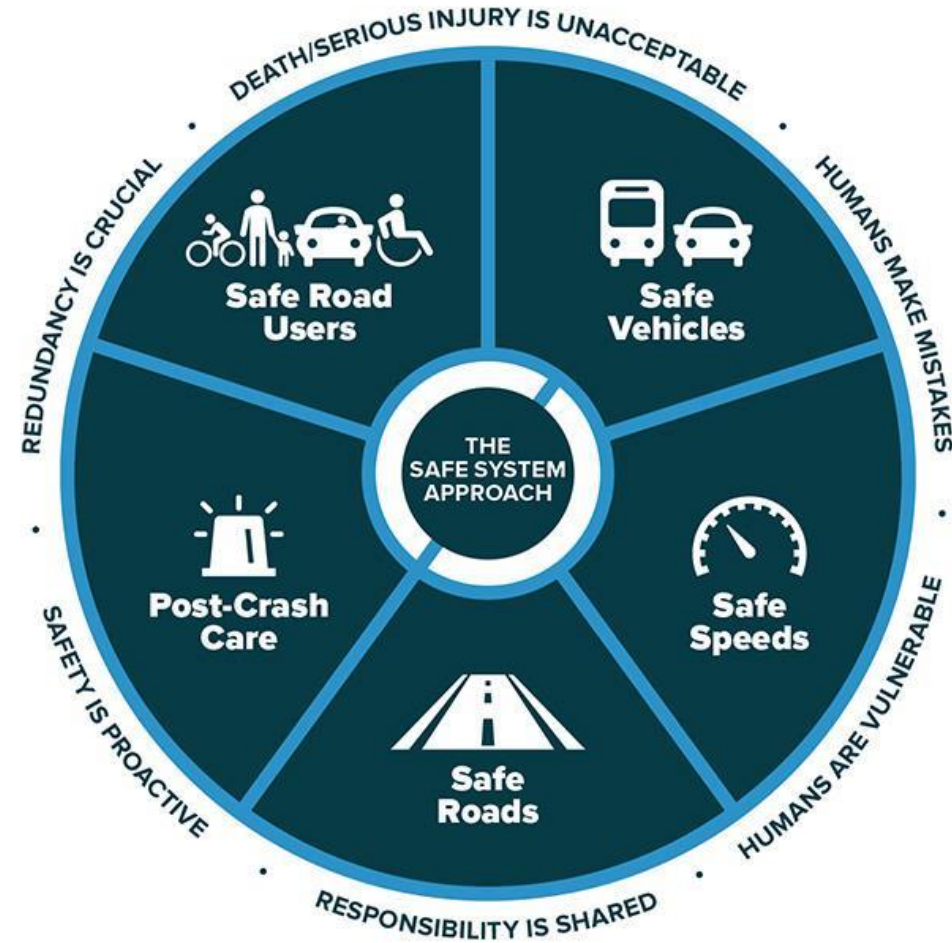
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Near Miss Conflict Analysis

- The safety office has worked with vendors to set up multiple near-miss technology pilots on state and local roads.
- Near-miss technology allows us to identify areas with a high number of **potential conflicts**, allowing us to identify **potential countermeasures** before a crash ever occurs.



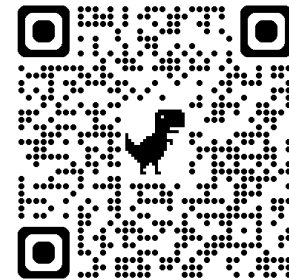
Near Miss Conflict Analysis



- Temporary Camera Installations:
 - 8 Hour, 24 Hour, 48 Hour, 1 Week, Etc.
 - Excel Reports and Video Clips
 - Captures:
 - Vehicles to Pedestrians
 - Vehicles to Bicycles
 - Vehicles to Vehicles
- Based on Post Encroachment Time (PET)
- 3 Thresholds: 1.5, 2.0 and 3.0 Seconds
- Prioritizes High-Risk Movements

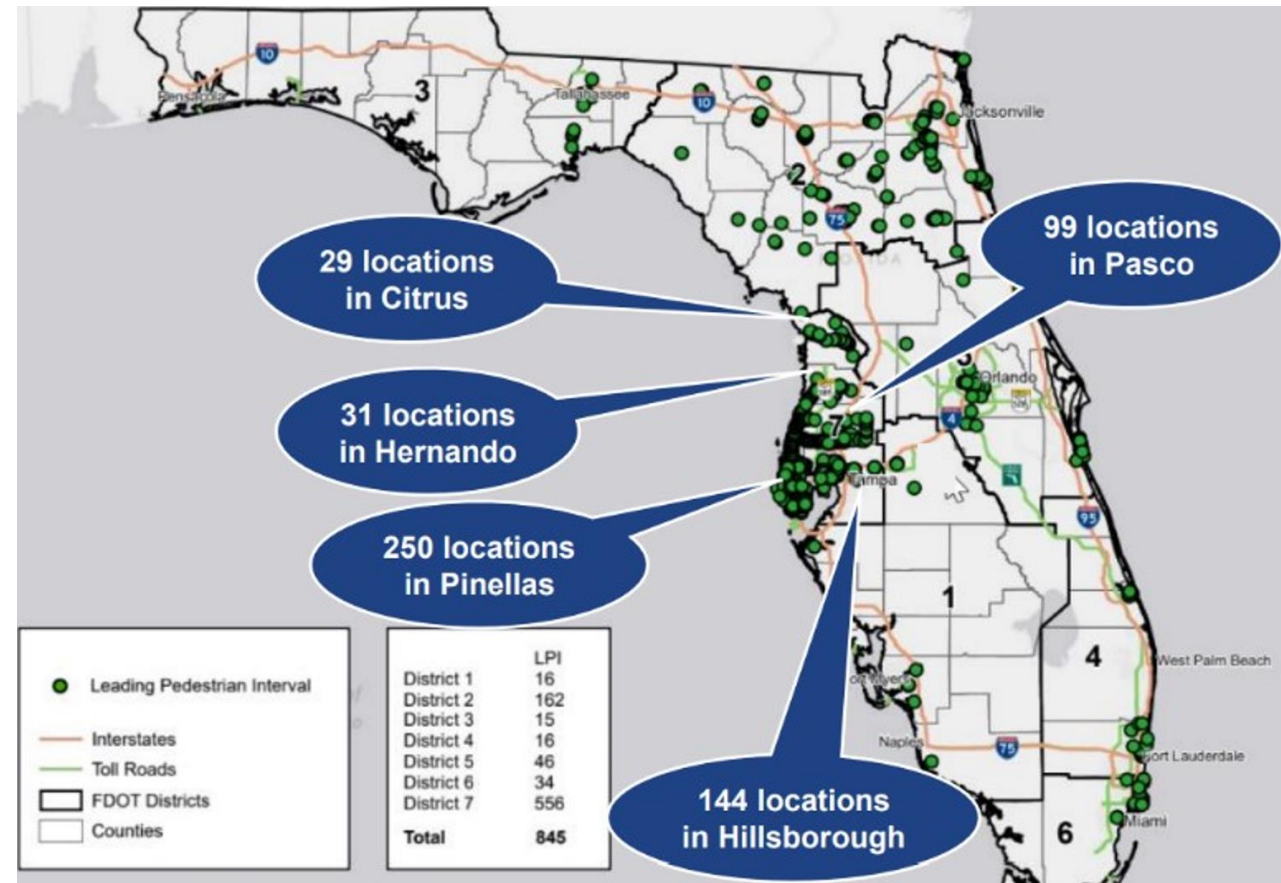
Two-Stage Crossings

- District 7 developed a PSA related to the usage of **two-stage crosswalks**.
 - The PSA covers the benefits of two-stage crossings, as well as the process for safely using them.
- Benefits of Two-Stage Crossings include:
 - Ability to wait comfortably after crossing one leg.
 - Gives pedestrians **more time to cross the intersection**.



Leading Pedestrian Interval (LPI)

- **556 signalized intersections in D7 with LPI**
- More locations have been identified and are currently in the works.
- Some challenges:
 - Old or incompatible signal equipment
 - Shortage of expertise and manpower in smaller counties
- Before & After Evaluation - Data collection phase ongoing



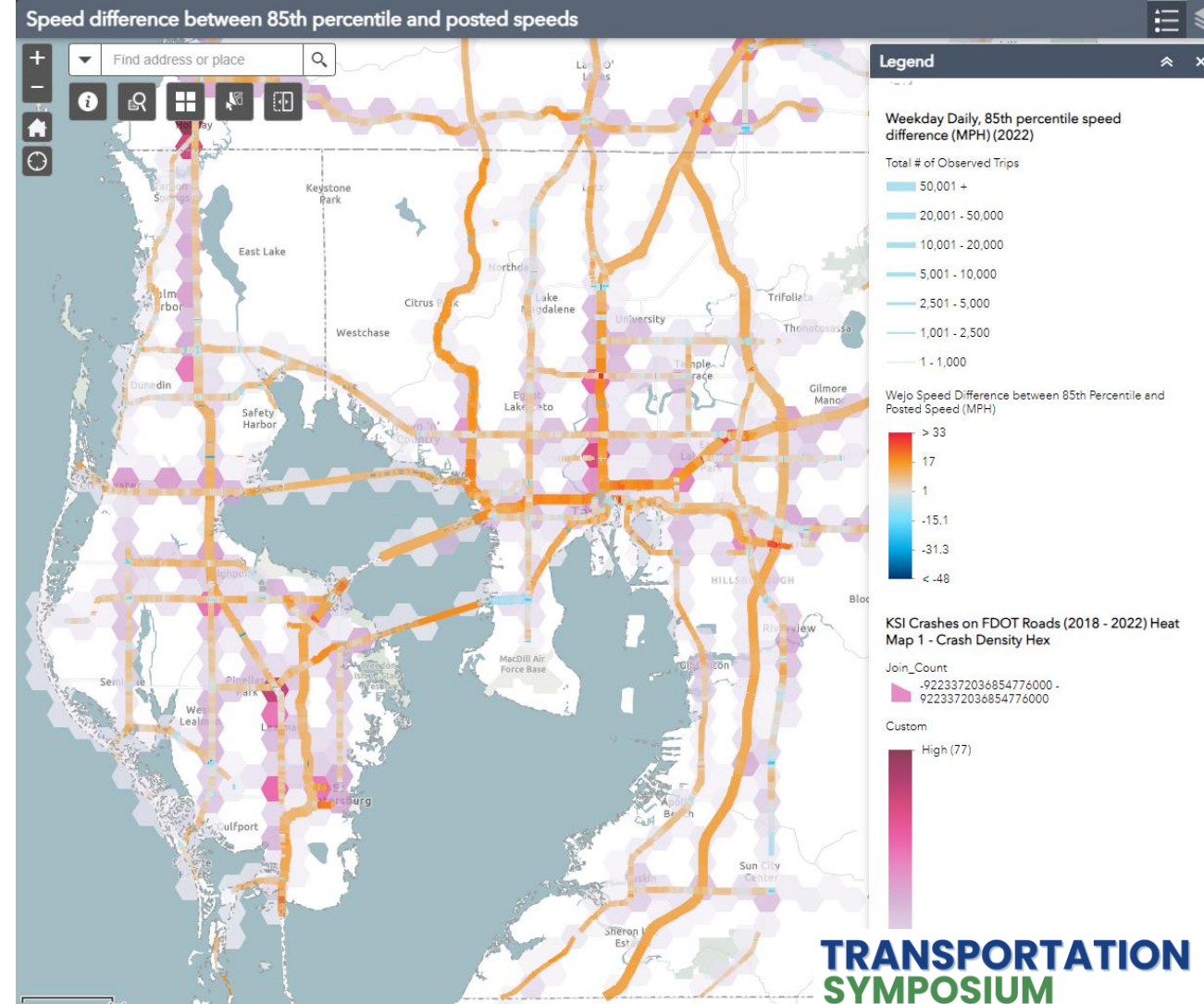
Signal Cabinet Wraps

- Signal cabinet wraps at high pedestrian crossing locations feature artistic safety messages around a signal cabinet as part of a high school competition.
- Sense of Community
- Multiple locations in Tampa Bay.



Speed Management

- D7 is analyzing the difference between the **85th percentile and posted speeds**.
- Created a dashboard to compare weekday and weekend speeds during peak and off-peak hours.
- Can be used to prioritize corridors for **speed management countermeasures**.



Reducing Right-Turn Turning Radii

- FDOT District 7 conducted a pilot study (2021 – 2022)
 - **Three** intersections along Fowler Ave in Tampa
 - Compare safety measures before and after tight corner implementation

56th St. @ Fowler Ave.



Before



After

Bruce B Downs Blvd. @ Fowler Ave.



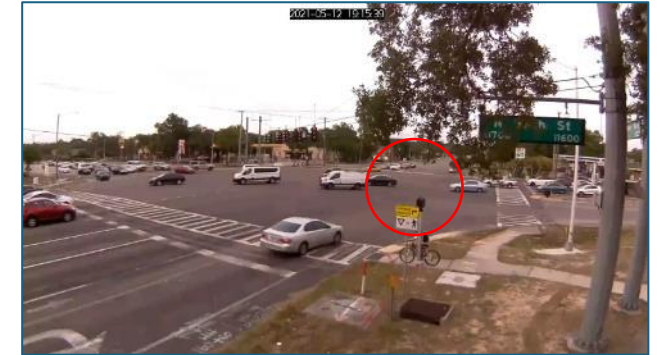
Nebraska Ave. @ Fowler Ave.



Reducing Right-Turn Turning Radii

- Record videos
 - Before: 5/12/2021
 - After: 5/18/2022
- Review videos to observe:
 - Yielding-to-pedestrian behaviors
 - Right-turn speed
- Statistically compare surrogate safety measures

- Turning Vehicle Yield to Pedestrian/Bicyclist



- Turning Speed

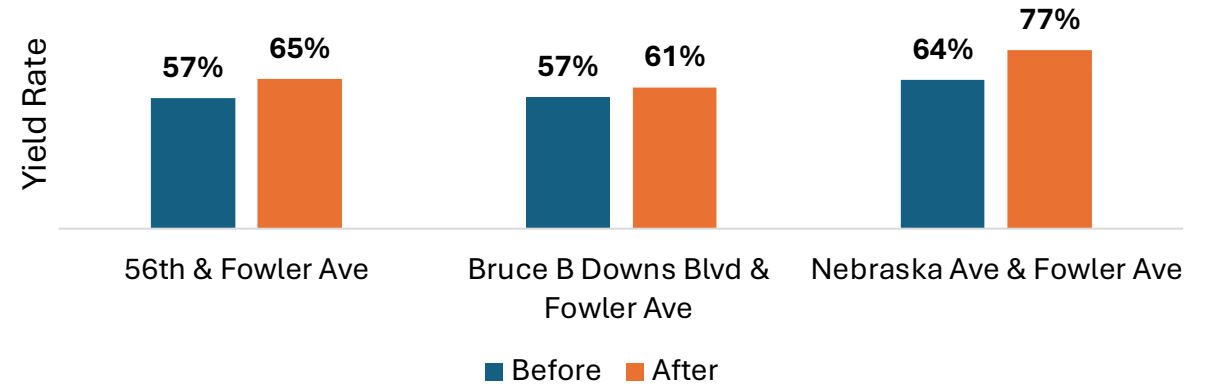


Reducing Right-Turn Turning Radii

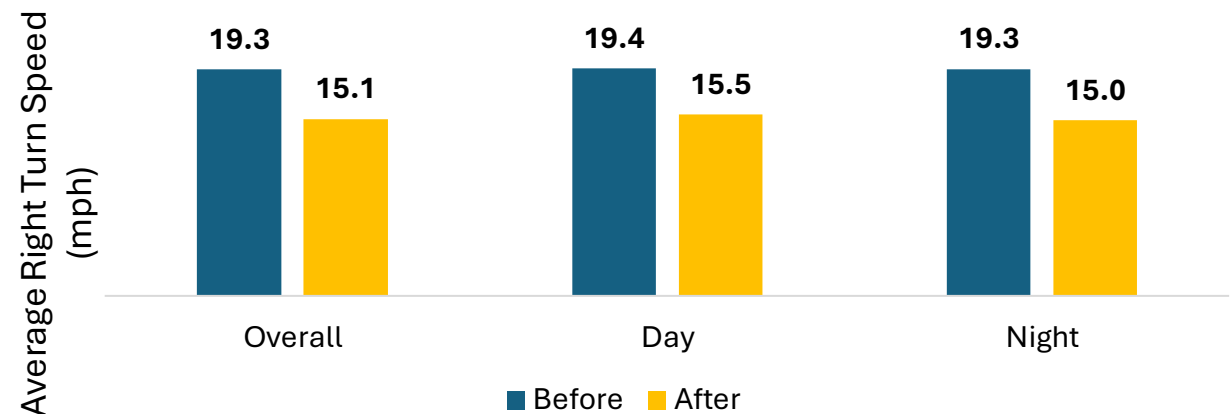
- The **tight right-turn corner design** significantly improves pedestrian safety at signalized intersections
 - Increase yielding-to-pedestrian rate by **7%**
 - Reduced right turn speed by **21.8%**



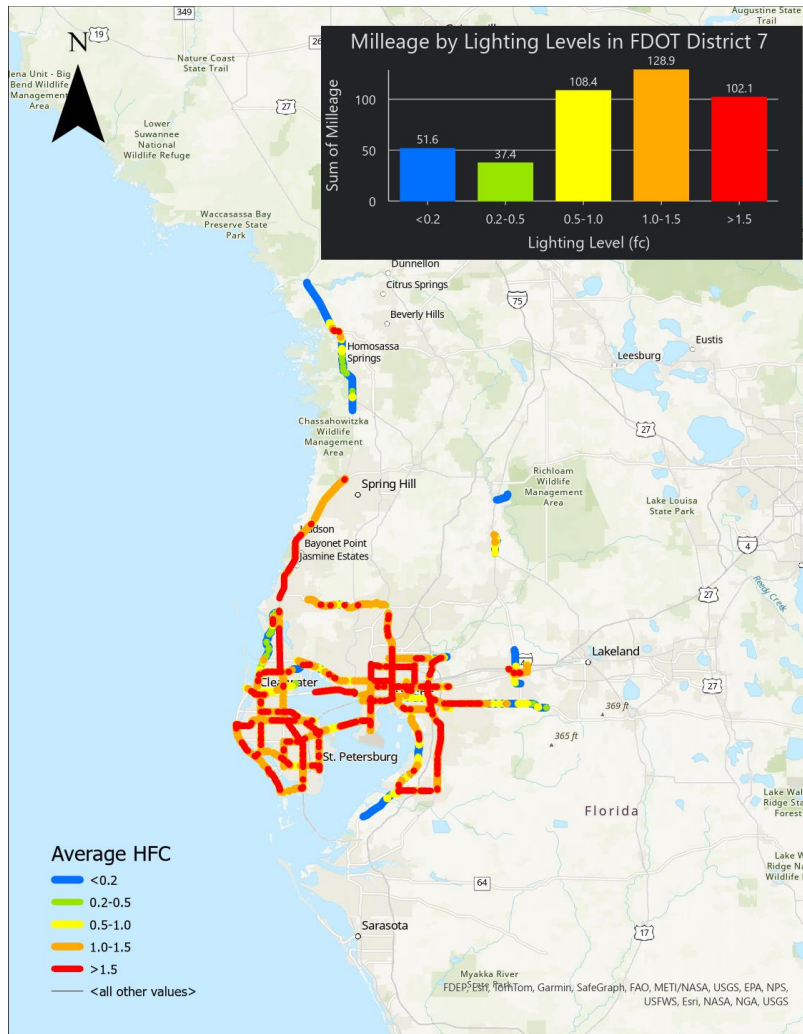
Vehicle-Yielding-to-Pedestrian



Average Turning Speed



Lighting Level Analysis Tool



- The results from this study indicate that LED not only introduces **economic benefits** (i.e., long service life, and energy savings) but also brings **safety benefits**.
- The effective performance of LED lighting enables drivers to see better roadway conditions, resulting in safety benefits by reducing nighttime crashes. The higher blue content of the LED light spectrum can render **brighter illuminance** than conventional light sources at the same lumen output.

Lighting Level Analysis Tool

- This study concludes that if the lighting system on a roadway segment is upgraded from HPS to LED, nighttime crash frequency is more likely to **be reduced by 17%**, as shown in Figure 8, in FDOT District 7.



•JUNE IS NATIONAL SAFETY MONTH

- Over 3,000 lives are lost every year to PREVENTABLE CRASHES in Florida.
- TOGETHER, we can bring this number down to ZERO.



•Let's Get Everyone Home



Thank You!

Emmeth Duran, P.E., RSP2I

District 7 Traffic Safety Program Engineer

Emmeth.Duran@dot.state.fl.us

For more information, visit:

www.TargetZeroFL.com