WORK ZONE MANAGEMENT PROGRAM

Data-Driven Work Zone Performance Management

Data-Driven Work Zone Performance Management Workshop

March 23, 2023

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Federal Highway Office of Operations

U.S. Department of Transportation

Federal Highway Administration

Source: Federal Highway Administration

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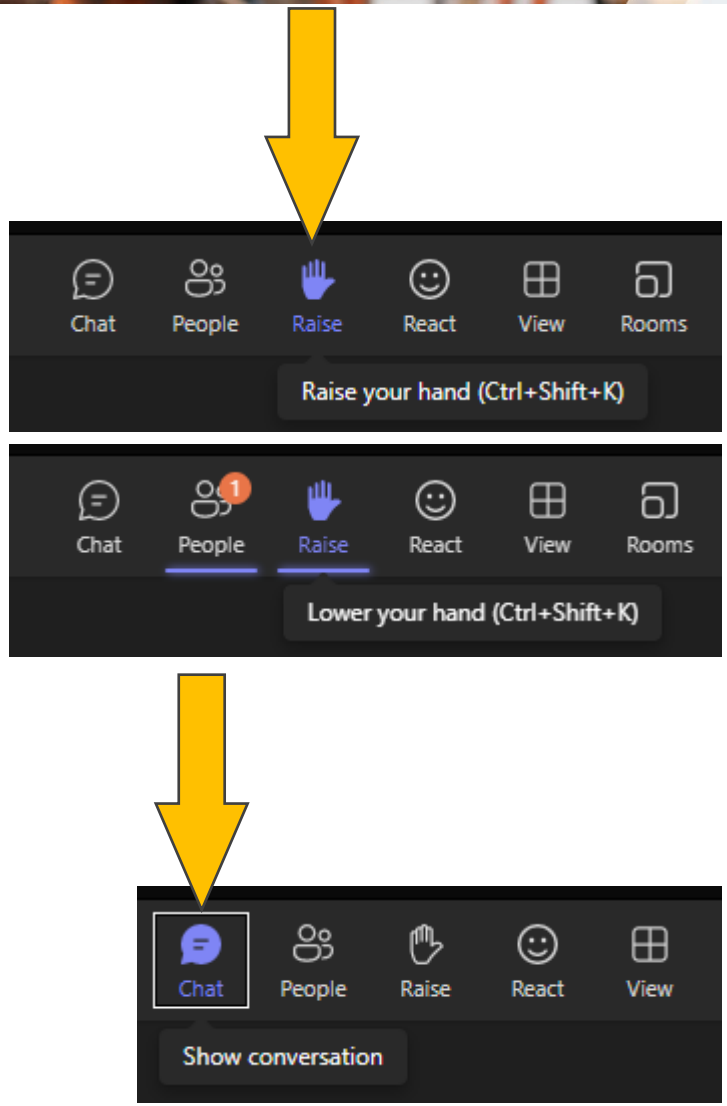
A few notes

- Call will be recorded

- Keep it conversational
  - Raise hand
  - Use chat feature
  - Send additional thoughts/comments via email



Workshop Agenda

- Introductions
- Overview of Work Zone Performance Measurement
- Deep-Dive Sessions:
  - Safety
  - Mobility
  - Agency Efficiency
- Questions and Answers

23 CFR Part 630 Subpart J

- "Work Zone Safety and Mobility Rule"
  - Encourages States to develop and implement systematic procedures to assess work zone impacts and to manage safety and mobility during project implementation
  - Requires States to use field observations, crash data, and operational information to manage work zone impacts during implementation
- Agencies can improve these efforts through the use of work zone safety and mobility performance measures.

Work Zone Performance Measurement

What is it?

- Performance measurement is an outcome-based approach that uses objective and subjective evidence to quantify the degree to which an intended outcome is occurring over time.
- Work zone performance measurement quantifies how roadway construction impacts workers, travelers, residents, and businesses at the project and agency program levels.
- Successful performance monitoring is based on collecting, analyzing, and monitoring three types of data:
  - Performance data
  - Exposure data
  - Indicator data

Where is it used?

- Agencies conduct performance measurements in work zones where they would like to:
  - Compare the trends and patterns of safety, mobility, project quality, and customer satisfaction with agency goals
  - Evaluate the success of the intelligent transportation system deployments—specifically in the areas of safety and mobility

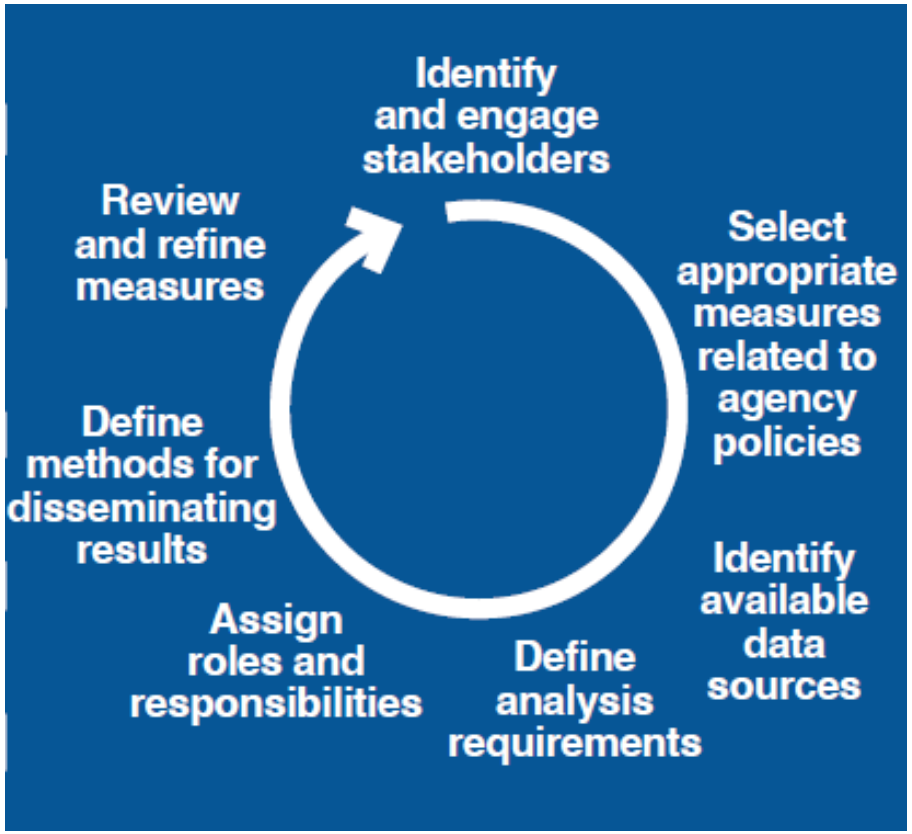
Why Measure and Manage Performance?

- "What gets measured gets managed."
- Allows agencies to:
  - Understand how their work zone management decisions affect safety and mobility
  - Monitor and improve conditions at an existing work zone
  - Improve how they make future decisions regarding work zone management
  - Identify specific problems or issues that may be occurring
  - Review and improve work zone policies and procedures
  - "Tell the story" about work zone impacts and efforts to mitigate those impacts

Workshop Objectives

- Reemphasize work zone performance measurement (WZPM)
- Present examples of WZPM
  - Project-level and program-level WZPM
- Discuss the current state of practice
- Explore opportunities, methods, and resources for agencies to identify and implement WZPM at project and program levels.

Performance Measurement Areas and Process



Seven-step performance measurement process
Source: Webinar—"A Tutorial on Establishing Effective Work Zone Performance Measures" (www.workzonesafety.org)

Performance Areas:

- Safety, mobility, and agency efficiency

Selection and Evaluation of Performance Measures:

- Select performance measures matching agency goals
- Identify and determine data sources to use
- Decide work zone analysis scope and timeframe
- Compute specific measures of interest

Work Zone Performance Areas and Measures

Exposure		
Number of work zones, lane closures, work zone locations, miles, hours, vehicle throughput, vehicle miles traveled, and costs		
Mobility	**Safety**	**Agency Efficiency**
• Delay • Queue length and duration • Travel time • Travel time reliability • Congestion events	• Crash statistics • Fatality rates • Worker accidents • Safety surrogate data • Frequency of intrusions	• Field review ratings • Actual versus planned costs • Actual versus planned schedule • Enforcement statistics

Safety Performance

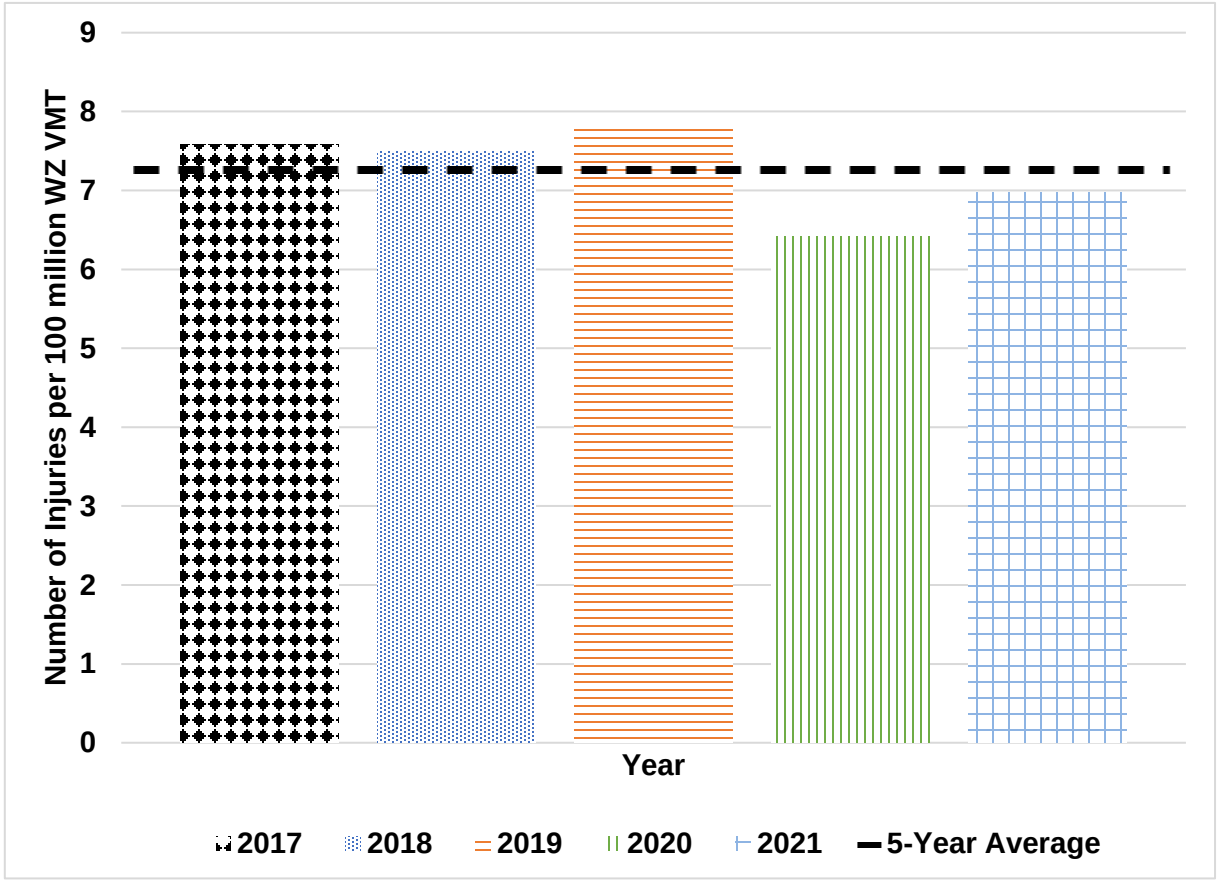
Why is it important to measure safety performance in work zones?

- Work zones present complex challenges (reduced lanes, diverging lanes, detours, reduced speeds) for motorists and traffic operators.

- Understanding, measuring, and quantifying the safety impacts of various aspects of work zones offer critical insights for proactive planning and management of work zones.

Safety Performance Measurement Examples (slide 1/4)

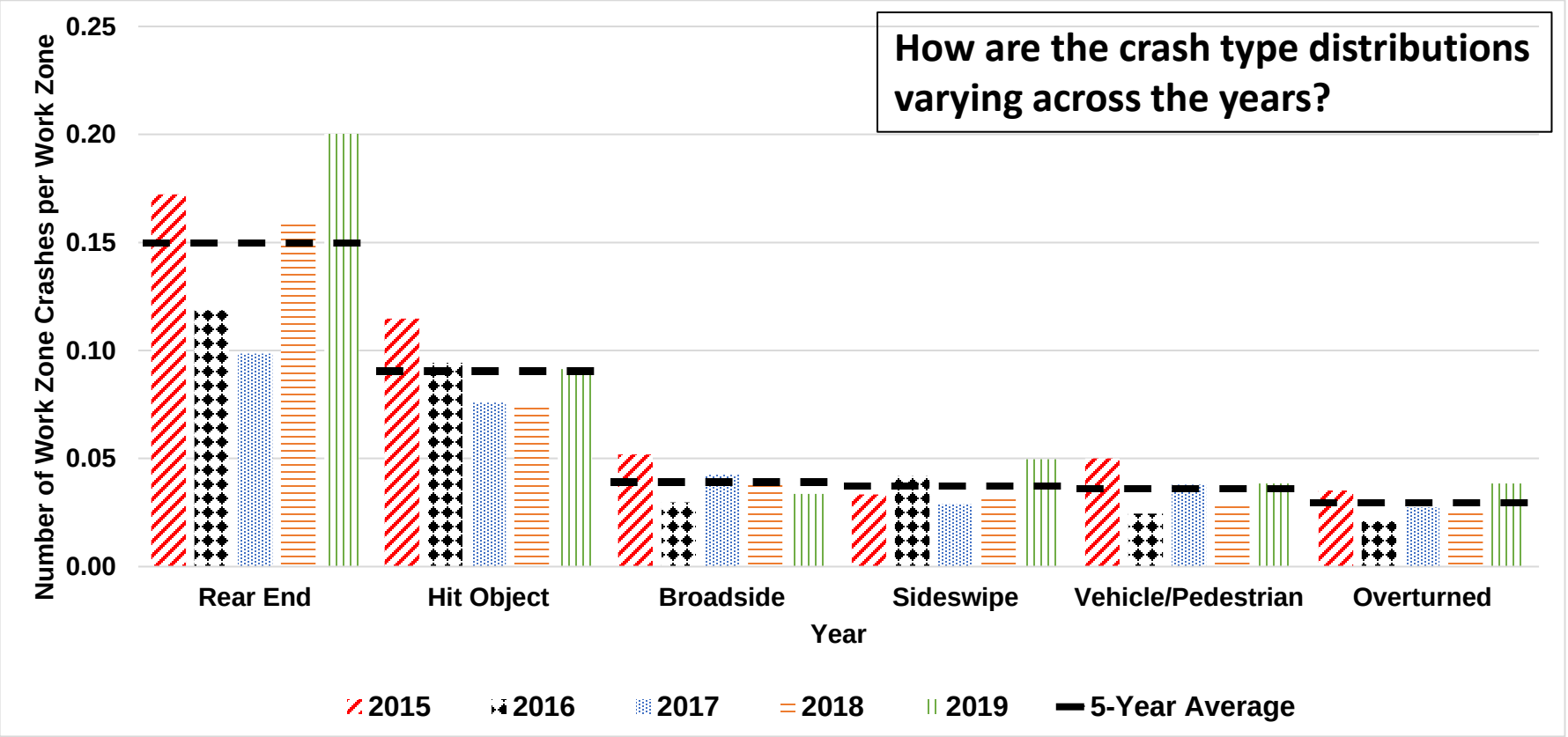
How are injury rates varying across different years?



Number of work zone injuries per 100 million work zone (WZ) vehicle miles traveled (VMT)

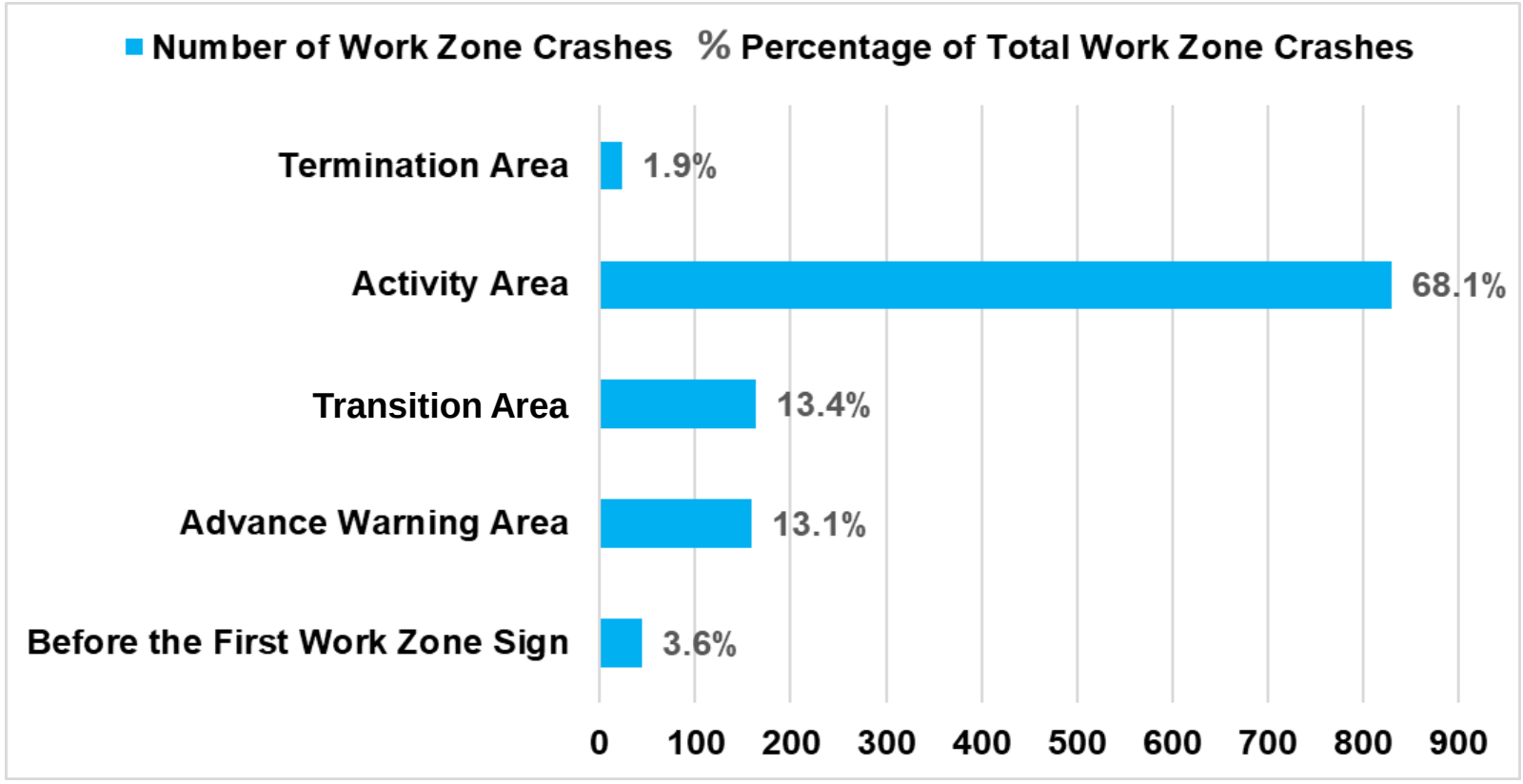
Source: Illinois Department of Transportation

Safety Performance Measurement Examples (slide 2/4)



Number of work zone crashes per work zone
Source: California Department of Transportation

Safety Performance Measurement Examples (slide 3/4)



Where are the crashes occurring?

Work Zone Crashes by Work Zone Location
Source: Delaware Department of Transportation

Safety Performance Measurement Examples (slide 4/4)

	Total	May	June	July	August	Sept	Crash Reduction
2016	13	1	2	8	2	0	-
2017	11	1	2	6	2	0	15%

Work Zone Crashes by Month
Source: Wisconsin Department of Transportation

	Injury				PDO	Total # People Injured
	K	A	B	C		
2016	0	0	2	6	5	12
2017	0	0	2	1	8	9

Work Zone Crashes by Severity
Source: Wisconsin Department of Transportation

	Injury				PDO	Total Cost
	K	A	B	C		
2016	$0	$0	$76,890	$189,216	$21,020	$287,126
2017	$0	$0	$153,780	$63,072	$33,632	$250,484

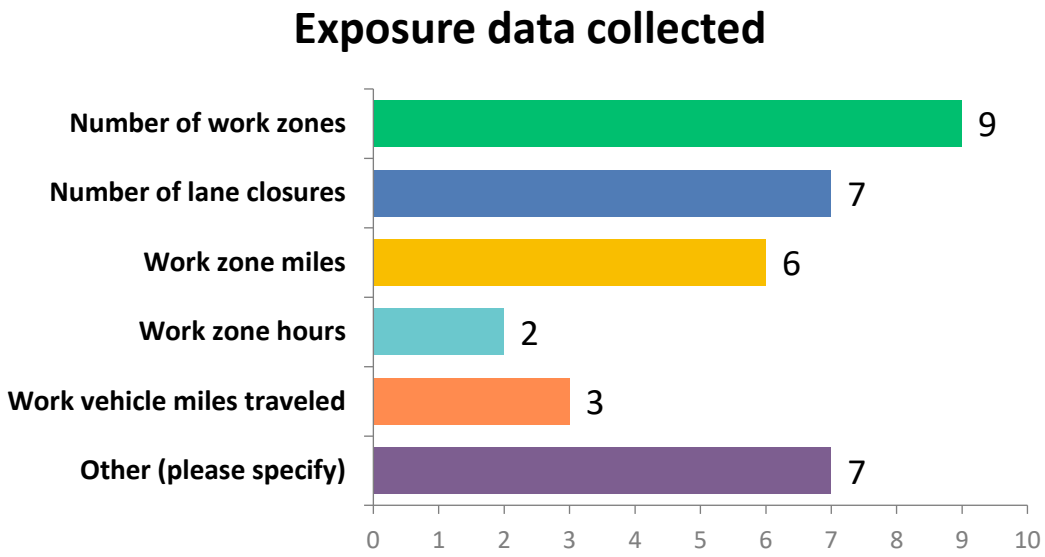
Work Zone Crash Cost Comparison
Source: Wisconsin Department of Transportation

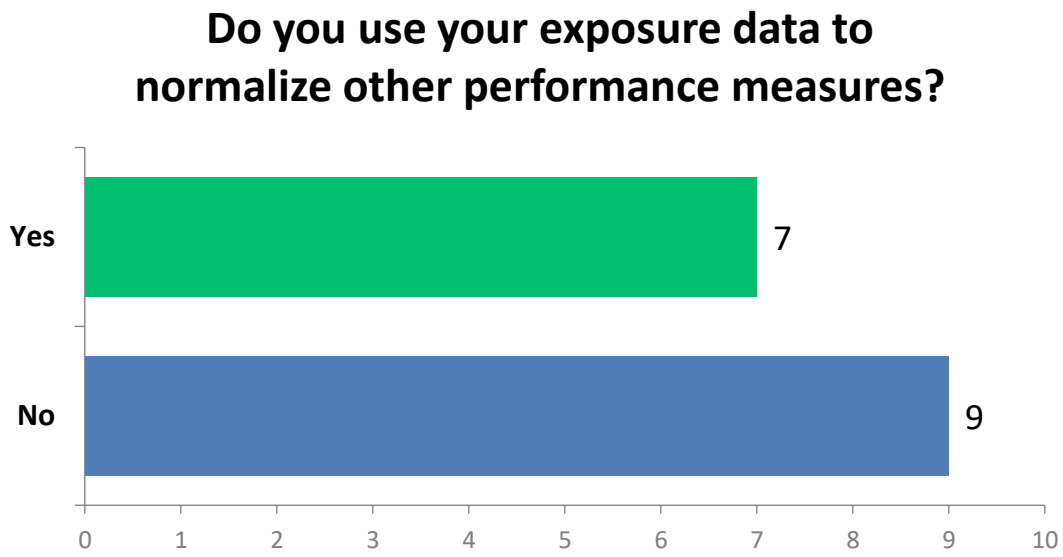
Project-Level Comparison of Crash Performance

Safety Performance Measures

- Conventional Measures (Normalized)—Traditional Data:
  - Crashes per work zone vehicle mile traveled
  - Crash severity (fatality, injury, and property damage only) per work zone vehicle mile traveled
  - Worker incidents per work zone vehicle mile traveled
- Contextual Measures:
  - Crash contributing factors (distracted driving, speeding, driving under the influence, hitting work zone equipment)
  - Work zone crash location (termination area, activity area, transition area, advance warning area, and before the first work zone sign)
  - Crash types (e.g., sideswipe, head-on, rear-end, fixed object)
- Measures—Emerging Data:
  - Hard-braking events and locations

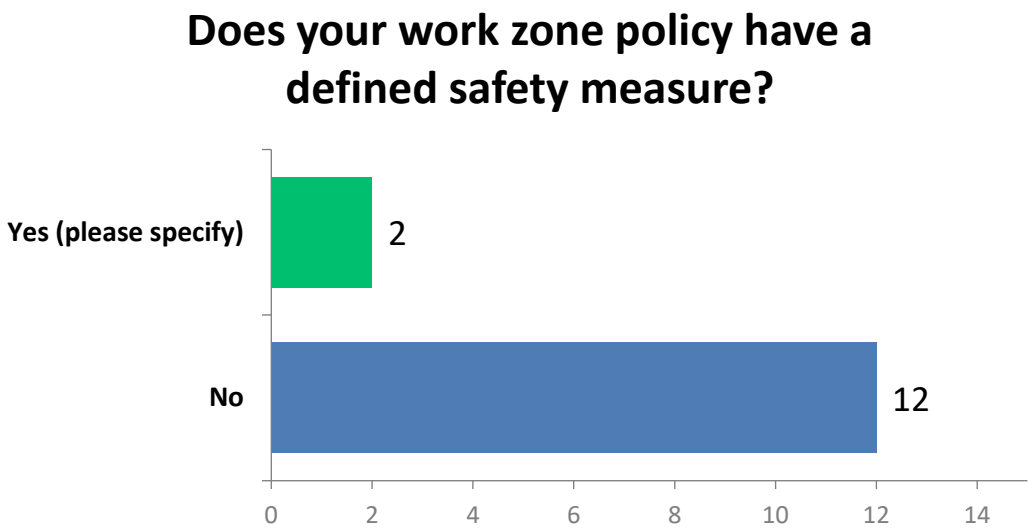
Survey Responses: Work Zone Exposure Data

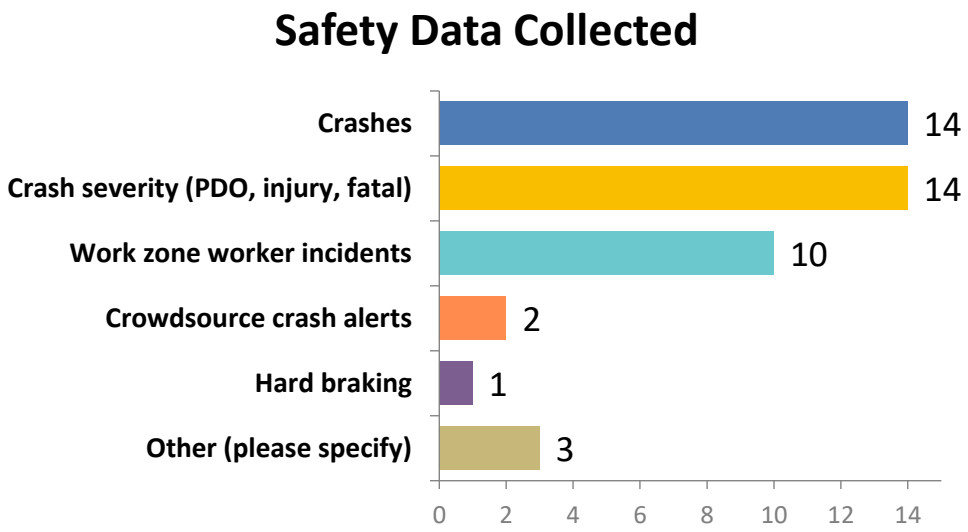




7 out of 16 participants responded that they use exposure data to normalize performance measures. Most respondents mentioned that their agencies uses exposure data to normalize work zone crashes (crashes per VMT, crashes per 1,000 work zone miles, crashes per 1,000 work zone hours)

Survey Responses: Safety Performance Area (slide 1/2)

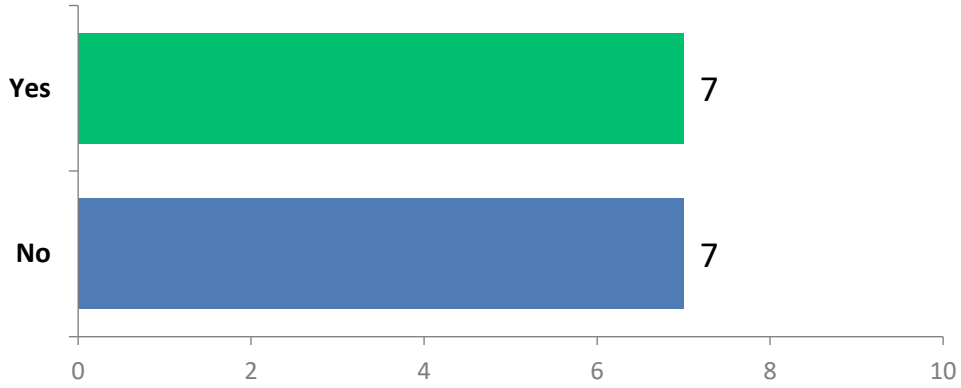




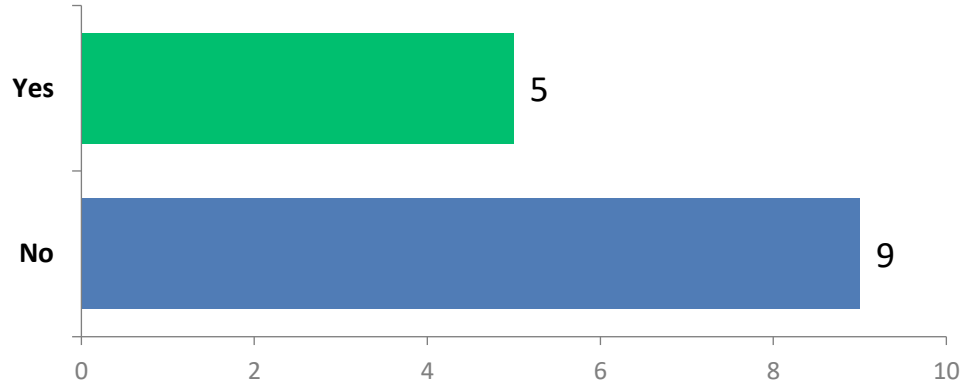
12 out of 14 respondents mentioned that their work zone policy does not have a defined safety measure. States Collect and digitize detailed safety data. States also started exploring emerging data sources.

Survey Responses: Safety Performance Area (slide 2/2)

Do you filter your safety data to your work zones?



Do you use your safety data to quantitatively assess your work zones?



7 out of 14 respondents mentioned that their agencies filter data specific to work zone boundaries (spatial and temporal). 5 respondents mentioned that they use safety data to assess work zone performance. Most respondents indicated an annual cadence for performing program-level safety assessments.

Data Driven Work Zone Performance

Presentation by Chris Lambert

Online Peer Exchange | March 23, 2023

TEAM KENTUCKY®
TRANSPORTATION CABINET

Vision

Striving to be national leaders in transportation who provide transportation infrastructure and services for the 21st century that deliver new economic opportunities for all Kentuckians.

Mission

To provide a safe, efficient, environmentally sound and fiscally responsible transportation system that delivers economic opportunity and enhances the quality of life in Kentucky.

Real-Time Data Sources

- HERE Traffic Speeds
- HERE Incidents
- Waze Jams
- Waze Traffic Viewer
- Waze Incidents
- iCone Traffic Speeds
- Twitter
- KYMesonet
- CoCoRahs
- NWS Doppler Radar
- NWS Forecasts
- TMC Reports
- Snowplows
- Roadway Weather Stations
- County SNIC Activity Reports
- Dynamic Message Signs
- Truck Parking
- Permitted Work Zones
- AASHTOWare SiteManager

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Real-Time Data Management

Raw Data (“Data Lake”)

- Stored as native file format
- Simple folder structure
- Saving new file every 2 minutes

Processed Data

- Various Timestamp
- Added LRS Attributes
  - District
  - County
  - Route
  - Mile Point
  - Direction
  - Etc.

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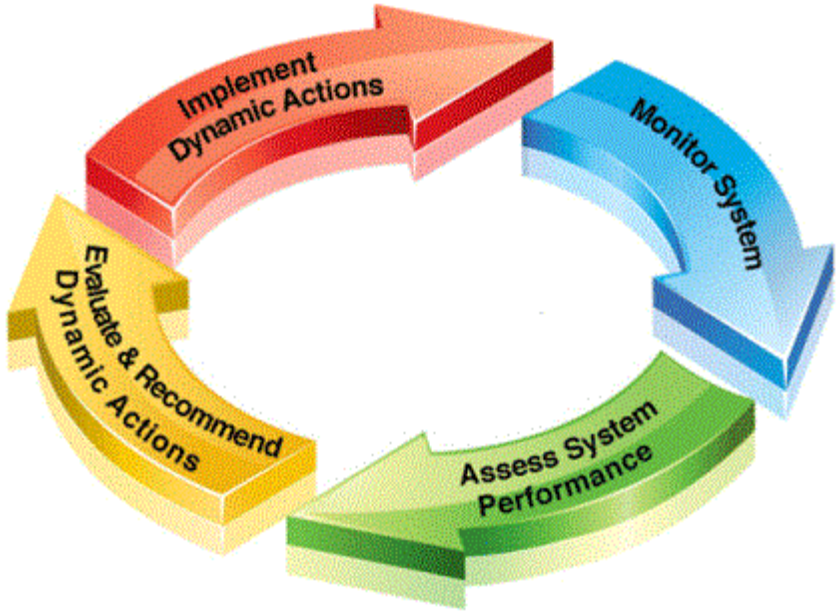
Various Use Cases

- Traveler Information System
- Incident Detection & Monitoring
- Roadway Weather Decision Support
  (aka “Snow and Ice Decision Support”)
- Emergency Management Support
- **Work Zone Monitoring**
- Various Research Projects
- **Performance Management**



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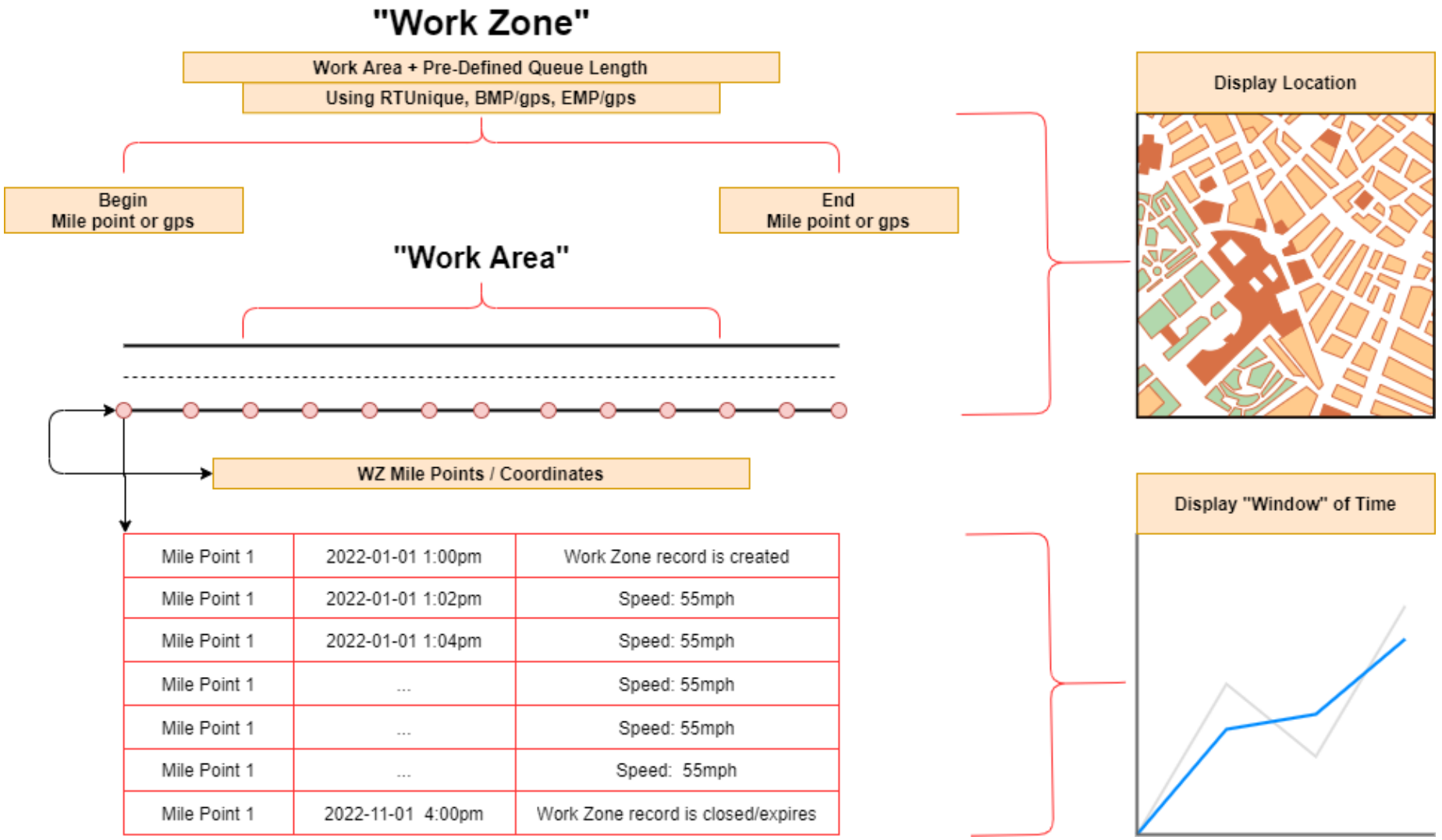
Work Zone: Definition



Mile Point 1	2022-01-01 1:00pm	Work Zone record is created
Mile Point 1	2022-01-01 1:02pm	Speed: 55mph
Mile Point 1	2022-01-01 1:04pm	Speed: 55mph
Mile Point 1	...	Speed: 55mph
Mile Point 1	...	Speed: 55mph
Mile Point 1	...	Speed: 55mph
Mile Point 1	2022-11-01 4:00pm	Work Zone record is closed/expires

Work Zone: Alerts

Close [ITS] I-265 in Jefferson County Work Zone Incident Report

Kentucky Transportation Cabinet (Do Not Reply)
To: Lambert, Chris C (KYTC)
Mon 2023-03-20 5:23 PM

DISTRICT 5							
County	Route	Road Name	Work Zone Begin Milepoint	Reference Milepoint	Work Zone End Milepoint	Current Avg Speed	Reference Information
Jefferson	I-265	I-265	25.0	26.0	27.0	9.0	GoKY | Google Maps | Waze | Here WeGo | NWS Detailed Forecast

Please check here for the most up-to-date information.
The data contained in this alert is current at time of sending and may be subject to change.

TMC Crash reported in Work Zone

Close [ITS] Work Zone Interstate Speed Summary

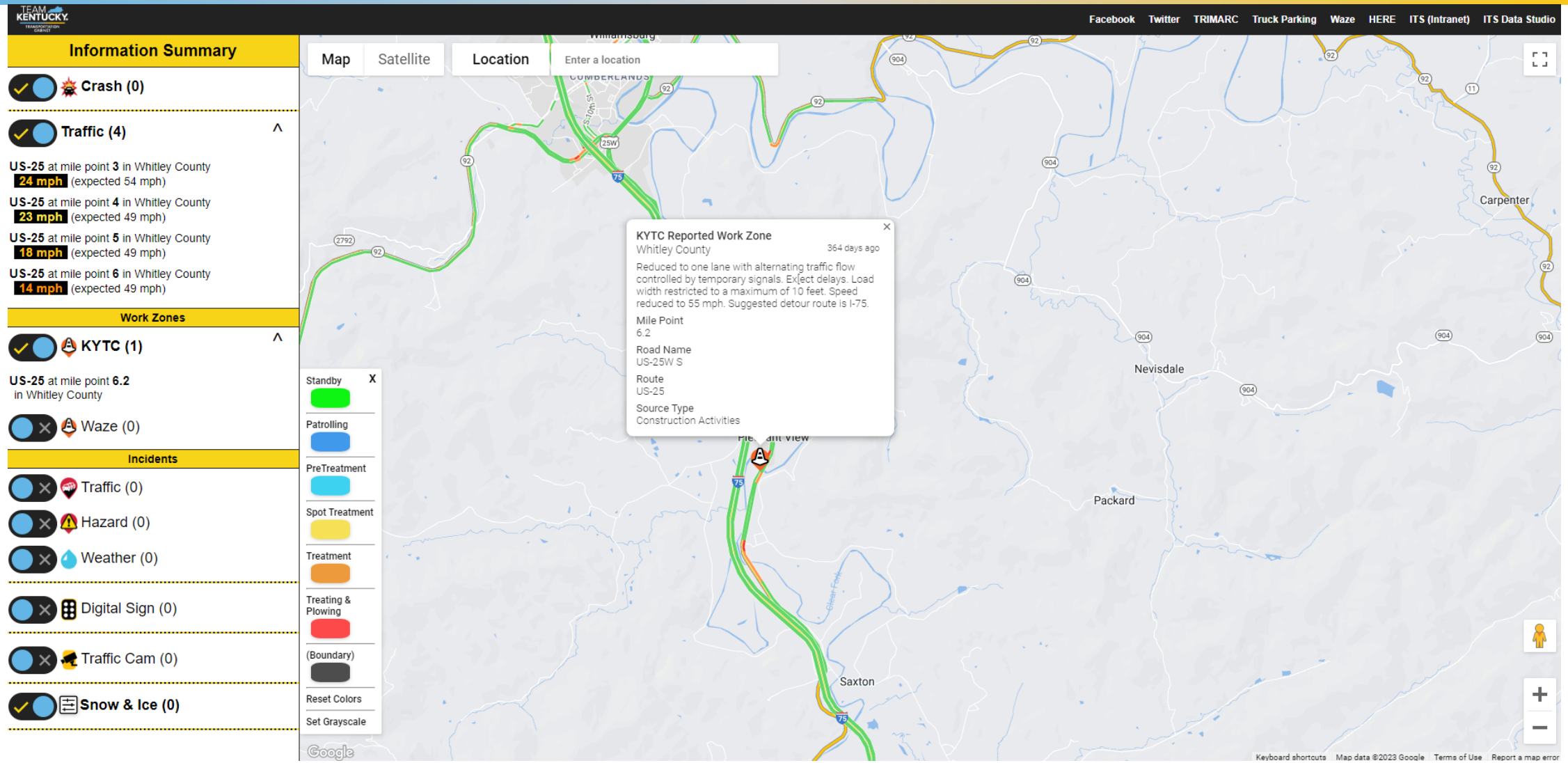
Kentucky Transportation Cabinet (Do Not Reply)
To: Lambert, Chris C (KYTC)
Wed 2023-03-22 2:50 PM

District 5							
County	Route	Road Name	Begin Milepoint	Reference Milepoint	End Milepoint	Current Avg Speed	Reference Information
Oldham	I-71	I-71	12.0	11.6	14.0	14.1	GoKY | Google Maps | Waze | Here WeGo | NWS Detailed Forecast

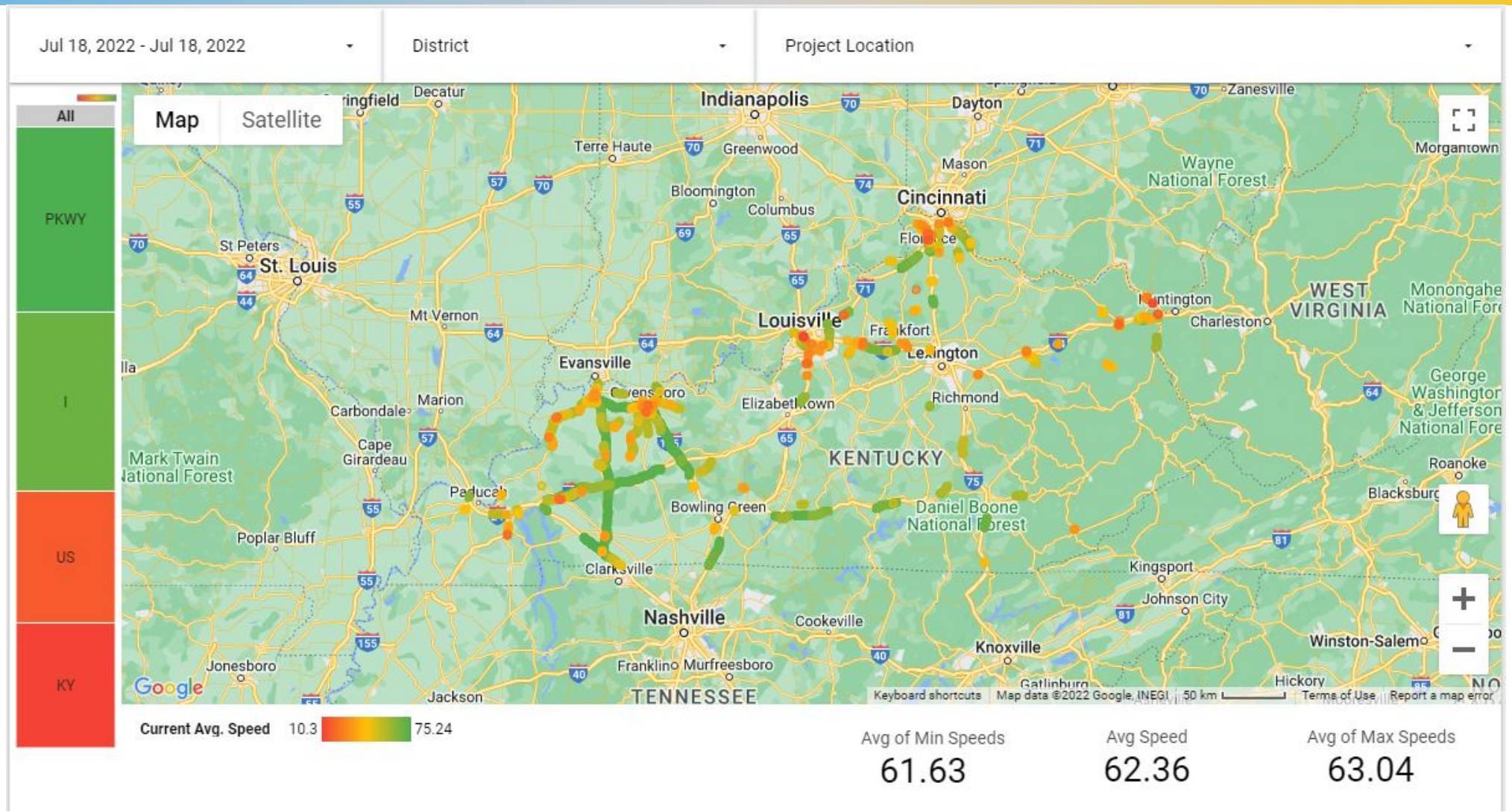
Please check here for the most up-to-date information.
The data contained in this alert is current at time of sending and may be subject to change.

Work Zone averages 25mph or less for 10min or more.

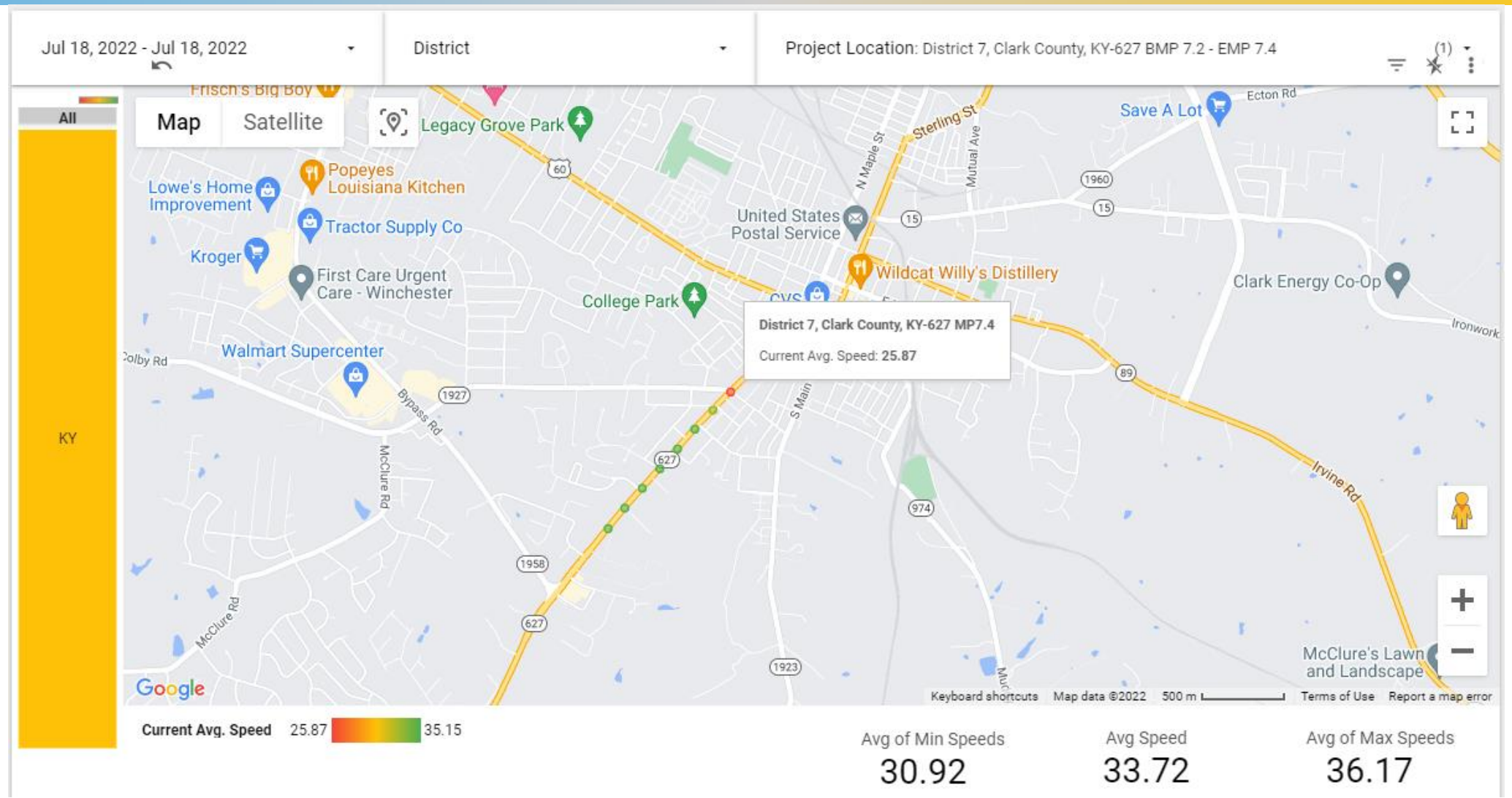
Work Zones: Traveler Information



Work Zone Monitoring



Work Zone Monitoring



Work Zone Crash Summaries

Jul 18, 2022 - Jul 18, 2022

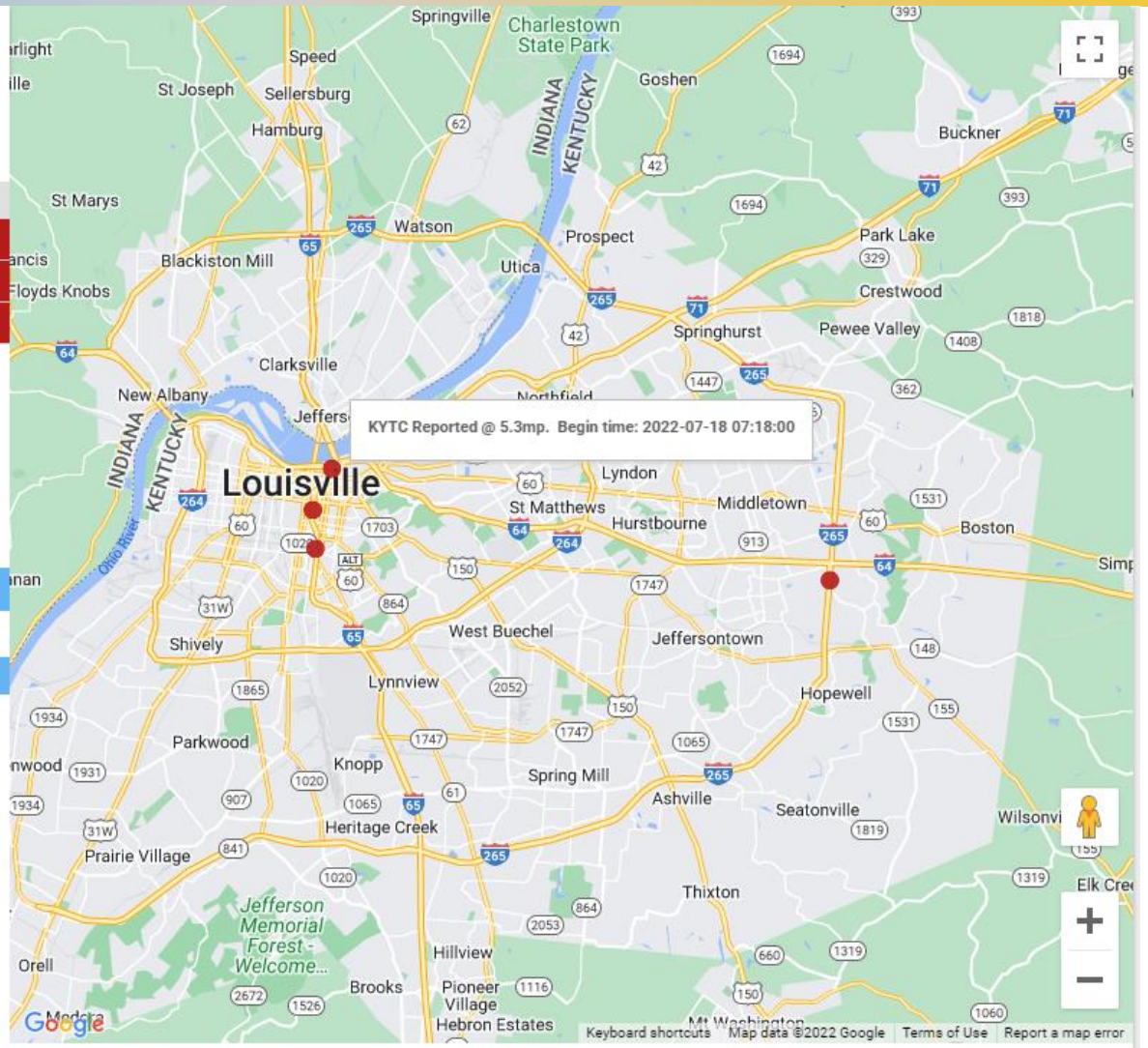
TOC Reported Crashes, Drill Down Capable

	WZ Location	Crashes
1.	I-265 from 29 to 23	1
2.	I-65 from 131 to 135.4	1
3.	I-64 from 5.4 to 5.4	1

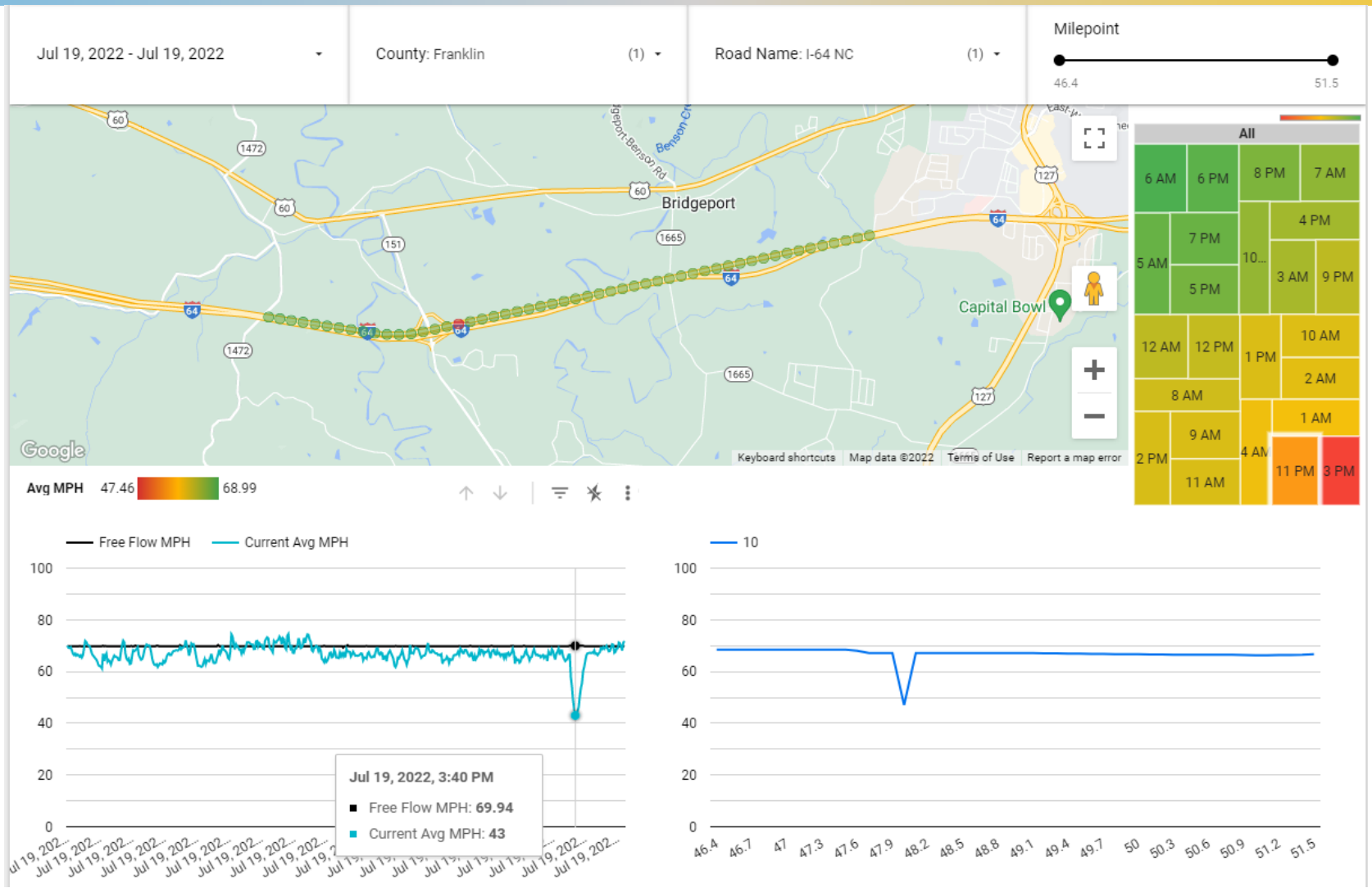
1 - 3 / 3

Waze Reported Crashes, Drill Down Capable

District	Crashes
No data	



Work Zone Crash Impact



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@KYTC

@kytc120

@KYtransportation

@KYtransportation

transportation.ky.gov

Questions?

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Indiana Work Zone Analytics

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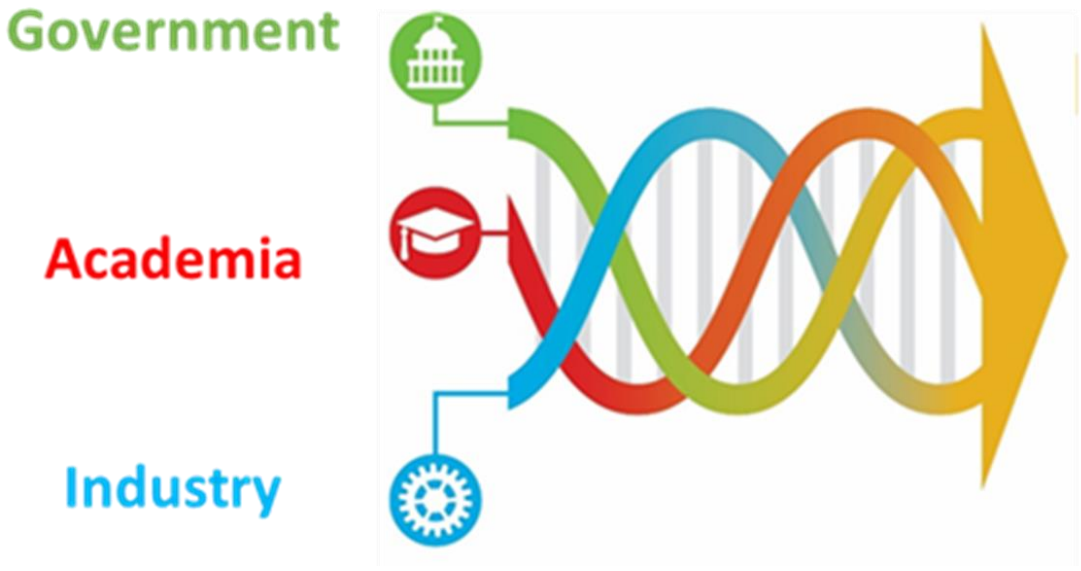

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Extended Team

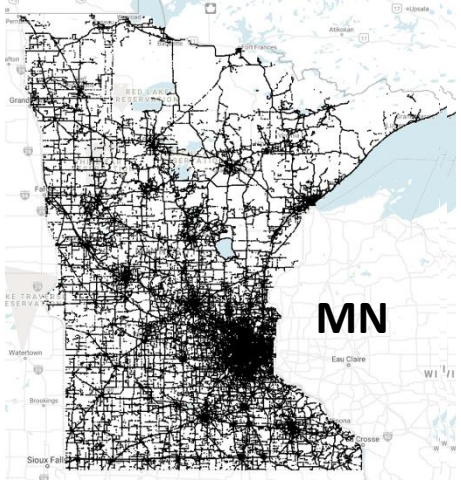
Agenda

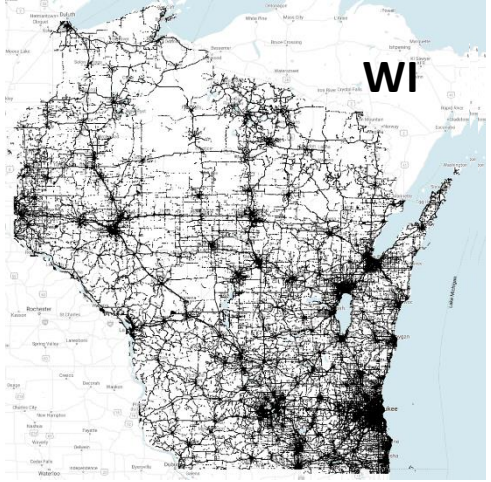
- **Message**
- Connected Vehicle Data
- Work Zone Safety Applications
- Weekly Work Zone Reports
- Pooled Fund Opportunity

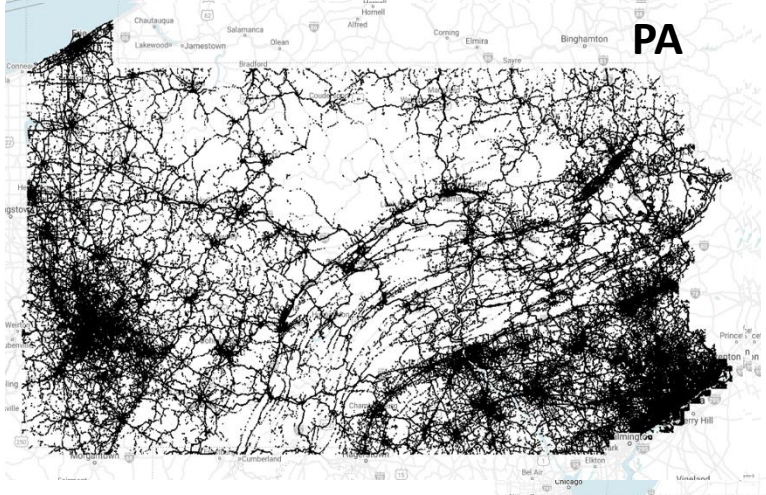
Message

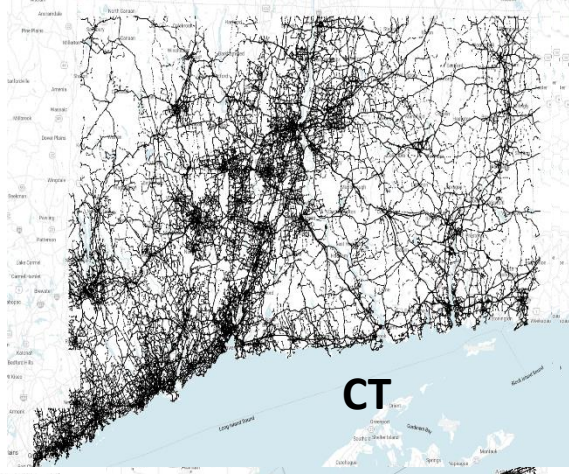
- Connected Vehicle Data is an important source of information for identifying areas of interest
  - Hard Braking is a good surrogate for crashes
  - We can effectively map in real time queue lengths and duration
- Key applications of hard braking
  - Back of Queue
  - Critical areas in a work zone

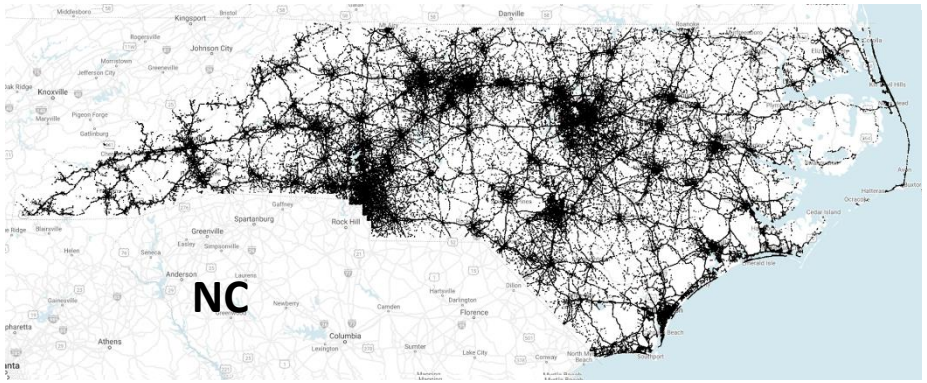
Our vehicles know more about our roads than we do.
Connected vehicle data is particularly important for understanding and managing construction work zone traffic.



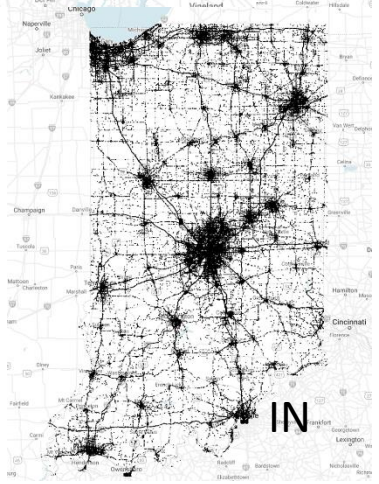


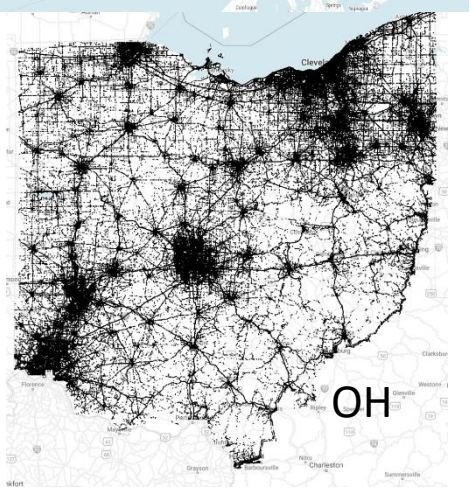


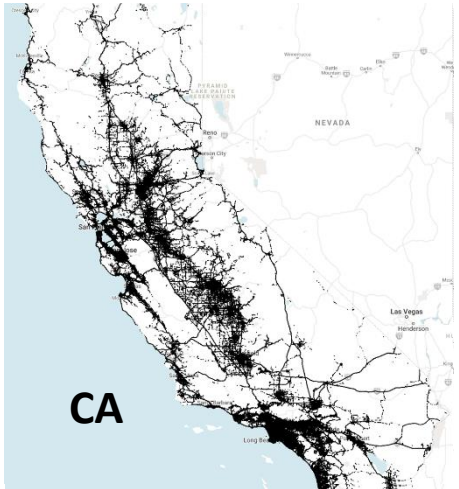


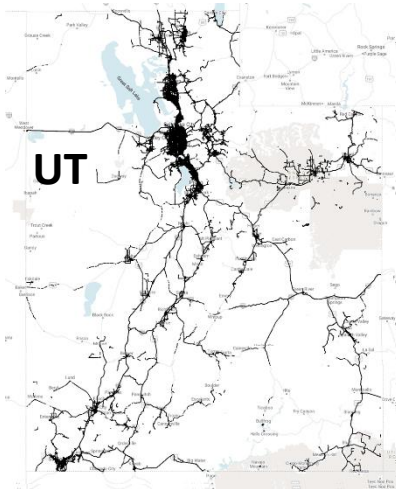


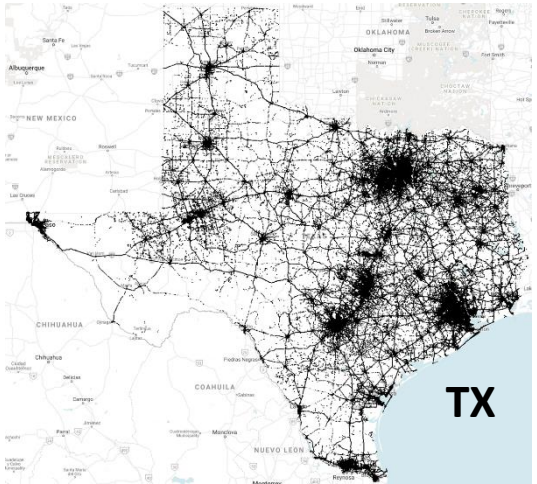
One Hour of Connected Vehicle Data from Selected States

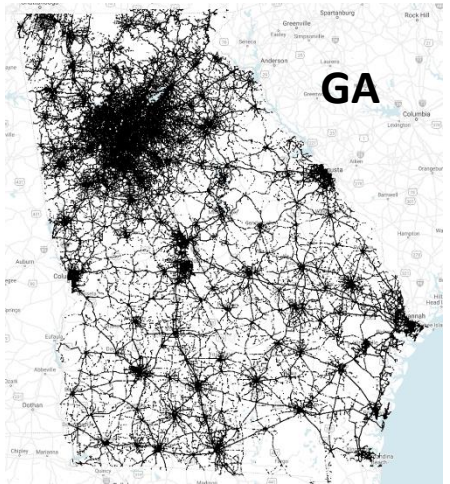






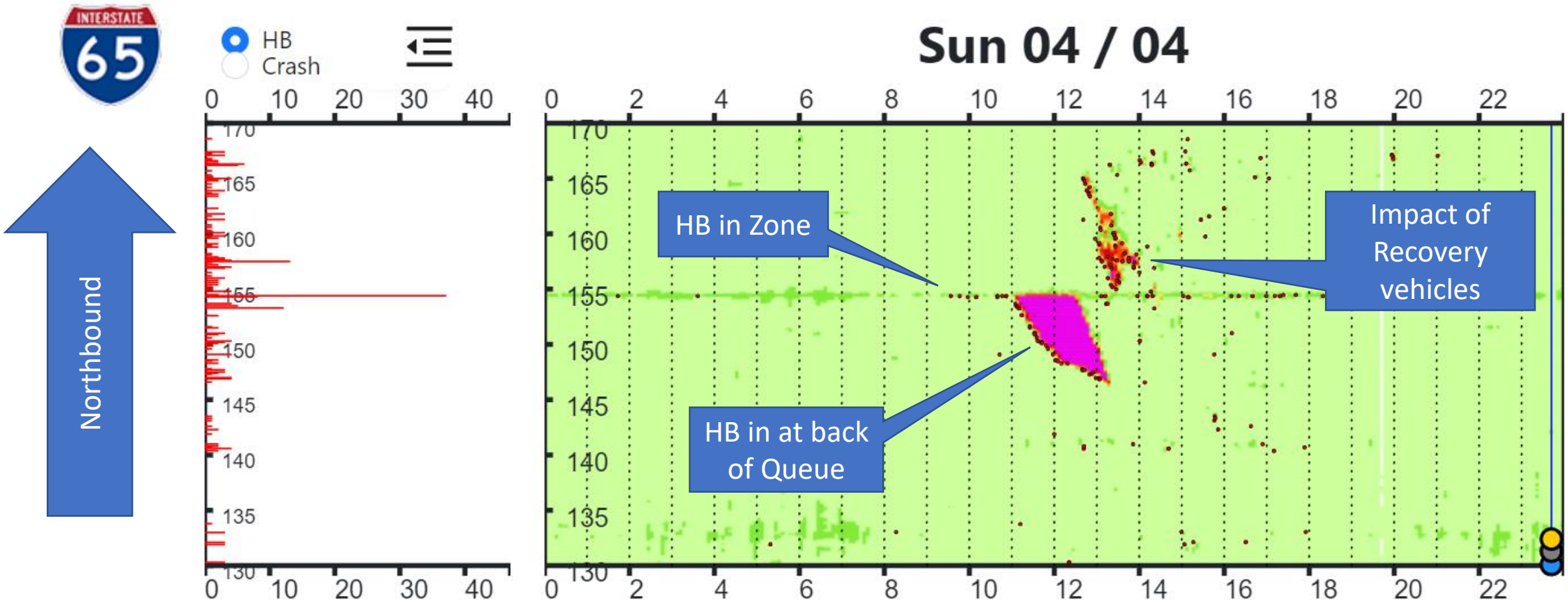






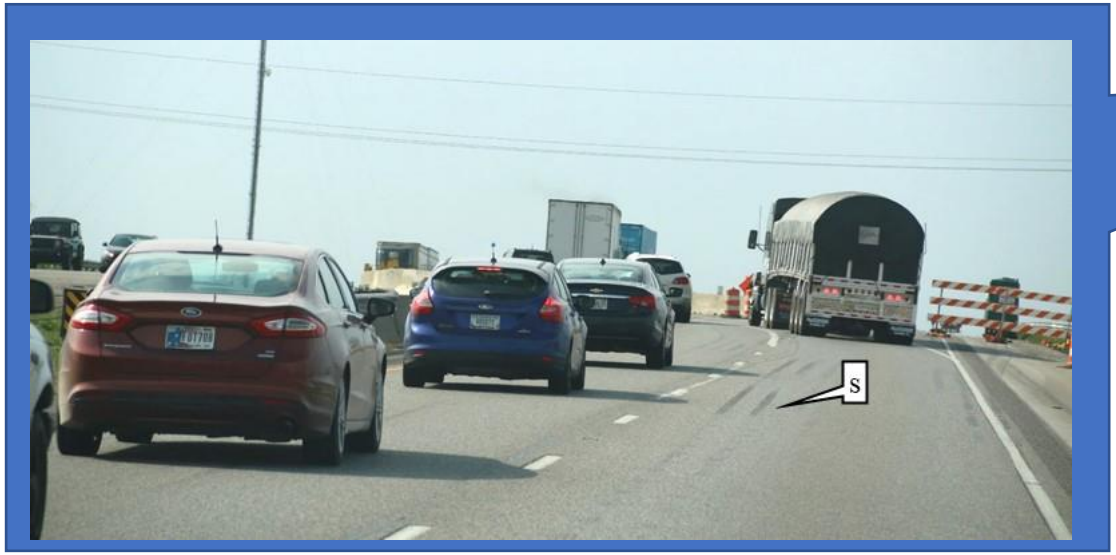
Connected Vehicle Hard-braking is more scalable and better than looking for skid marks

Hard Braking & 10 Mile Work Zone Queue



Hard-braking Events in Region of WZ By Mile Marker

Before Lane Shift
(Dec 2020 During Pandemic)



After Lane Shift
(May 2021)

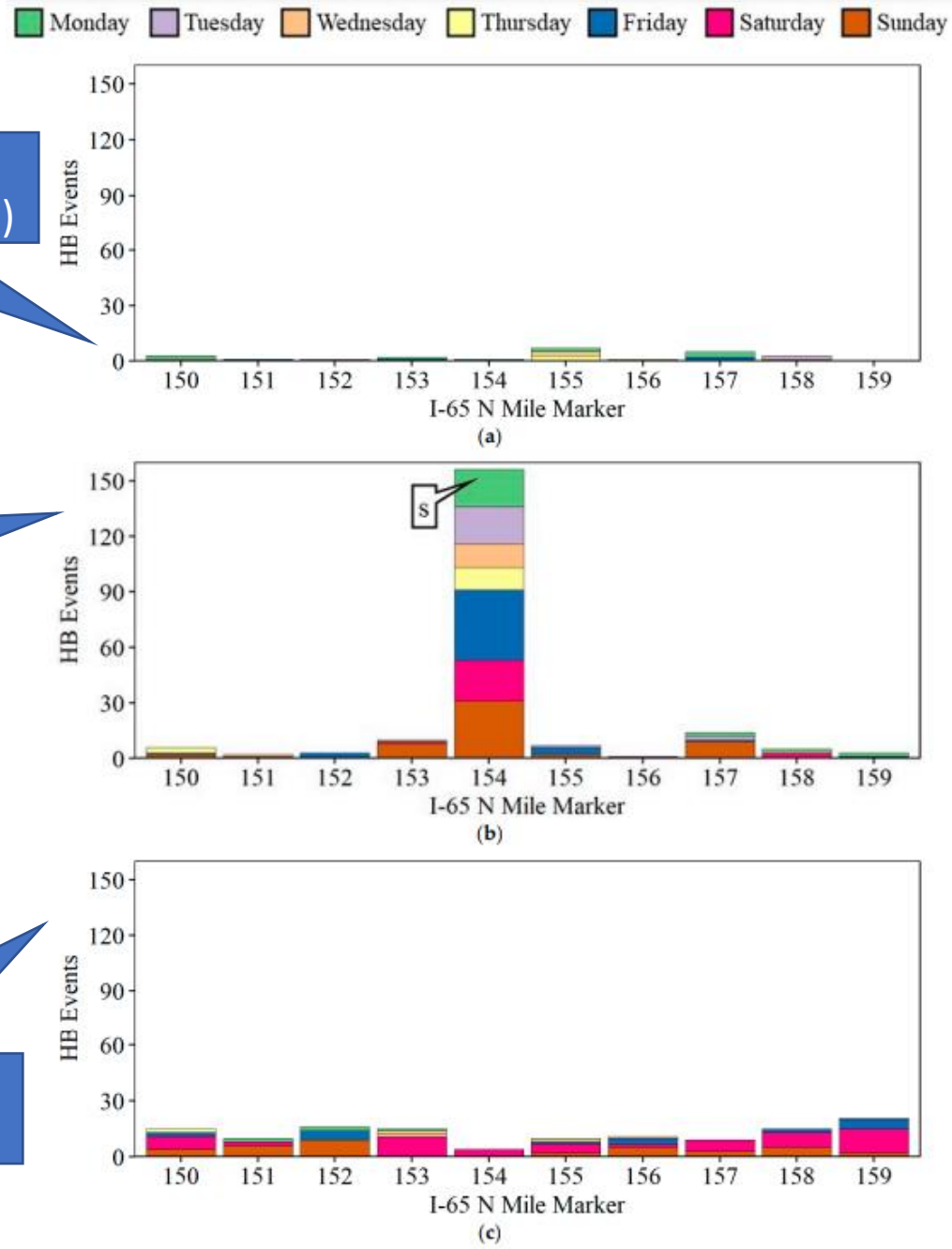
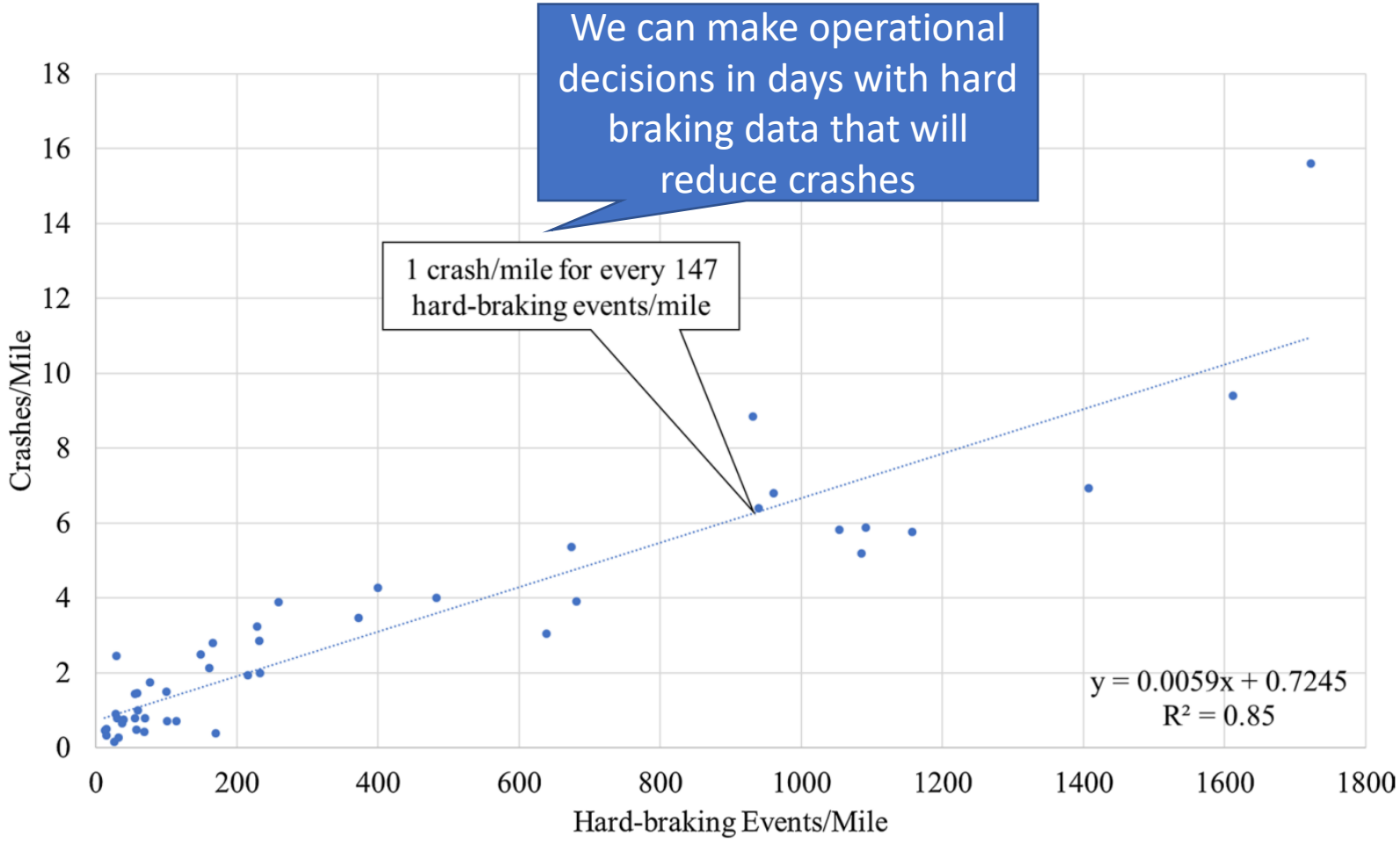


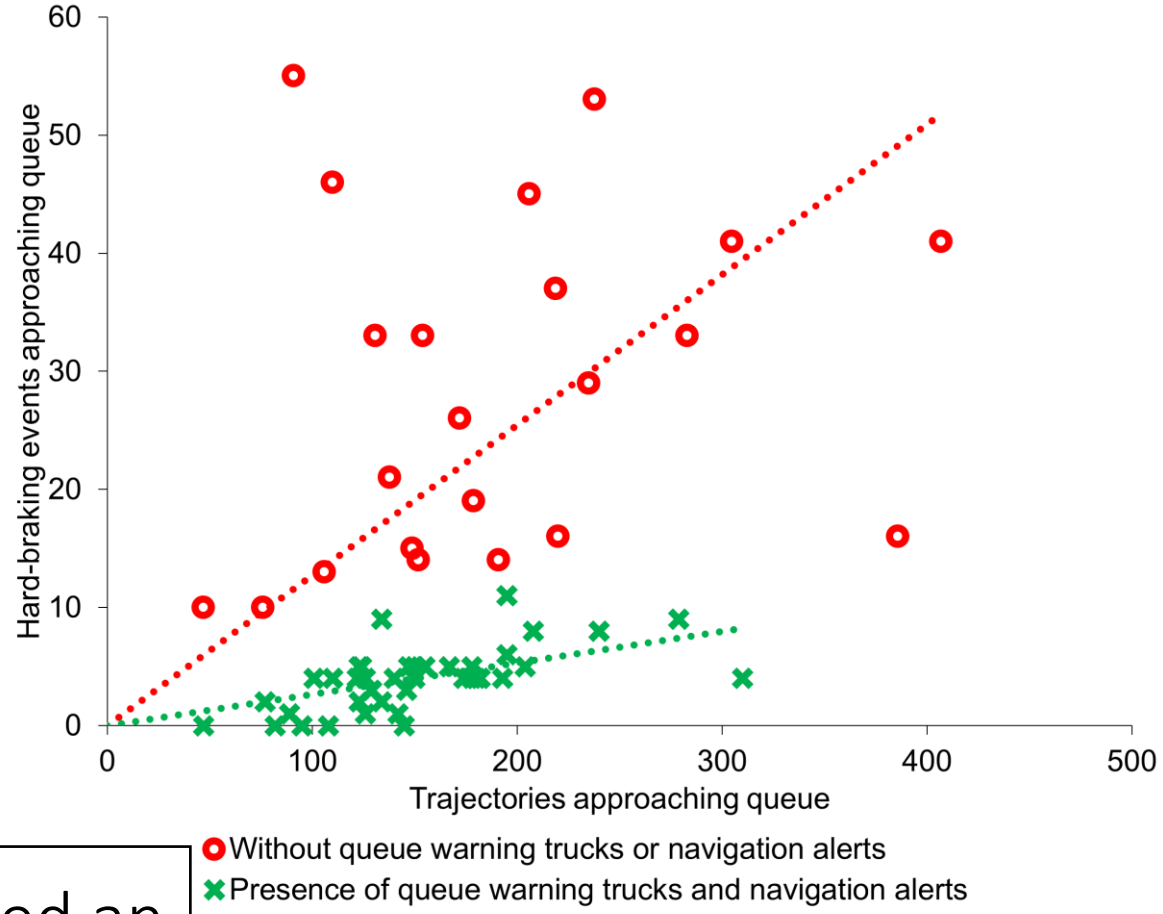
Figure 17. Hard-braking events by 1 mile-segments along I-65 NB between MM 150 and MM 160. (**a**) Monday, 21 December 2020–Sunday, 27 December 2020 (before); (**b**) Monday, 5 April 2021–Sunday, 11 April 2021 (during crossover); (**c**) Monday, 3 May 2021–Sunday, 9 May 2021 (after return to normal).

Relationship between hard-braking events per mile and crashes per mile

196,215 hard-braking events and 3,132 crashes analyzed over 23 interstate work zones



Desai, J., Li, H., Mathew, J. K., Cheng, Y. T., Habib, A., & Bullock, D. M. (2021). Correlating hard-braking activity with crash occurrences on interstate construction projects in Indiana. *Journal of Big Data Analytics in Transportation*, *3*(1), 27-41.



Analysis of nearly 430 hours of queuing showed an **80% reduction** in hard-braking events when queue warning trucks were present

Sakhare, R.S., Desai, J.C., Mahlberg, J., Mathew, J.K., Kim, W., Li, H., McGregor, J.D. and Bullock, D.M. (2021) Evaluation of the Impact of Queue Trucks with Navigation Alerts Using Connected Vehicle Data. *Journal of Transportation Technologies*, **11**, 561-576. doi: 10.4236/jtts.2021.114035.

Lane Shift Impact on Hard Braking Events

Manson Colfax, I-65 MM 154

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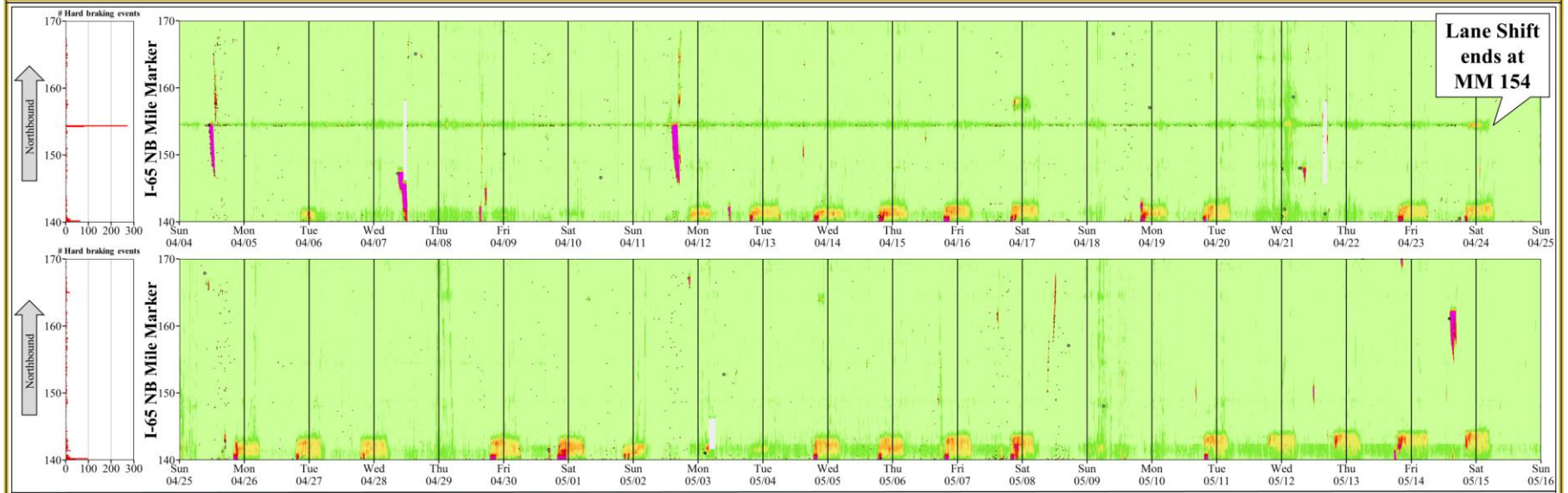
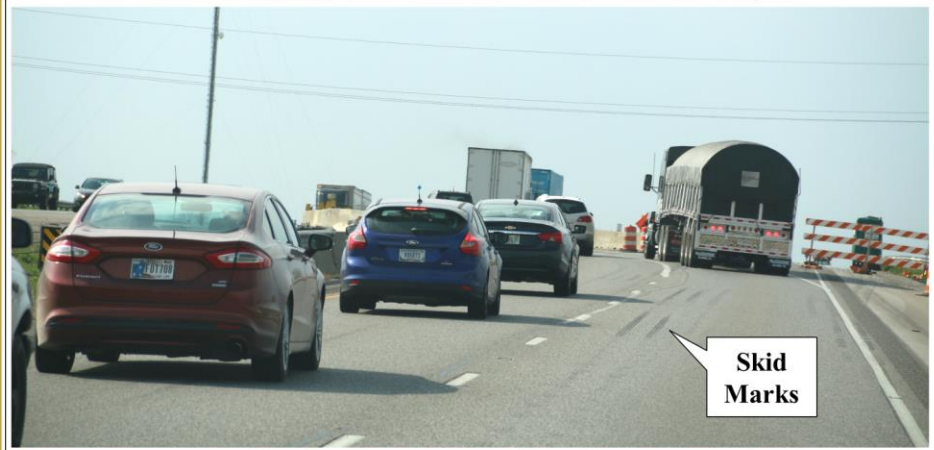
Speed Legend

No Data | > 65 | 55 to 64 | 45 to 54 | 35 to 44 | 25 to 34 | 15 to 24 | 0 to 14

● Hard braking events





➢ **During Lane Shift**

- ~ **272** Hard braking events over 3 weeks from 4/4 to 4/24
- **2** significant crashes

➢ **After Lane Shift ends on 4/24**

- Hard braking events reduce to near **0** and no crashes

April 2021

S	M	T	W	T	F	S
30	31			1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

May 2021

S	M	T	W	T	F	S
30	31					1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29

Lane Shift Impact on Hard Braking Events

Manson Colfax, I-65 MM 154

PURDUE UNIVERSITY

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Speed Legend

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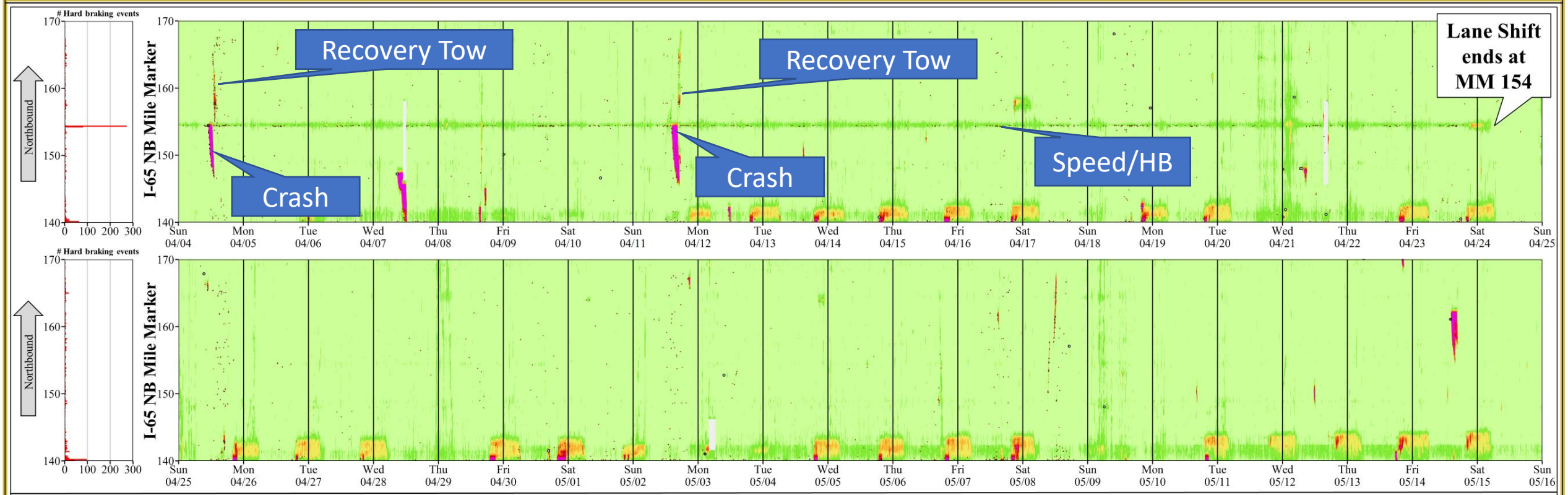
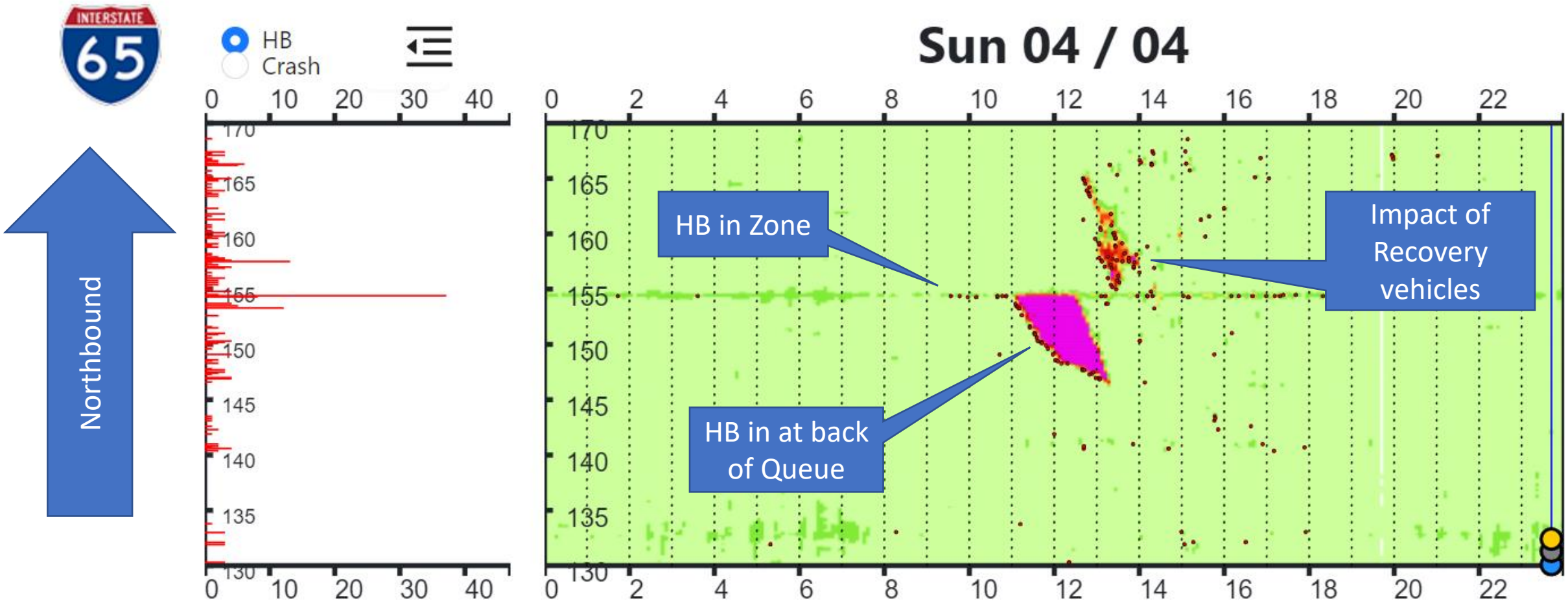


Hard Braking & 10 Mile Work Zone Queue



We have a lot of work zones. It is important to focus attention on areas of concern.

24-month Speed Profiles for Indiana Interstates

Hours of Speed by Speed-Bin

Jan 2021 – Dec 2022

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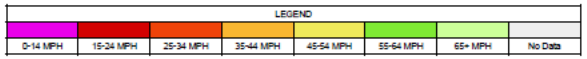
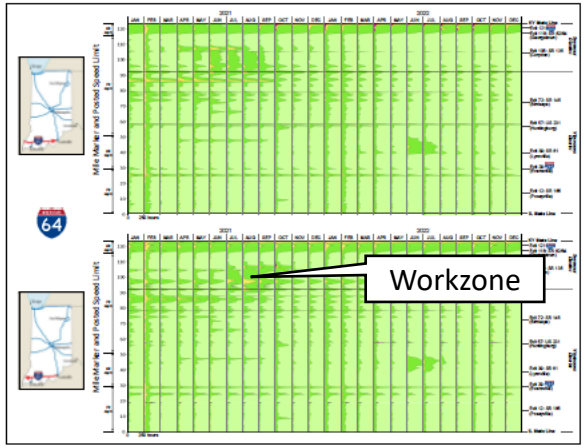
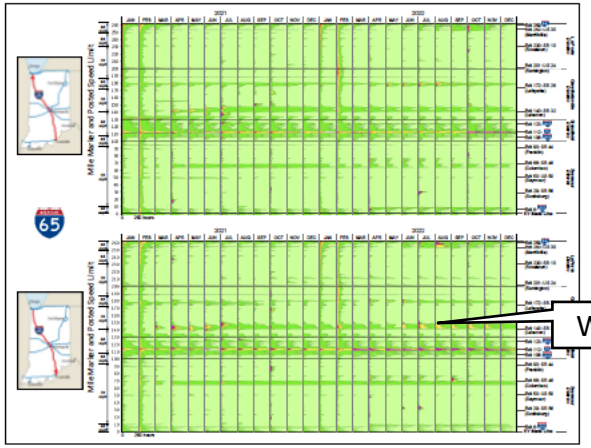
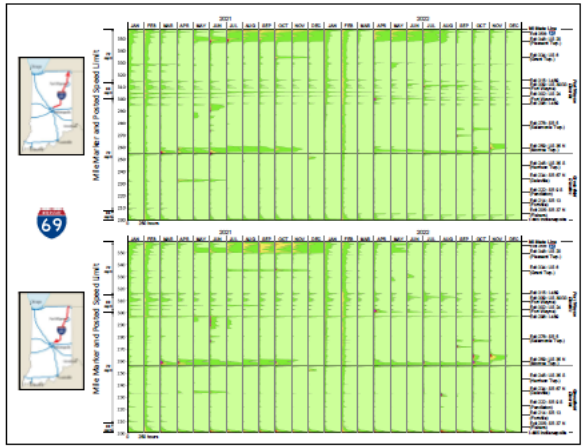
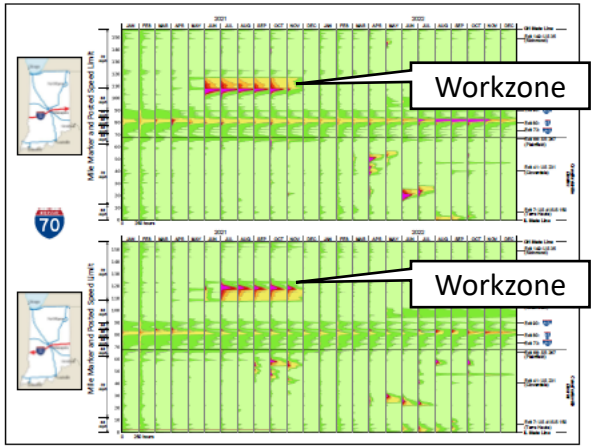
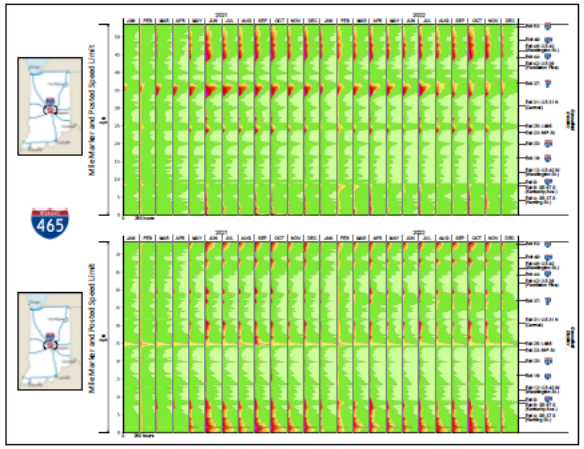


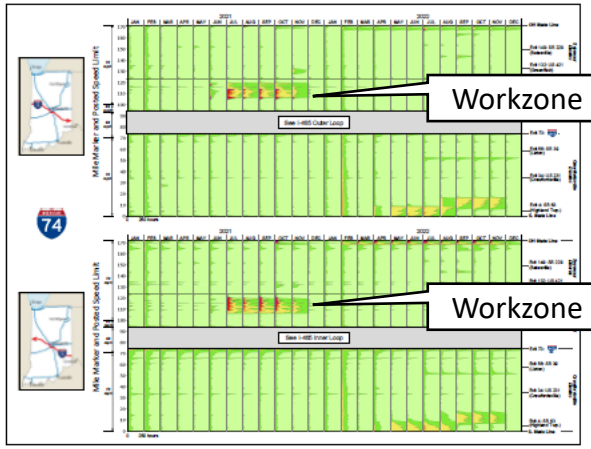


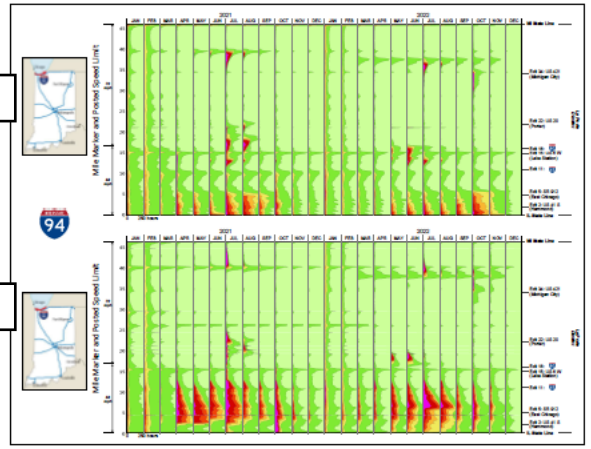












Message

- Connected Vehicle Data is an important source of information for identifying areas of interest
  - Hard Braking is a good surrogate for crashes
  - We can effectively map in real time queue lengths and duration
- Key applications of hard braking
  - Back of Queue
  - Critical areas in a work zone

National Interstate Mobility Analysis

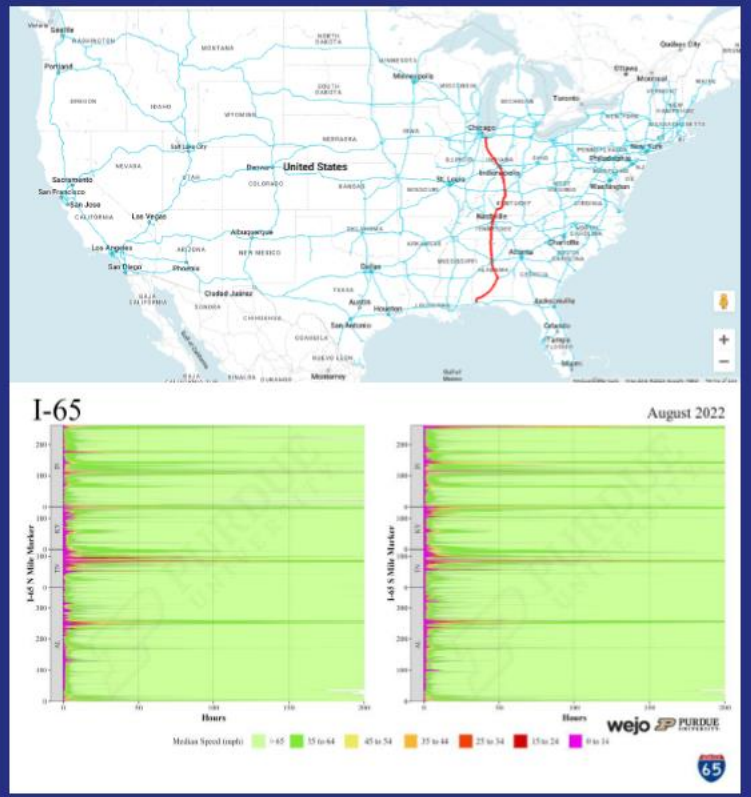
Additional Details at

Desai, J., Mathew, J. K., Li, H., Sakhare, R., Horton, D., & Bullock, D. M. (2022). *National mobility analysis for all interstate routes in the United States.* West Lafayette, IN: Purdue University. https://doi.org/10.5703/1288284317585

National Mobility Analysis for All Interstate Routes in the United States

August 2022

DOI: 10.5703/1288284317585



Jairaj Desai, Jijo K. Mathew, Howell Li, Rahul Sakhare, Deborah Horton, Darcy M. Bullock

PURDUE UNIVERSITY

Methodology for Monitoring Work Zones Traffic Operations Using Connected Vehicle Data

Sakhare, R.S., Desai, J., Li, H., Kachler, M. A. and Bullock, D. M. (2022). Methodology for Monitoring Work Zones Traffic Operations Using Connected Vehicle Data. *Safety* ***2022****, 8, 41.*
https://doi.org/10.3390/safety8020041

Figure 14. I-65 NB around MM 154.4 at Manson and Colfax.

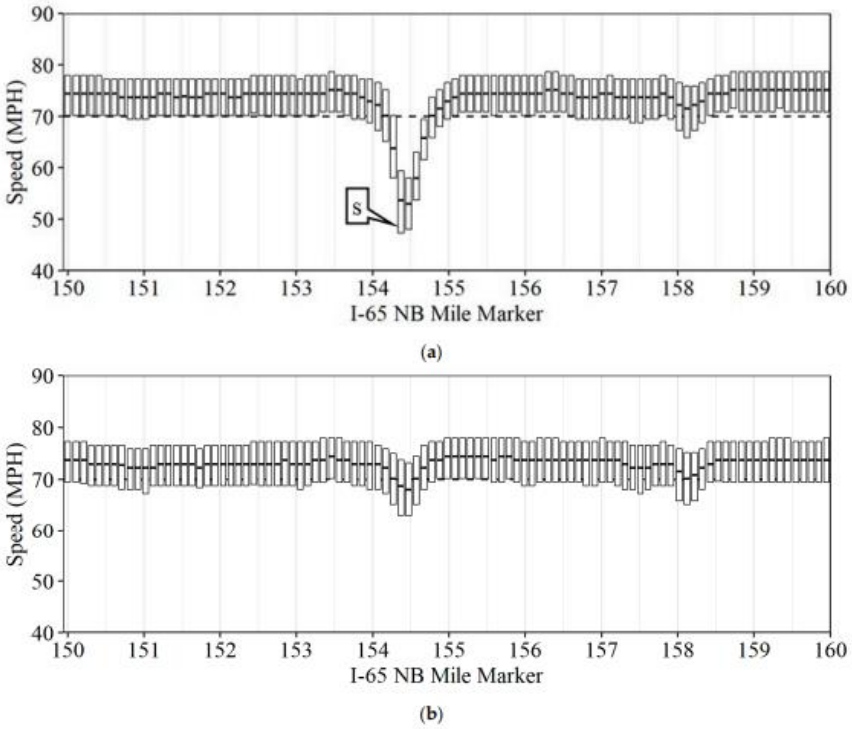


Figure 15. Interquartile speeds for 0.1-mile segments during and after the lane shift on I-65 NB. (**a**) Speeds during the lane shift (Monday, 12 April–Sunday, 18 April 2021); (**b**) Speeds after the lane shift (Monday, 3 May–Sunday, 9 May 2021).

DOI: https://doi.org/10.3390/safety8020041

Pooled Fund Study: Work Zone Analytics

Background & Impact

For the past 3 years, Purdue University and the Indiana Department of transportation have been monitoring congestion and hard braking data across all 2600 miles of Indiana Interstates using connected vehicle data. Figure 1 illustrates one such report for I-465 that shows the impact of the 2021 construction activities on congestion.

However, hard braking data has been found to be even more insightful and is a modern day surrogate for looking for skid marks on the road (Figure 2). For example, if one looks at hard braking connected vehicle data shown in Figure 3, one can see the horizontal line of hard braking at approximately MM 154.4, the same location as the Figure 2 photo that shows the entry into the work zone and the skid marks. Furthermore, one can visualize the impact of a crash that occurred in the work zone at approximately 11:00 a.m., and the subsequent queue that extended approximately 5.5 miles. One can also see numerous hard braking at the back of the queue as free flow traffic approached the queued traffic and suddenly slowed.

Figure 4 provides a crisp example of how these hard braking can be used to identify specific locations along a road that should be looked at further by comparing the before construction (Figure 4a) with the connected vehicle hard braking data during construction (Figure 4b).

Figure 5 and Figure 6 provide similar examples of specific work zone locations highlighted by a change in hard-braking activity which were then mapped using drone imagery to identify contributing factors the cause of the hard-braking.

Research Need

These reports have evolved over the past 3 years in Indiana and there is a need to develop a multi-state consensus on the most effective reports. This will provide a framework to formalize the reporting models, data reduction processes and decision making process so these techniques can be scaled to other states so they can pro-actively identify emerging safety concerns in their work zones, conduct effective after action reviews of past work zones, and ultimately identify best practices for future work zones that minimize congestion, hard braking and ultimately crashes.

Research Tasks

1. Meet with panel members to review work zone analytic reports that can be produced with existing data was well as formulate prioritized list of desirable additions to those reports. Developing a shared vision among multiple states will facilitate scaling this data and stimulate engagement with the connected vehicle data providers. For example, hard braking is useful, but there may be some opportunities to adjust or provide variable hard braking thresholds.
2. Identify commercial probe data sets that are available and procure probe data for each participating state. Data will include passenger car trajectories and passenger car hard braking, and commercial truck trajectories. There are also emerging data sets
    a. From trucks that provide hard braking and lateral deviation.
    b. From passenger cars that provide lateral deviation and lane marking quality.
3. Perform penetration analysis of connected vehicle data to understand how it varies by state. There is broad interest in ensuring that the connected vehicle data is representative and has sufficient penetration to provide accurate performance measures.
4. Prepare weekly work zone safety and mobility analytics report for distribution to member states.
5. Prepare weekly work zone change in hard-braking activity report for distribution to member states.
6. Conduct monthly webinars with participating states to review their reports, highlight emerging locations of safety and mobility concerns, and compare and contrast emerging best practices.
7. Convene panel of participating states and key stakeholders to review the multi state deployment of work zone reports and to obtain consensus on recommended data items to collect and the reporting format.
8. Prepare final report that summarizes research and has a recommended implementation plan for states to deploy weekly work zone analytics.

Funding Request

This will vary depending upon what data the state already has access to and what we will have to purchase for the Pooled Fund Study for Work Zone Analytics.

Proposed Start Date

April 1, 2023

References

1. Mathew, J.K., J.C. Desai, R.S. Sakhare, W. Kim, H. Li, and D.M. Bullock, "Big Data Applications for Managing Roadways," ITE Journal, Institute of Transportation Engineers, February 2021. https://www.nxtbook.com/ygsreprints/ITE/ite-journal-february-2021/index.php#/p/28
2. Hunter, M., Mathew, J.K., Li, H. and Bullock, D.M. "Estimation of Connected Vehicle Penetration on US Roads in Indiana, Ohio, and Pennsylvania." Journal of Transportation Technologies, 11, 597-610. (2021) https://doi.org/10.4236/jtts.2021.114037
3. Sakhare, R., Desai, J., Mathew, J., McGregor, J. and Bullock, D. (2021) "Evaluation of the Impact of Presence Lighting and Digital Speed Limit Trailers on Interstate Speeds in Indiana Work Zones," Journal of Transportation Technologies, 11, 157-167. https://doi.org/10.4236/jtts.2021.112010
4. Mathew, J.K., Desai, J., Li, H. and Bullock, D.M. "Using Anonymous Connected Vehicle Data to Evaluate Impact of Speed Feedback Displays, Speed Limit Signs and Roadway Features on Interstate Work Zones Speeds." Journal of Transportation Technologies, 11, 545-560. (2021) https://doi.org/10.4236/jtts.2021.114034
5. Sakhare, R.S.; Desai, J.; Li, H.; Kachler, M.A.; Bullock, D.M. Methodology for Monitoring Work Zones Traffic Operations Using Connected Vehicle Data. Safety 2022, 8, 41. https://doi.org/10.3390/safety8020041

https://www.pooledfund.org/Details/Solicitation/1592

Opportunity to get involved

- Email us if you are interested in participating in a Pooled Fund Study in this space

darcy@purdue.edu

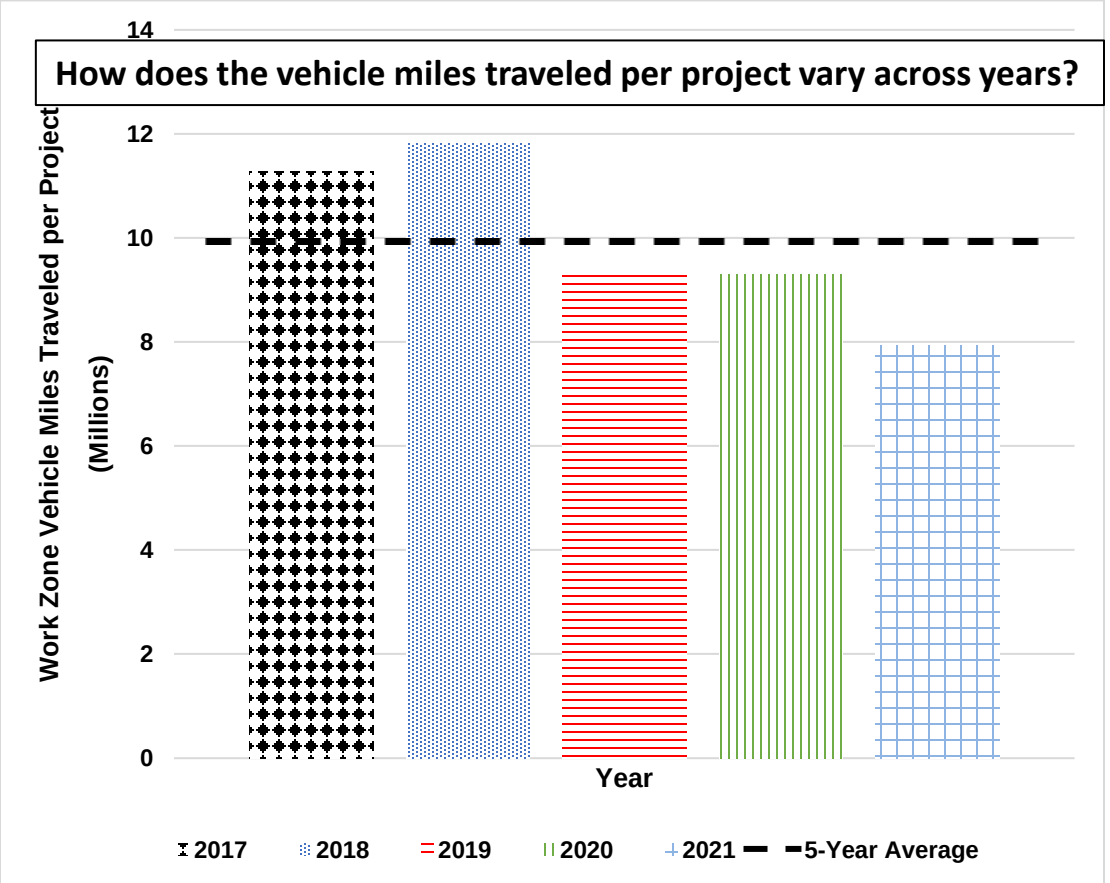
https://www.pooledfund.org/Details/Solicitation/1592

Mobility Performance

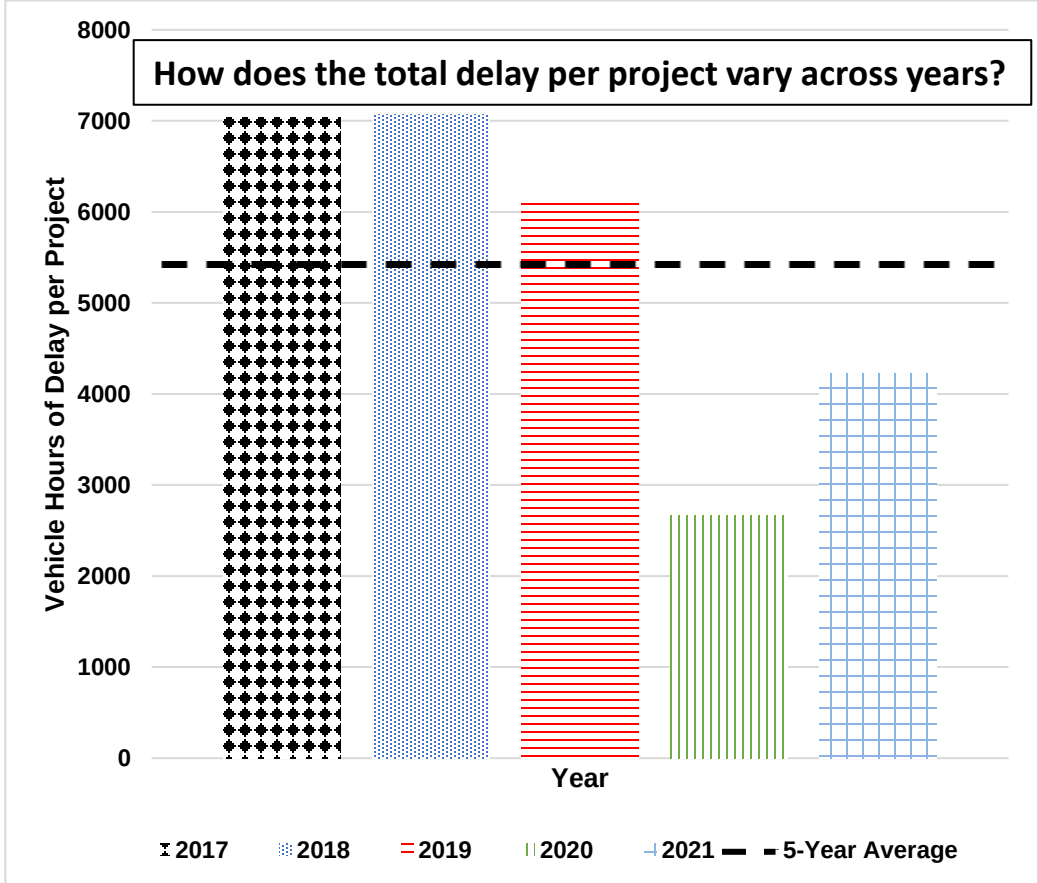
Why is it important to measure mobility performance in work zones?

- Work zones often require changes to roadway configurations (lane width and lane capacity reductions, diversions).
- These changes impact the mobility performance of the roadways (increased travel time, bottlenecks, queues).
- Agencies design and implement various work zone strategies and technologies to address/mitigate these mobility impacts.
- Identifying, measuring, and quantifying the mobility measures will enable agencies to assess the effectiveness of their work zone management strategies.

Mobility Performance Measurement Examples (slide 1/4)

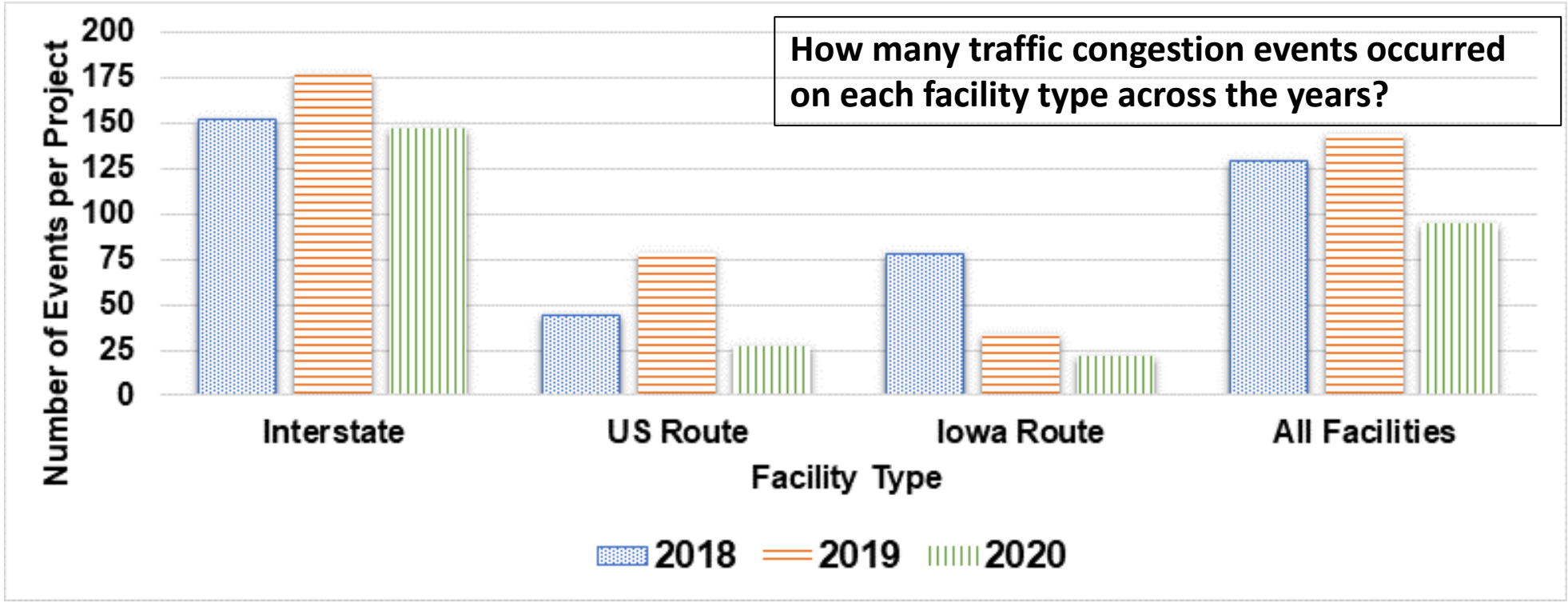


Number of work zone vehicle miles traveled per project
Source: Illinois Department of Transportation



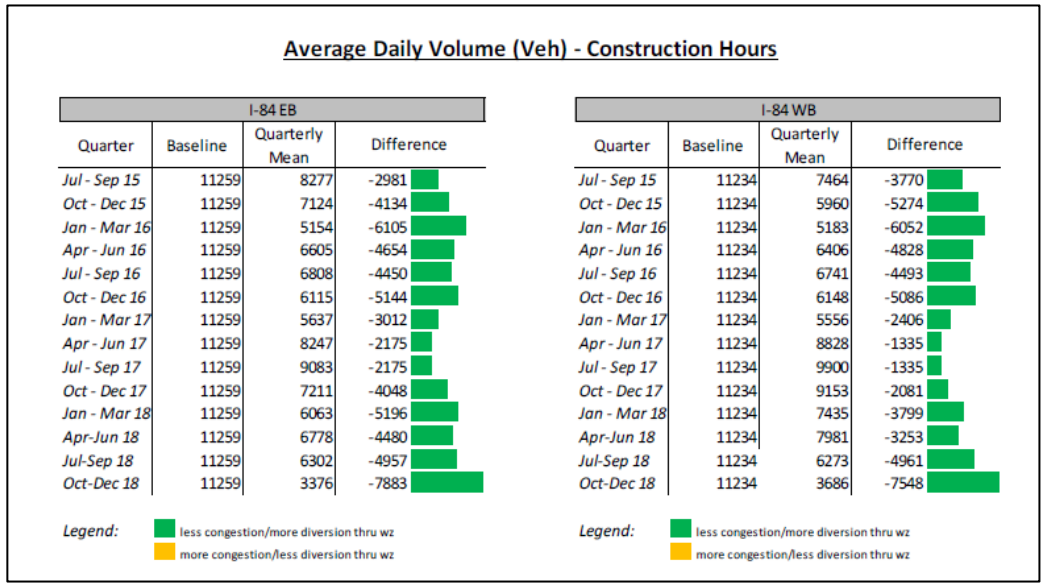
Vehicle hours of delay per project
Source: Illinois Department of Transportation

Mobility Performance Measurement Examples (slide 2/4)



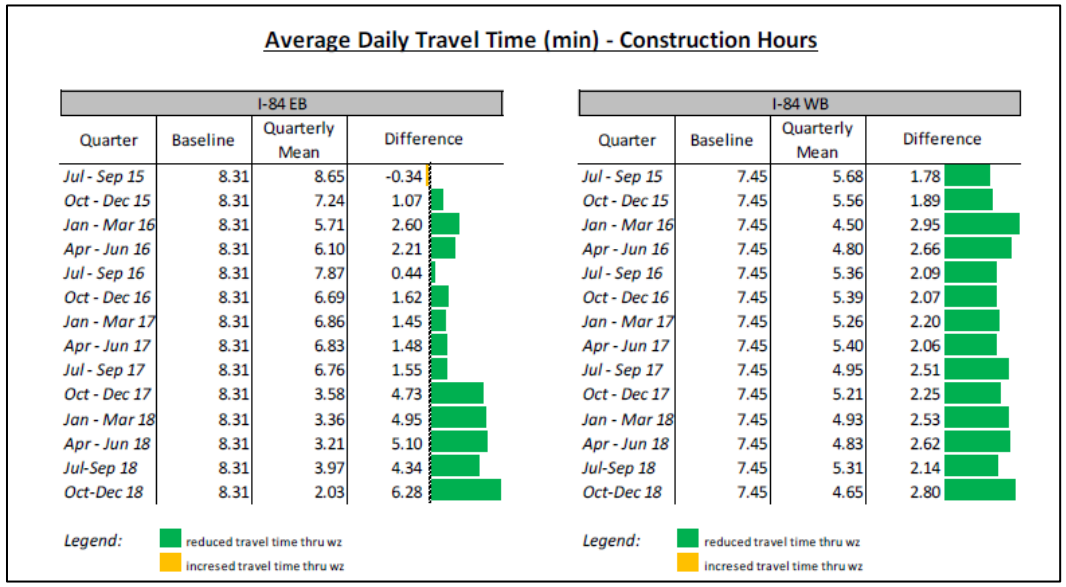
Number of traffic congestion events per work zone project
Source: Iowa Department of Transportation

Mobility Performance Measurement Examples (slide 3/4)



Comparison of daily volume during construction hours

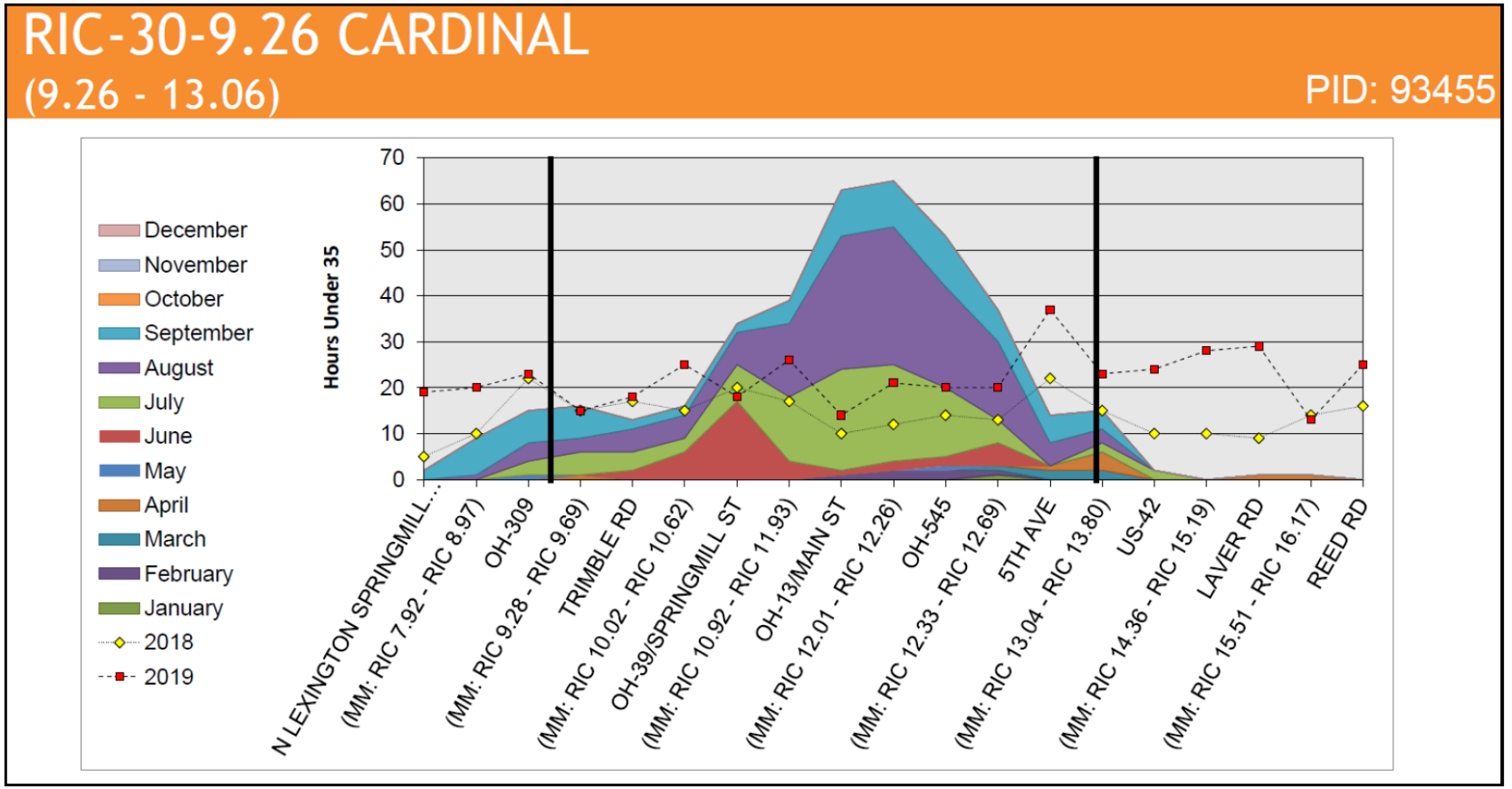
Source: Connecticut Department of Transportation



Comparison of daily travel time during construction hours

Source: Connecticut Department of Transportation

Mobility Performance Measurement Examples (slide 4/4)

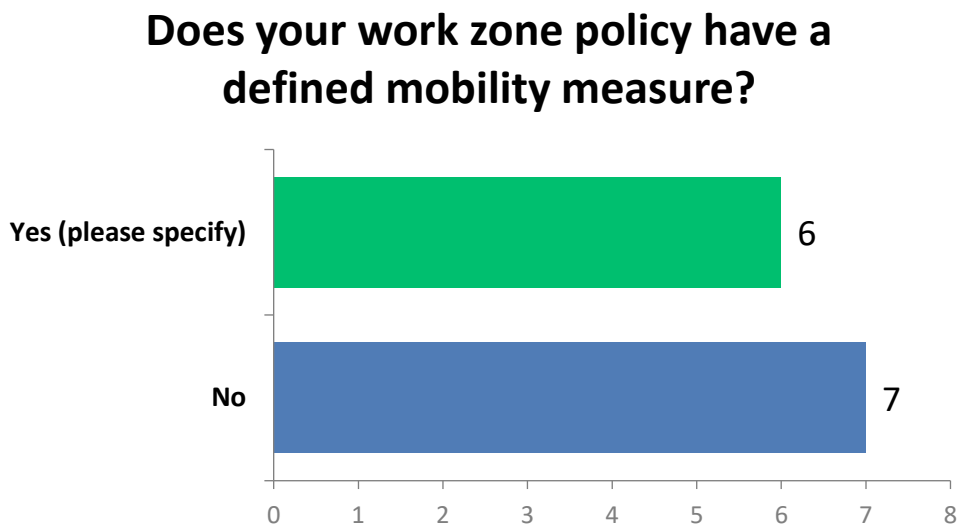


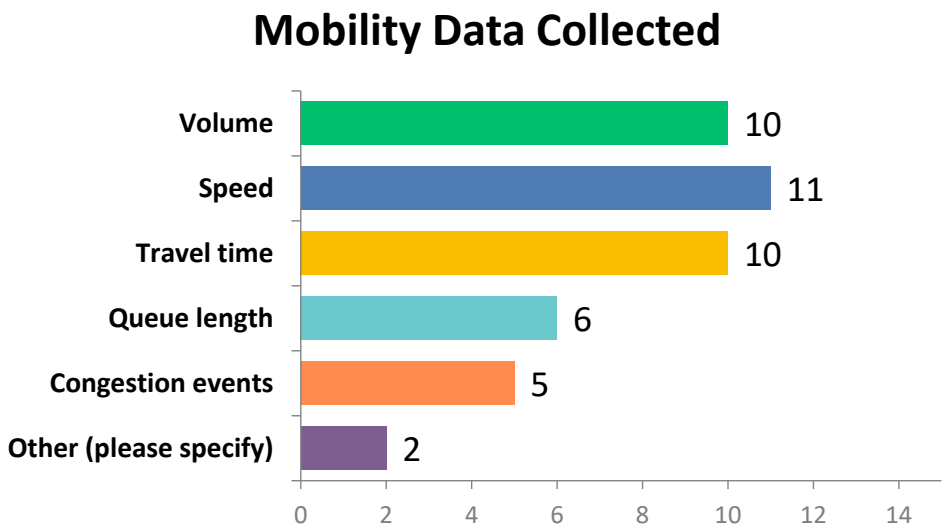
Monthly mobility report example comparing travel speeds in work zones
Source: Ohio Department of Transportation

Mobility Performance Measures

- Conventional Measures—Traditional Data:
  - Total delay
  - Delay per vehicle
  - Number of queuing incidents exceeding the agency's mobility policy
  - Duration of queues
  - Number of traffic congestion events per million work zone vehicle miles traveled
  - Percentage of traffic experiencing work zone congestion or delays
- Measures—Emerging Data:
  - Number of jams; total jam delay (Waze™)
  - Jams during crashes (within crash locations and timeframes); crash-jam-related delay

Survey Responses: Mobility Performance Area (slide 1/2)

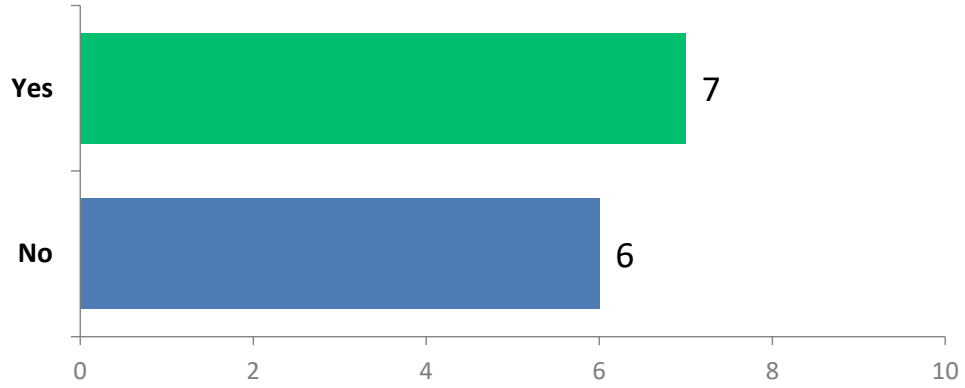




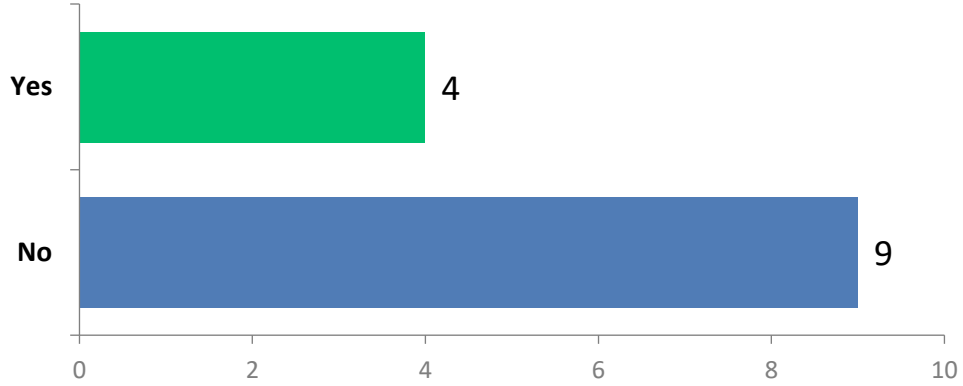
6 out of 13 respondents mentioned that their agency's work zone policy has a defined mobility measure. States have access to traditional and emerging mobility data, and advanced analytical tools. Filtering mobility data specific to work zones require data integration and processing.

Survey Responses: Mobility Performance Area (slide 2/2)

Do you filter your mobility data to your work zones?



Do you use your mobility data to quantitatively assess your work zones?



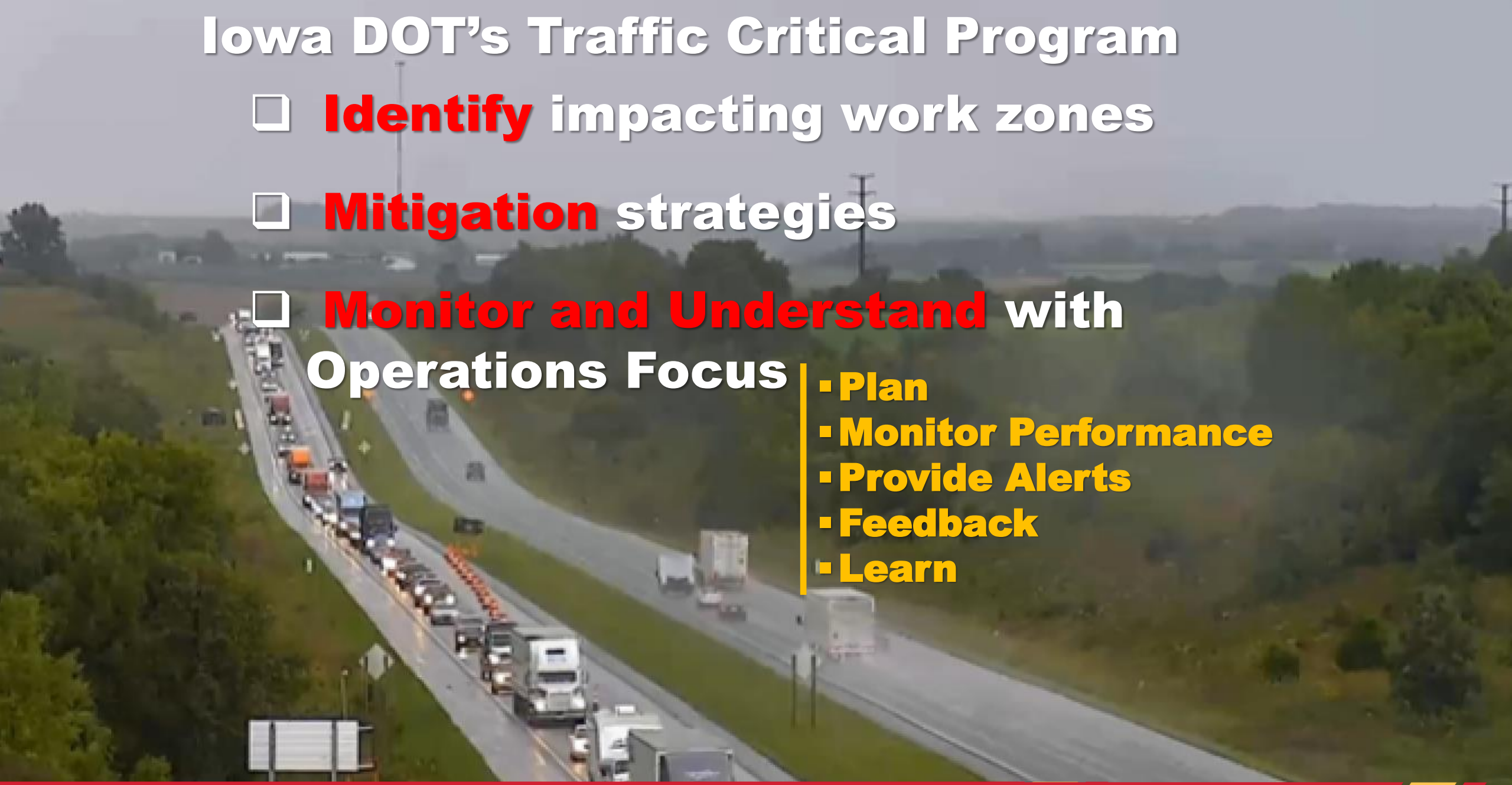
7 out of 13 respondents indicated that their agencies filter mobility data specific to work zones. 9 out of 13 respondents indicated that their agencies do not use mobility data to quantitatively access work zones.

Iowa DOTs Traffic Critical Project (TCP) Performance Monitoring

Skylar Knickerbocker

Iowa DOT's Traffic Critical Program

- ❑ **Identify** impacting work zones
- ❑ **Mitigation** strategies
- ❑ **Monitor and Understand** with Operations Focus
  - Plan
  - Monitor Performance
  - Provide Alerts
  - Feedback
  - Learn



Iowa DOT's Traffic Critical Program

❑ Mitigation strategies

- Traffic Incident Management Planning
- Work Day Restrictions (Day of Week / Seasonal)
- Limited Working Hours / Night Work
- Public Information (PI) Plan
- Innovative Contract Provisions (Lane Rental)
- Accelerated Scheduling
- Work Zone Length/Area Restrictions
- Intelligent Work Zones (IWZ)

Fields Devices Used:

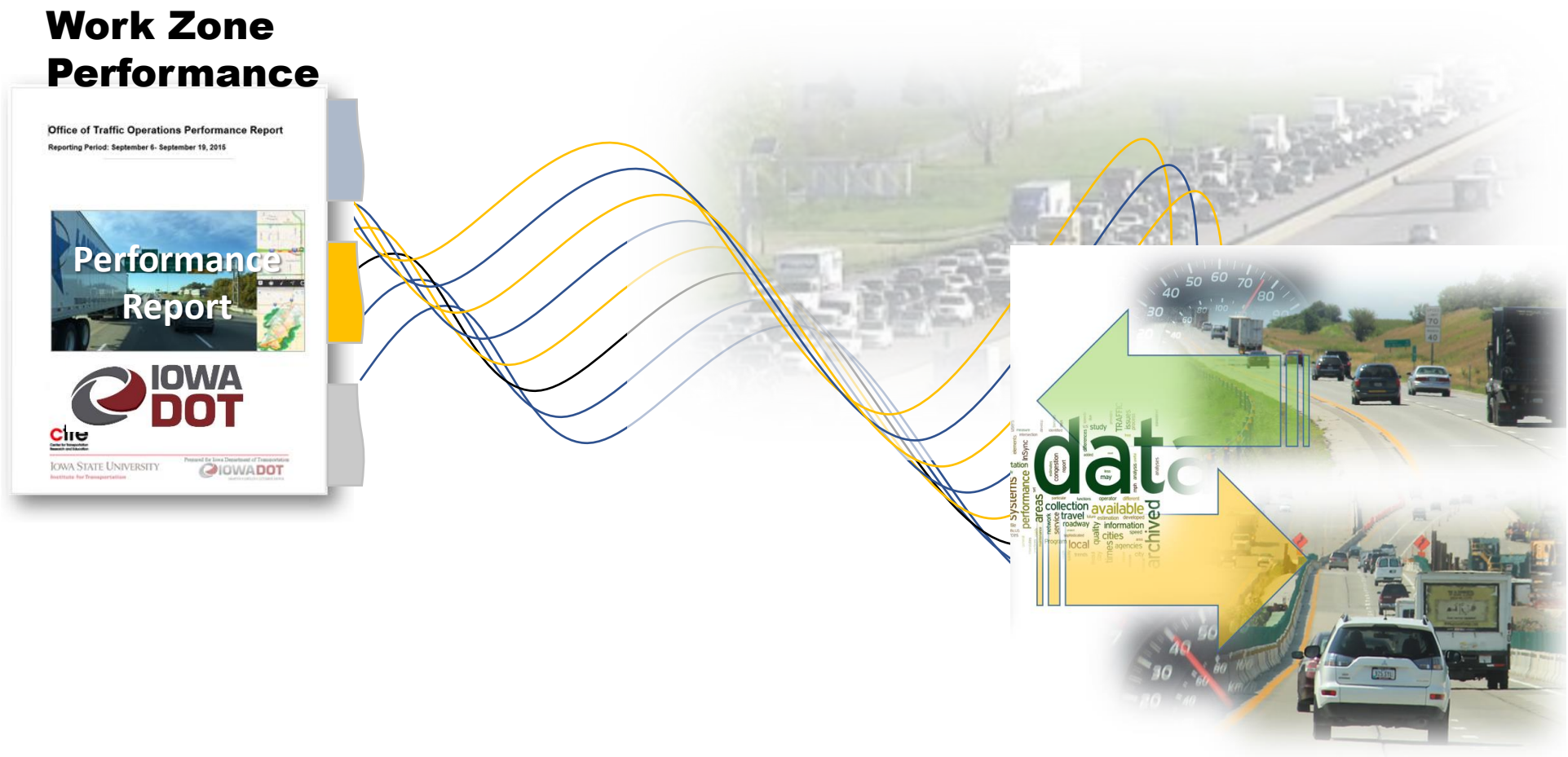
- Sensors
- Cameras
- Dynamic Message Signs
- Truck Entering System
- Bluetooth Sensors

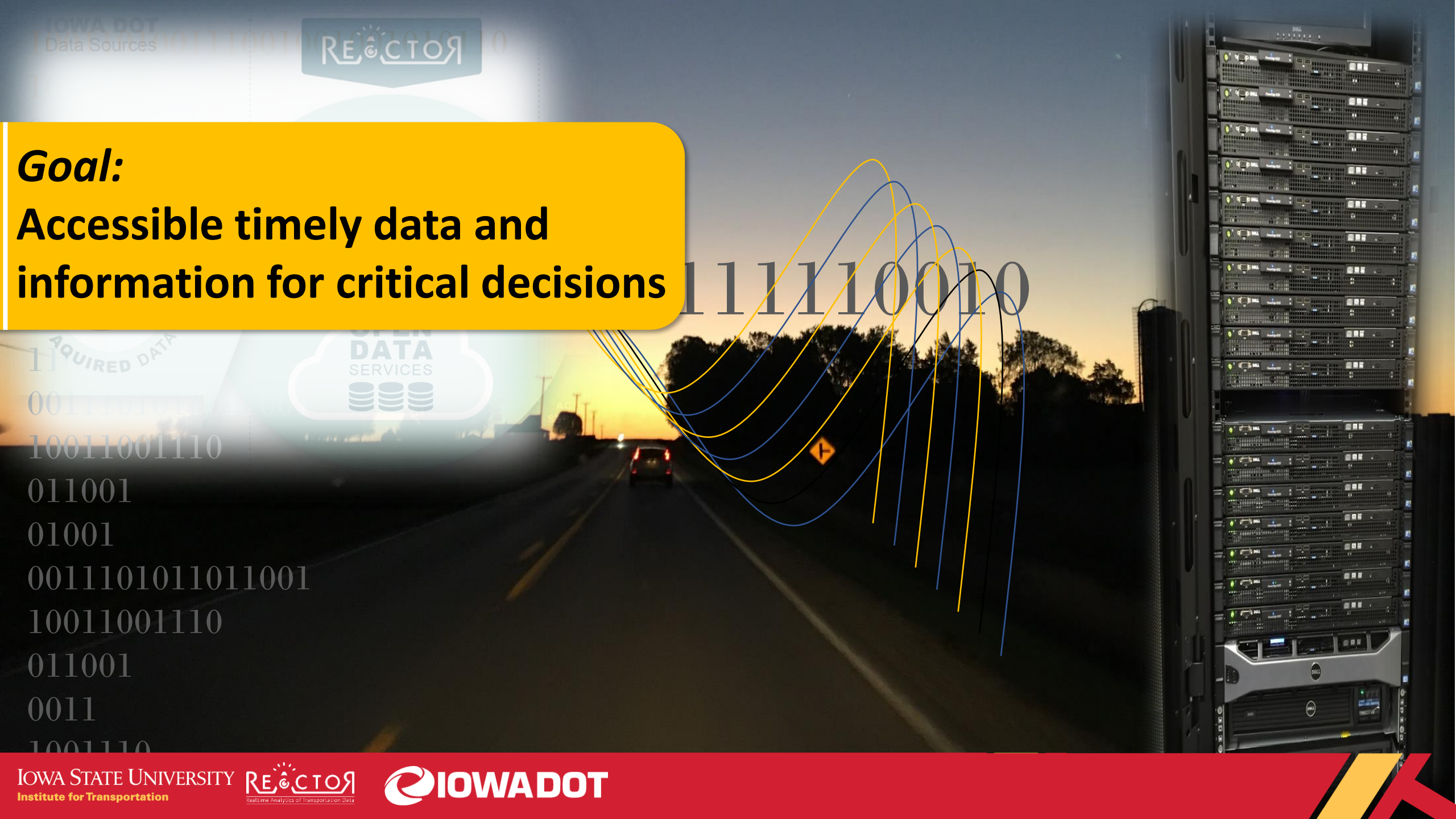
Work Zone Performance

IOWA STATE UNIVERSITY
Institute for Transportation

IOWA DOT

Started Performance Monitoring in 2014

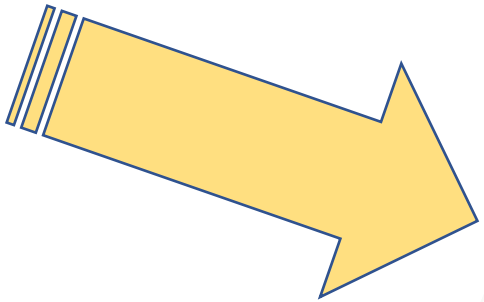


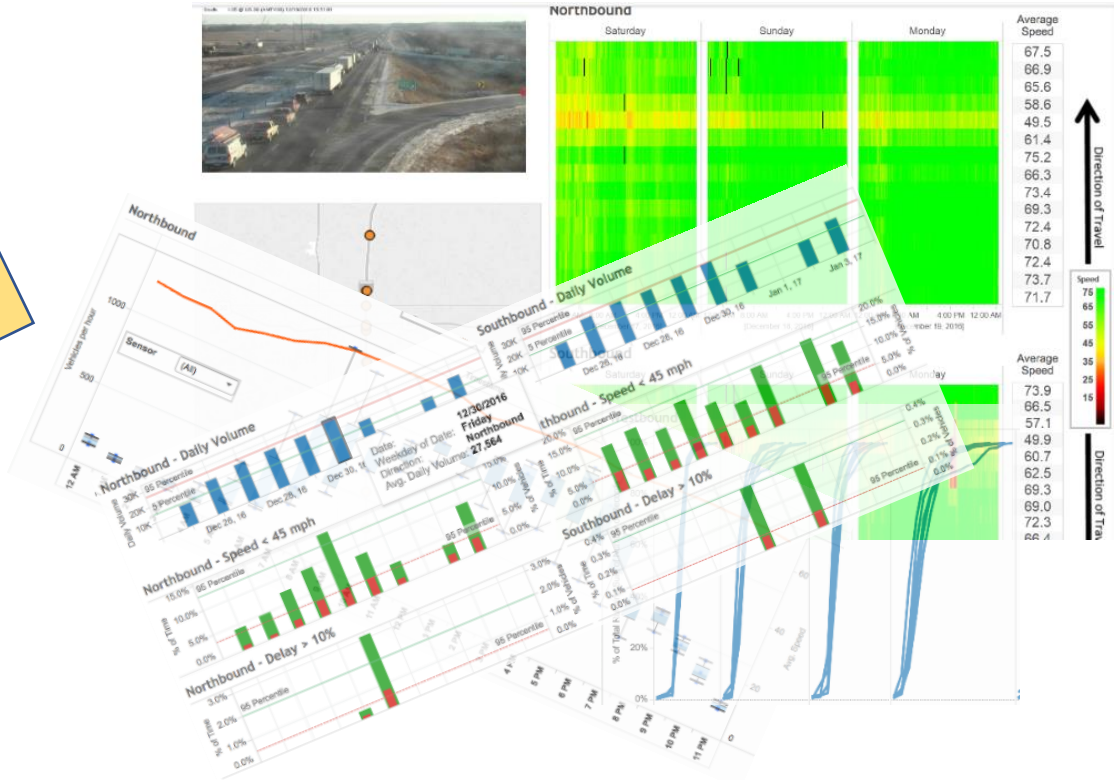


Goal:

Accessible timely data and information for critical decisions

Turning data…

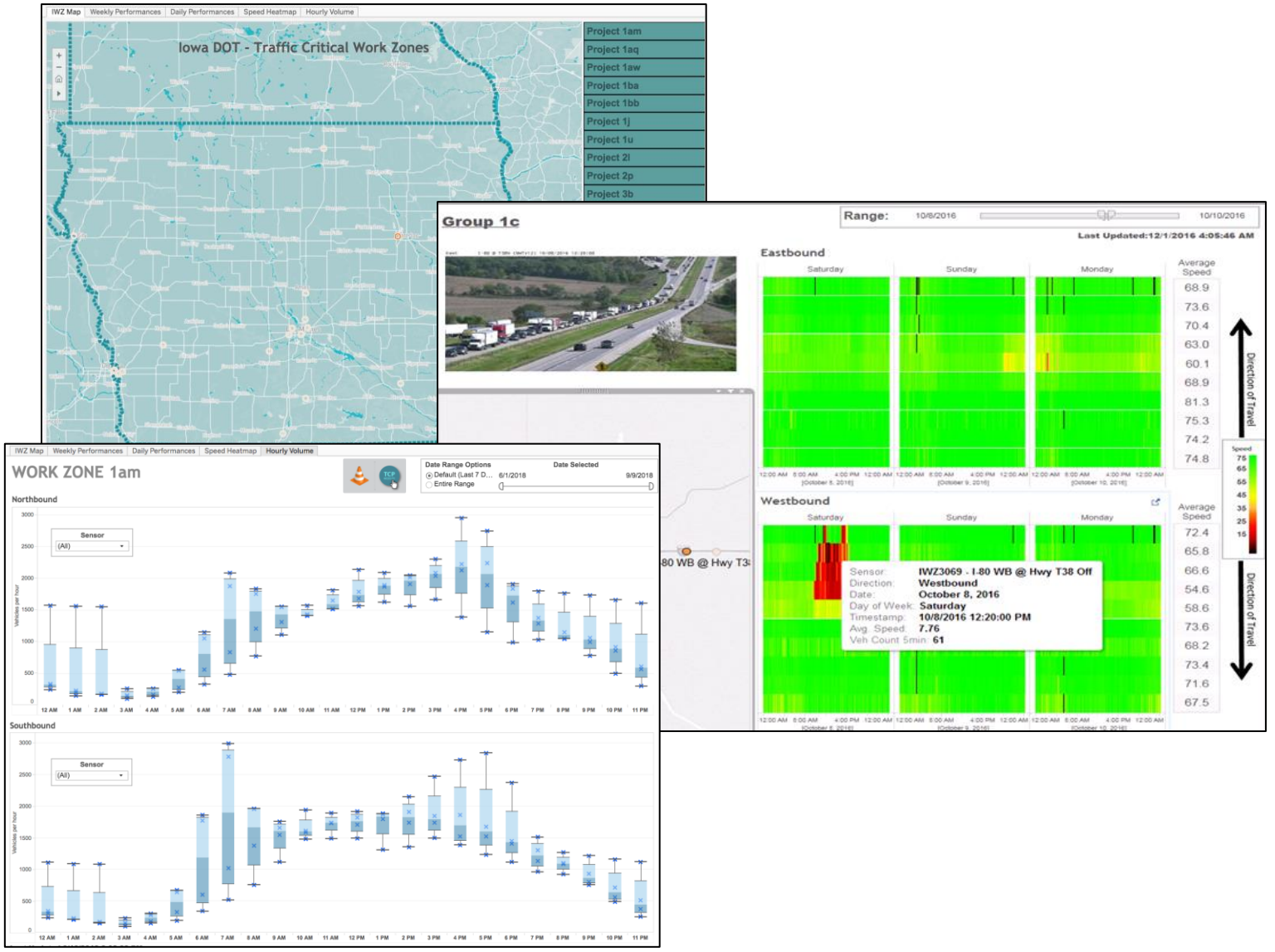




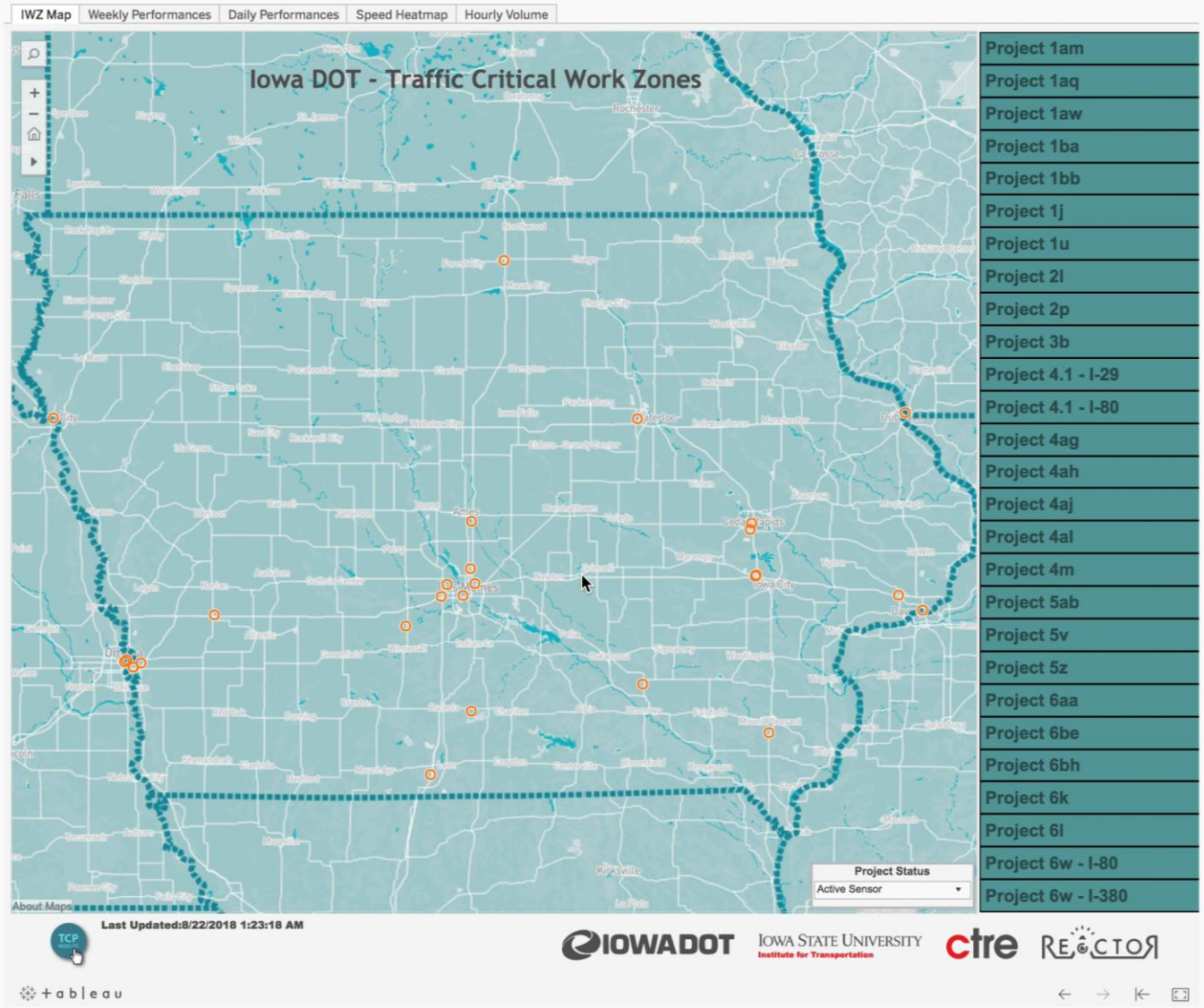
…into decisions

Web Based Visualization Tool

- Work Zone Map
- Weekly Performance
- Daily Performance
- Speed Heatmap
- Hourly Volume
- More added as needed



Work Zone Map



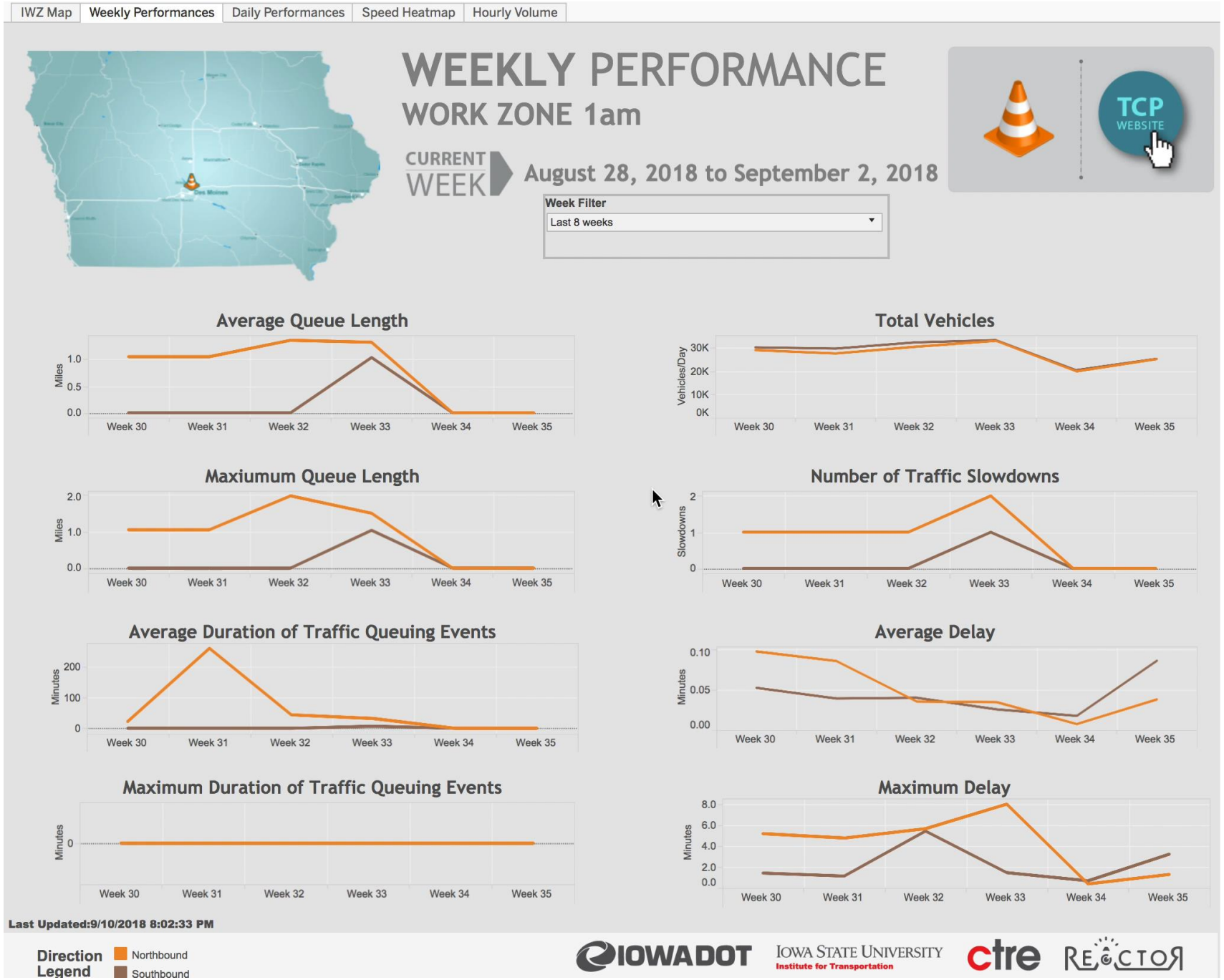
Interactive Tool

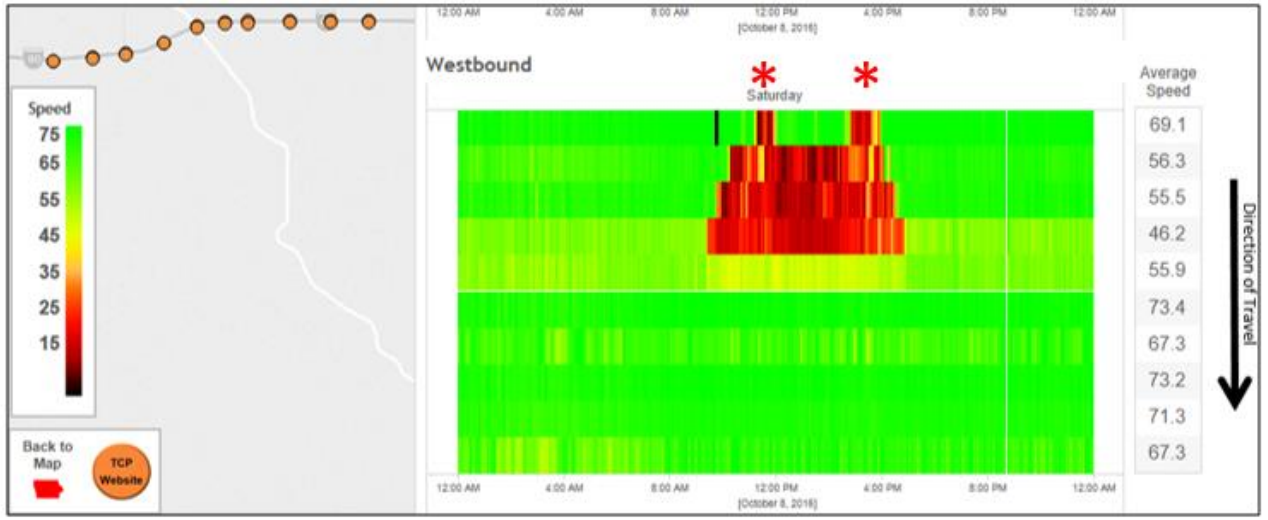
Overview of all Intelligent Work Zones across the state

Map shows location of all IWZ work zones

List on the side shows the project TCP number. Hovering over the project number will highlight the project on the map (see next slide)

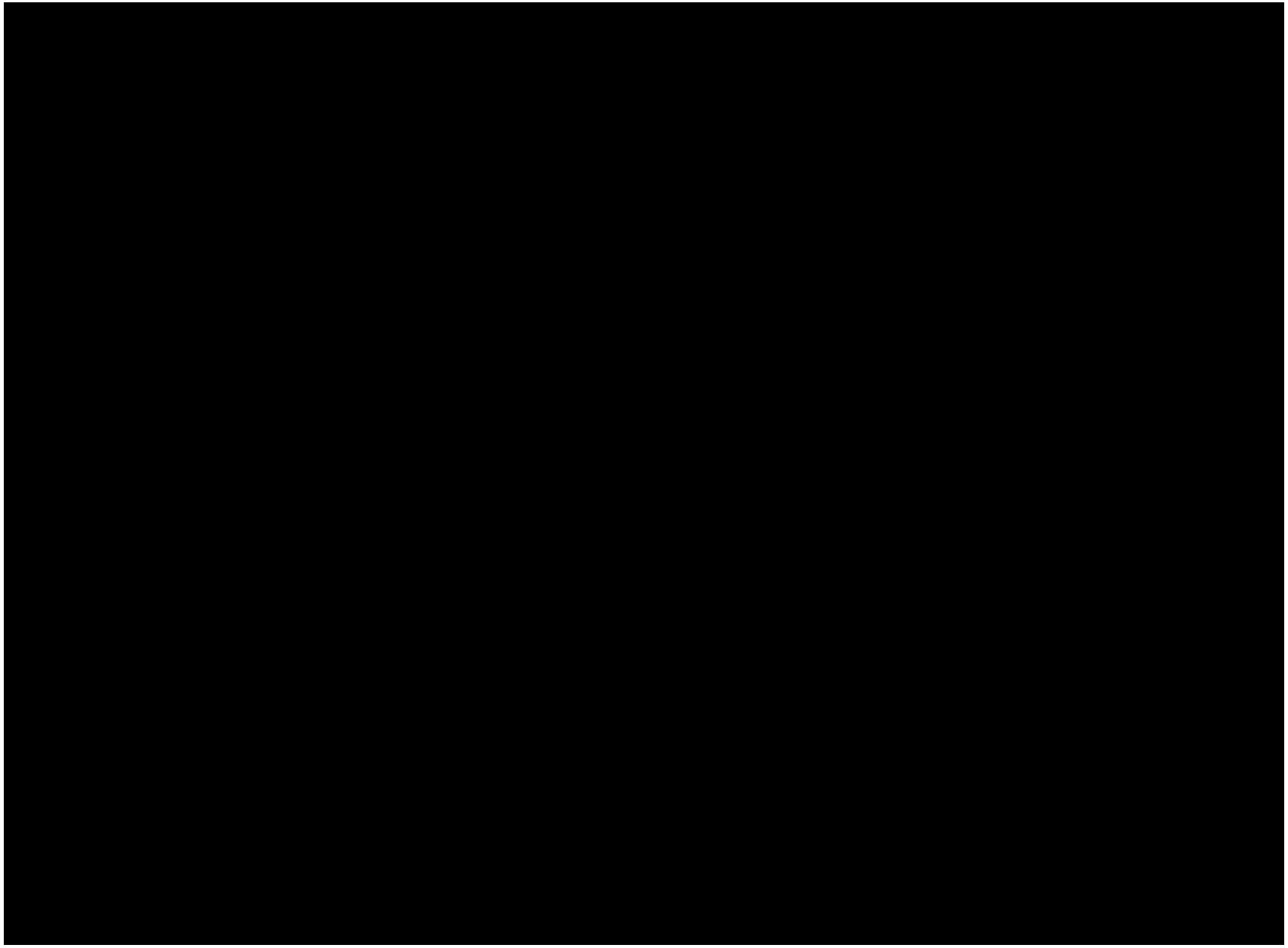
Weekly and Daily Performance



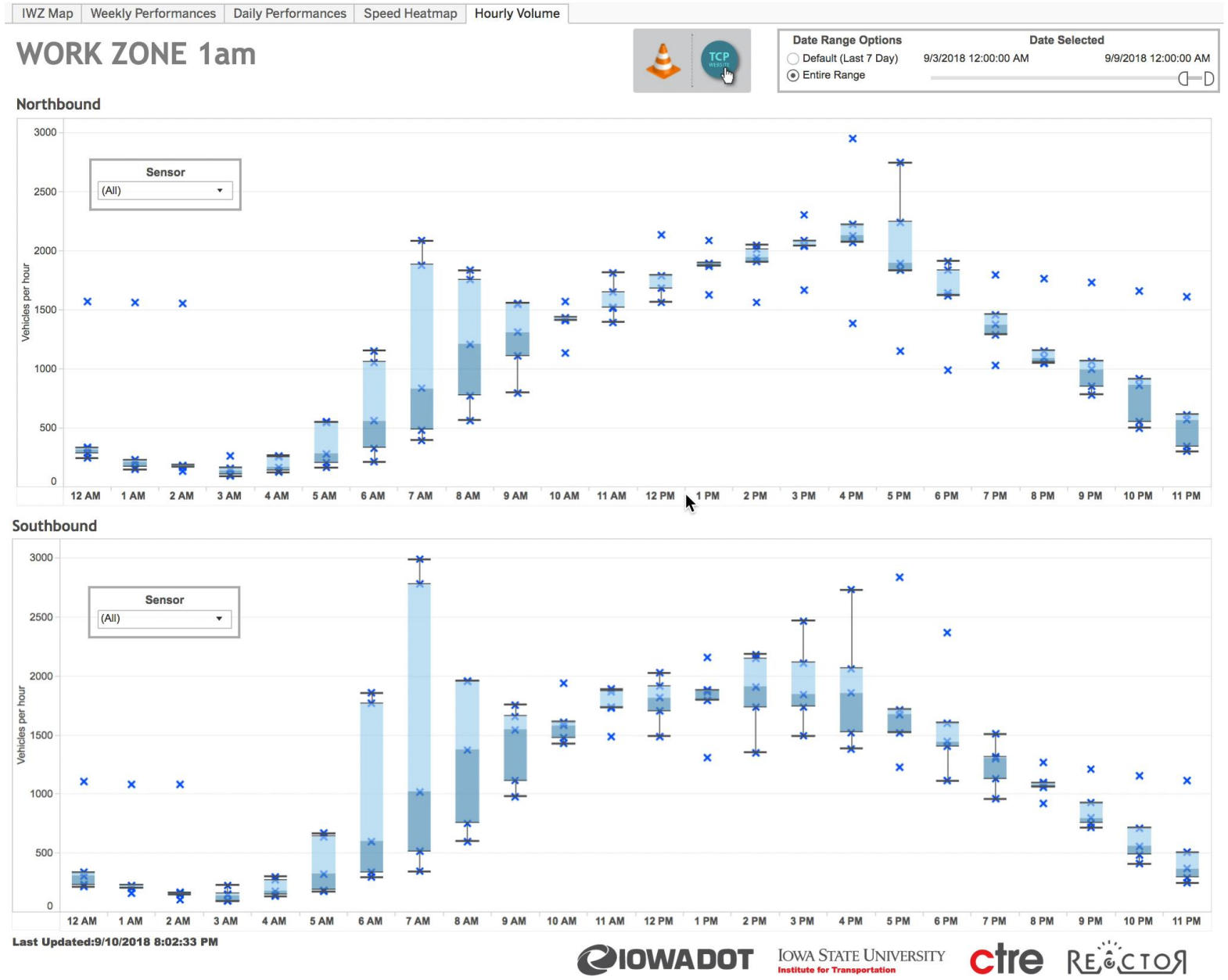


*The queue exceeded the farthest traffic sensor (around 3.7 miles) twice. From 11:10 am to 11:55am and from 2:45pm to 3:55pm.

Speed Heatmaps



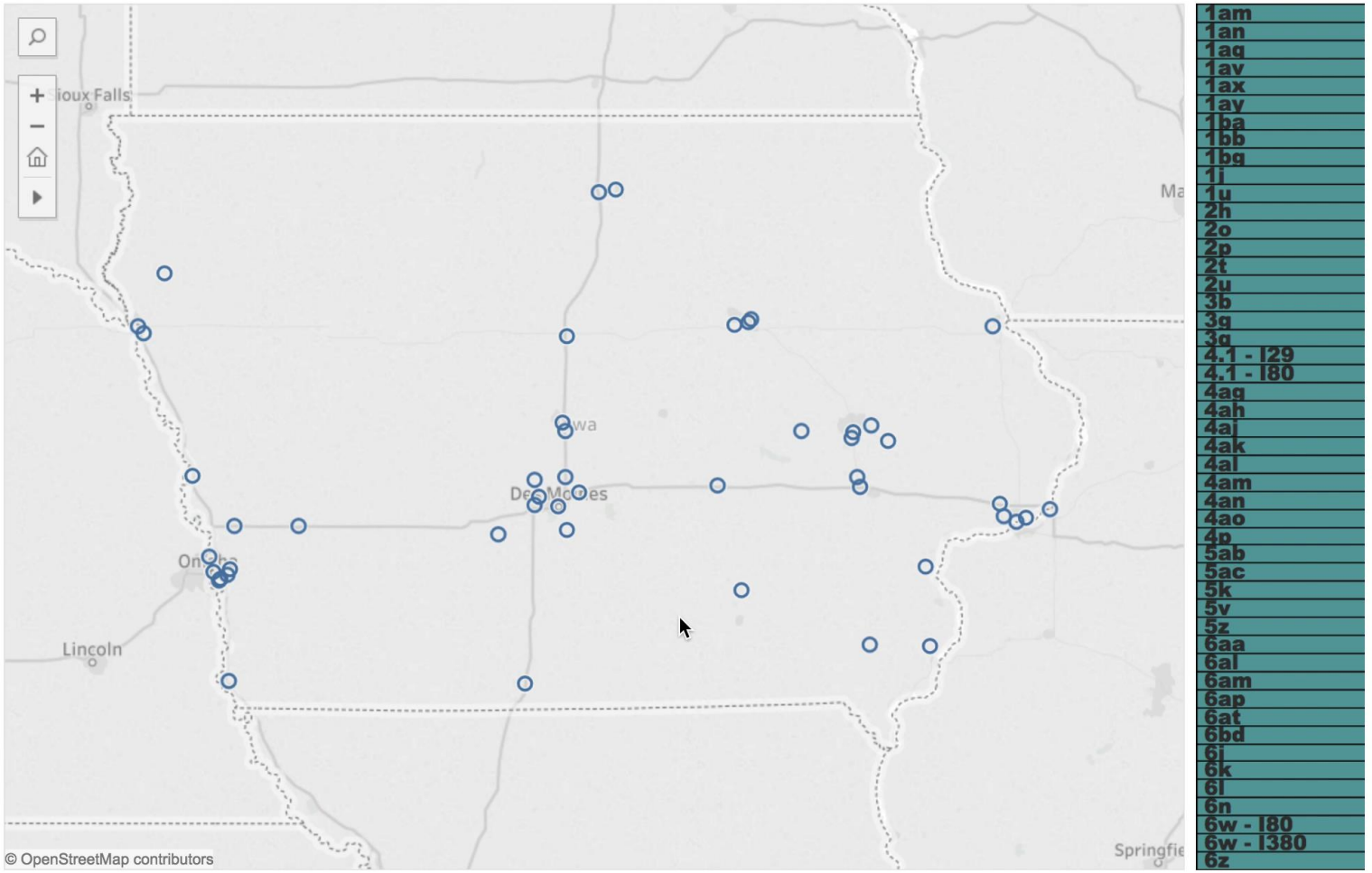
Hourly Volume



Work Zone Crash Performance

Work Zone Locations | Damage/Severity | Time | Roadway Conditions | Driver Information | Work Zone Related | Crash Map

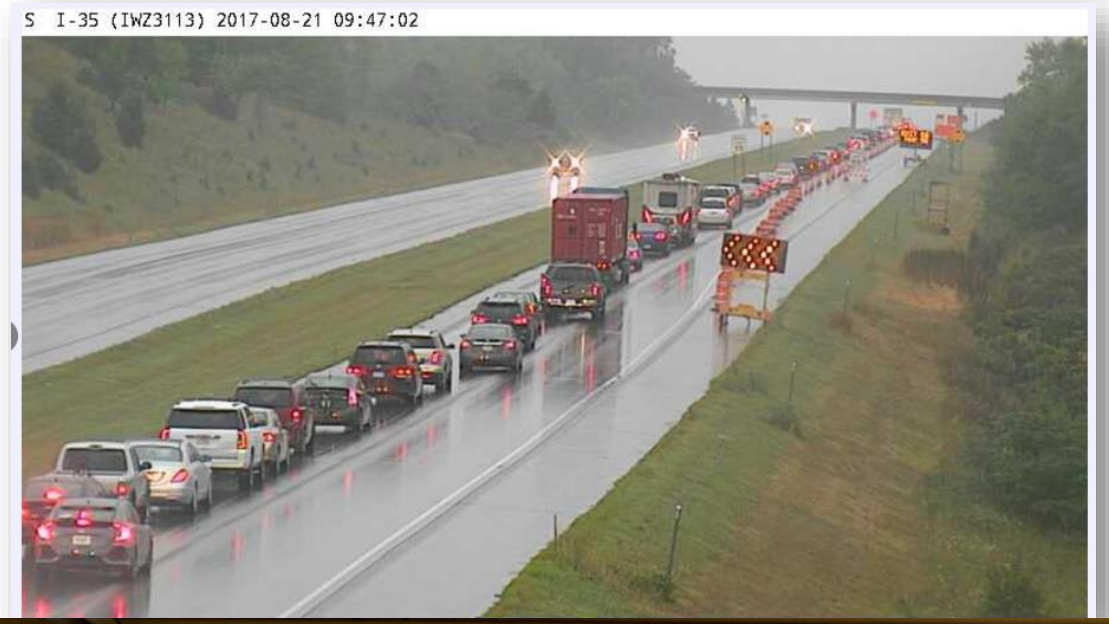
Work Zone Locations



Questions? Contact Skylar Knickerbocker (Institute for Transportation)
sknick@iastate.edu, 515-294-2238

IOWA DOT | IOWA STATE UNIVERSITY Institute for Transportation | ctre | REACTOR

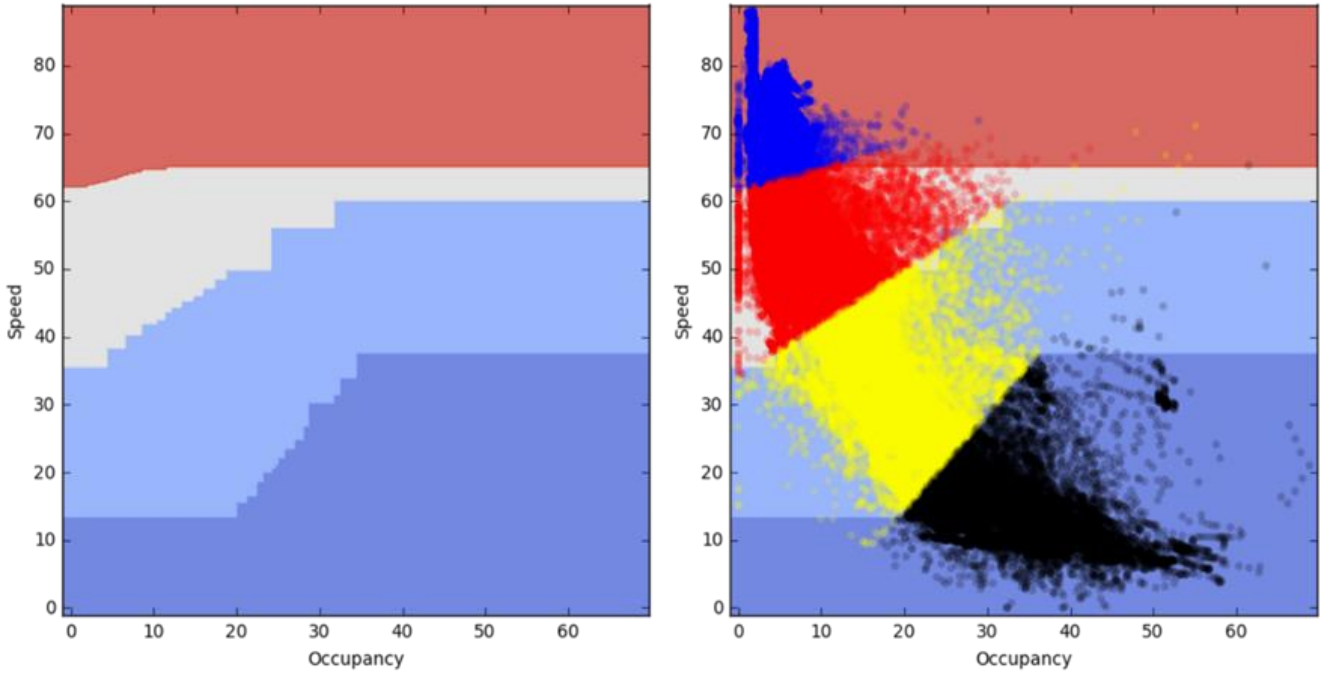
Alerting


S I-35 (IWZ3113) 2017-08-21 09:47:02


TRAFFIC MANAGEMENT CENTER
Council Bluffs I-80
Council Bluffs I-29
Des Moines I-235
Des Moines I-80/35
Des Moines I-35
Cedar Rapids I-380
Iowa City I-380/US 218
Iowa City I-80
Waterloo I-380/US 20
Waterloo US 218
Cedar Rapids IA 100
Quad Cities I-80/I-280

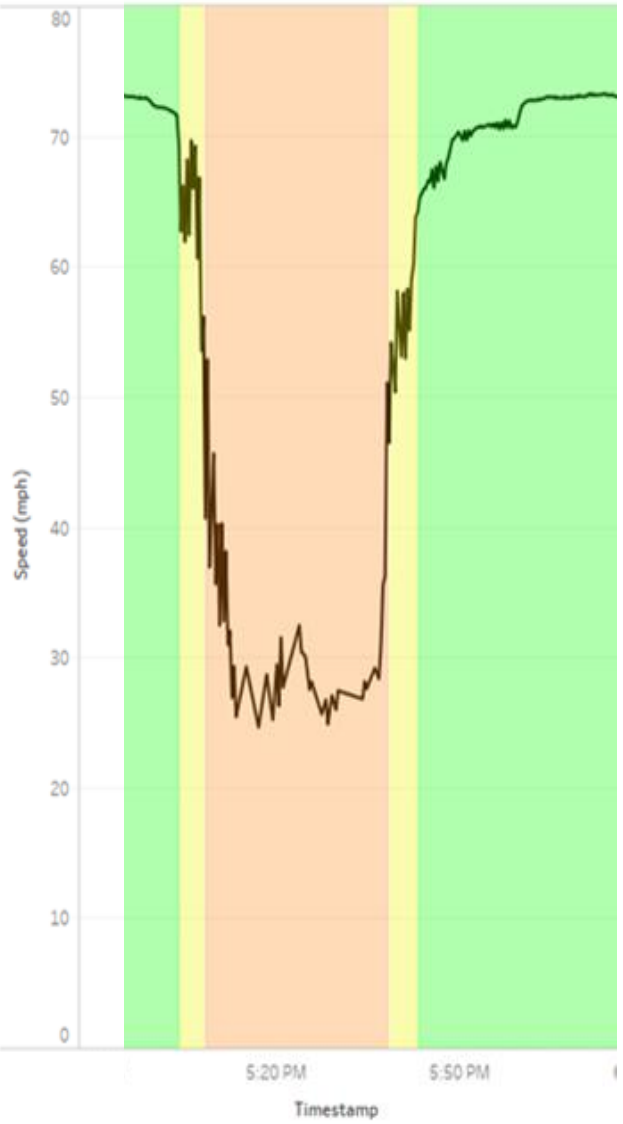
Alerting

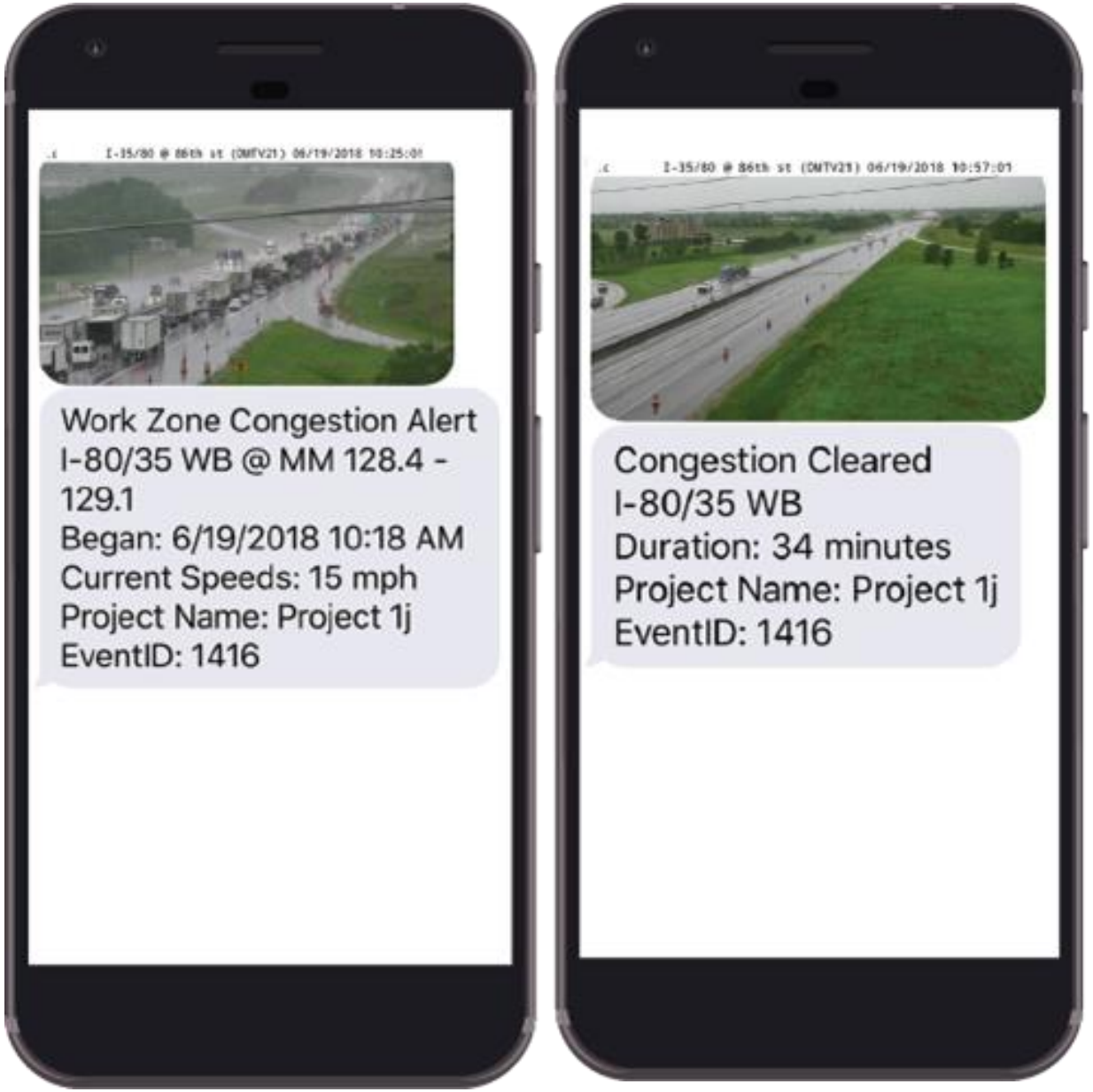
- **Machine Learning Decision Boundaries** to identify slow and stopped conditions
- Alert DOT for significant events and minimize false calls



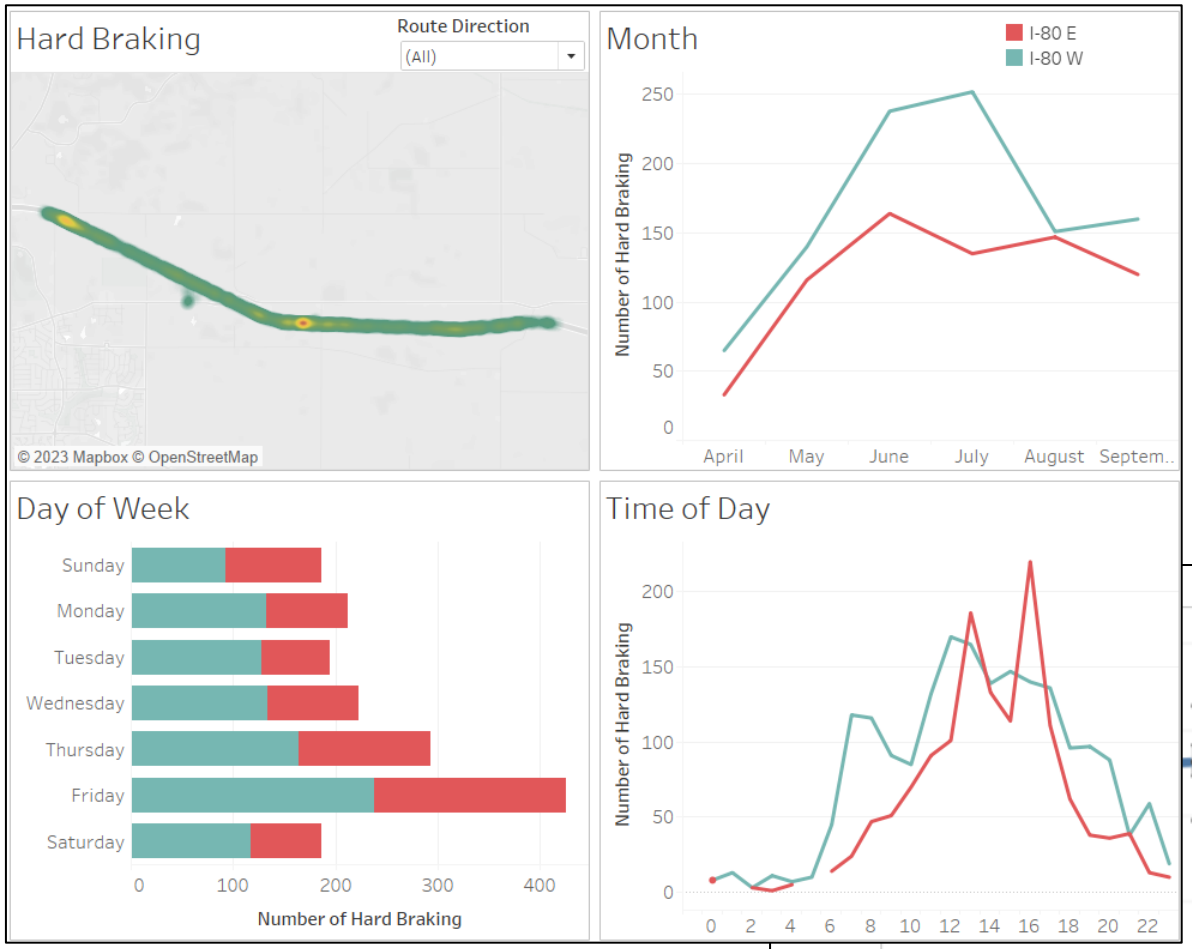
- Normal
- Slow Traffic Ahead
- Stopped Traffic Ahead

Alerting-Mobile

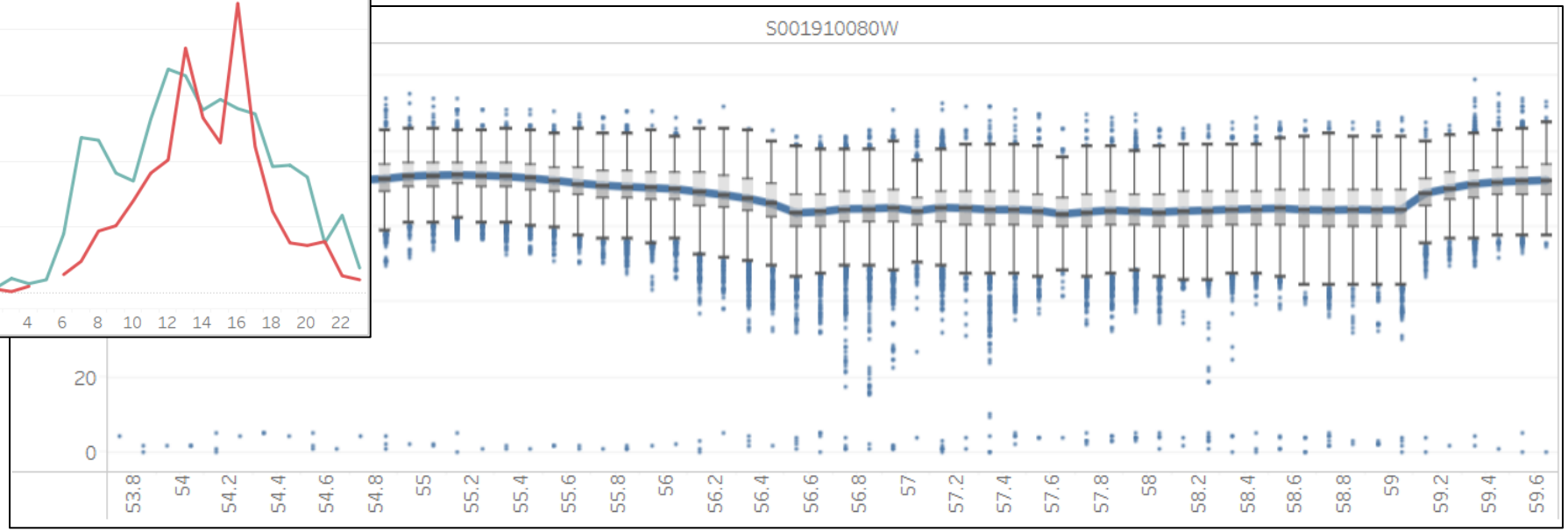




Next Steps – Connected Vehicle Data

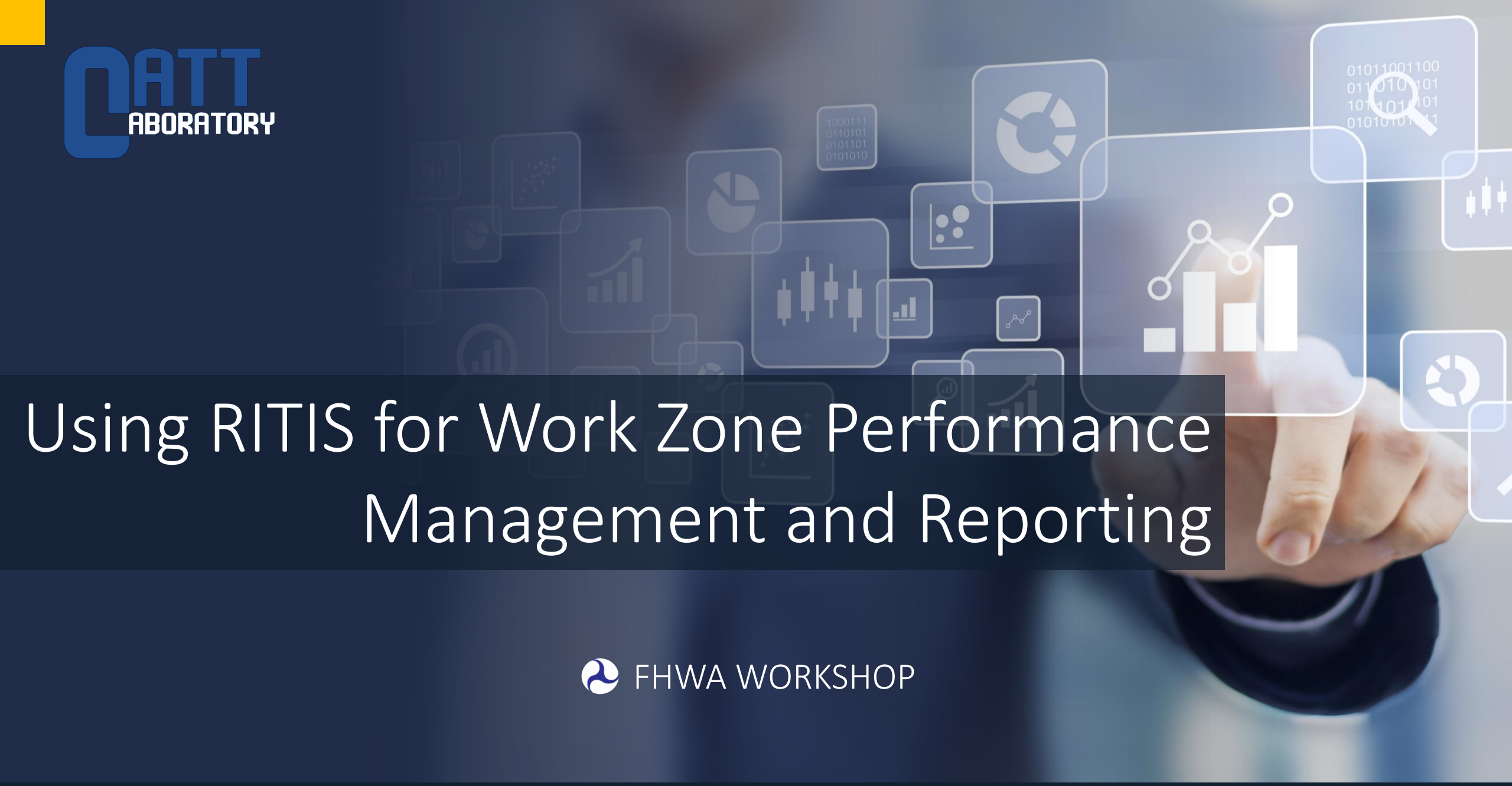


Hard Braking and Trajectory Data



Iowa DOTs Traffic Critical Project (TCP) Performance Monitoring

Skylar Knickerbocker



Using RITIS for Work Zone Performance Management and Reporting

FHWA WORKSHOP

Coverage Areas for Today

Work Zone Performance Monitoring

Causes of Congestion Graphs

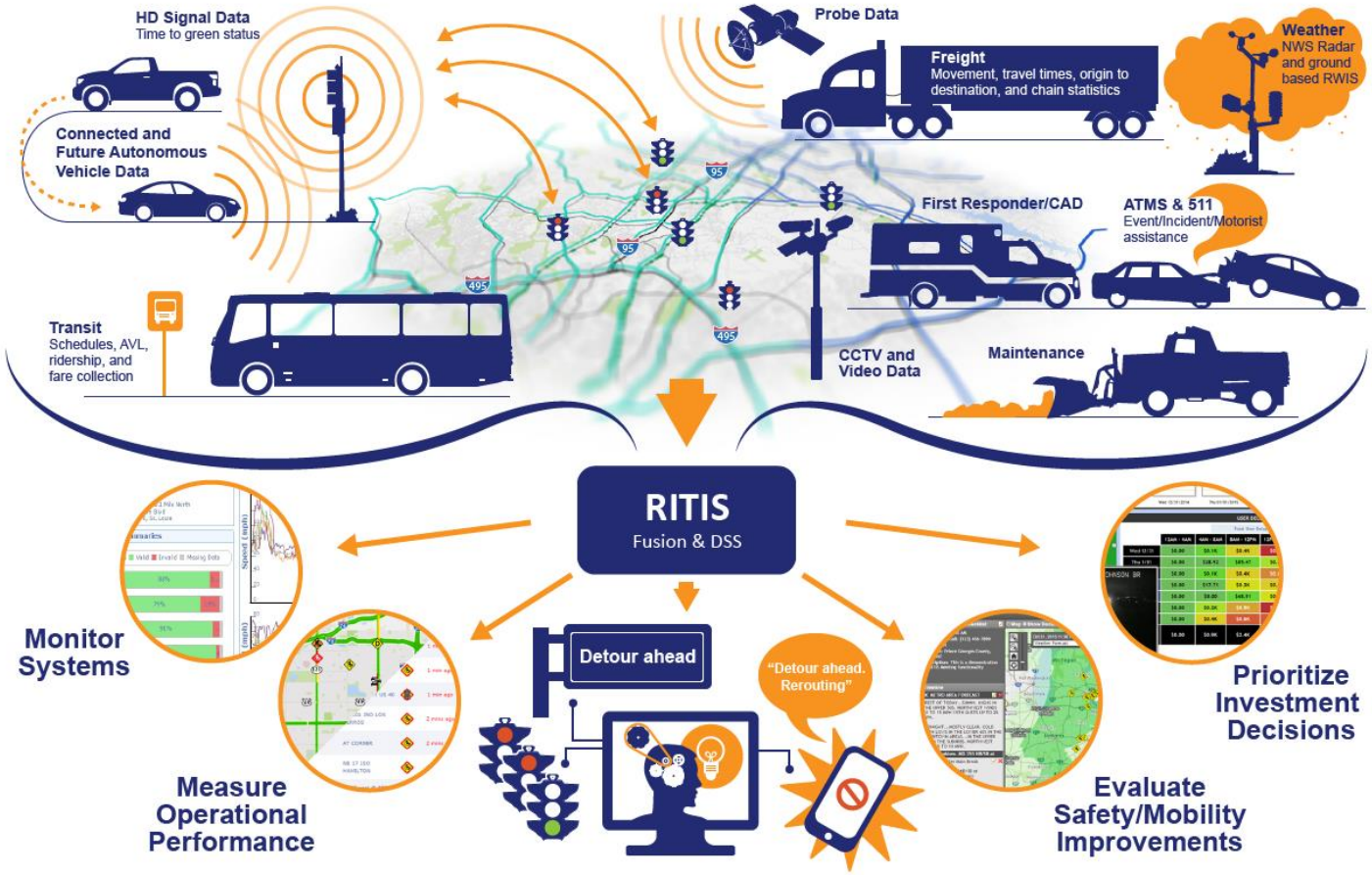
RITIS Performance Reporting

RITIS - the Regional Integrated Transportation Information System - is:

- A big data aggregation and dissemination platform
- Used for situational awareness, data archiving and deep-dive analysis
- Has over 10,000 users in 45 states

A **RITIS User Group** was formed to:

- Share best practices
- Learn about the latest features
- Suggest improvements



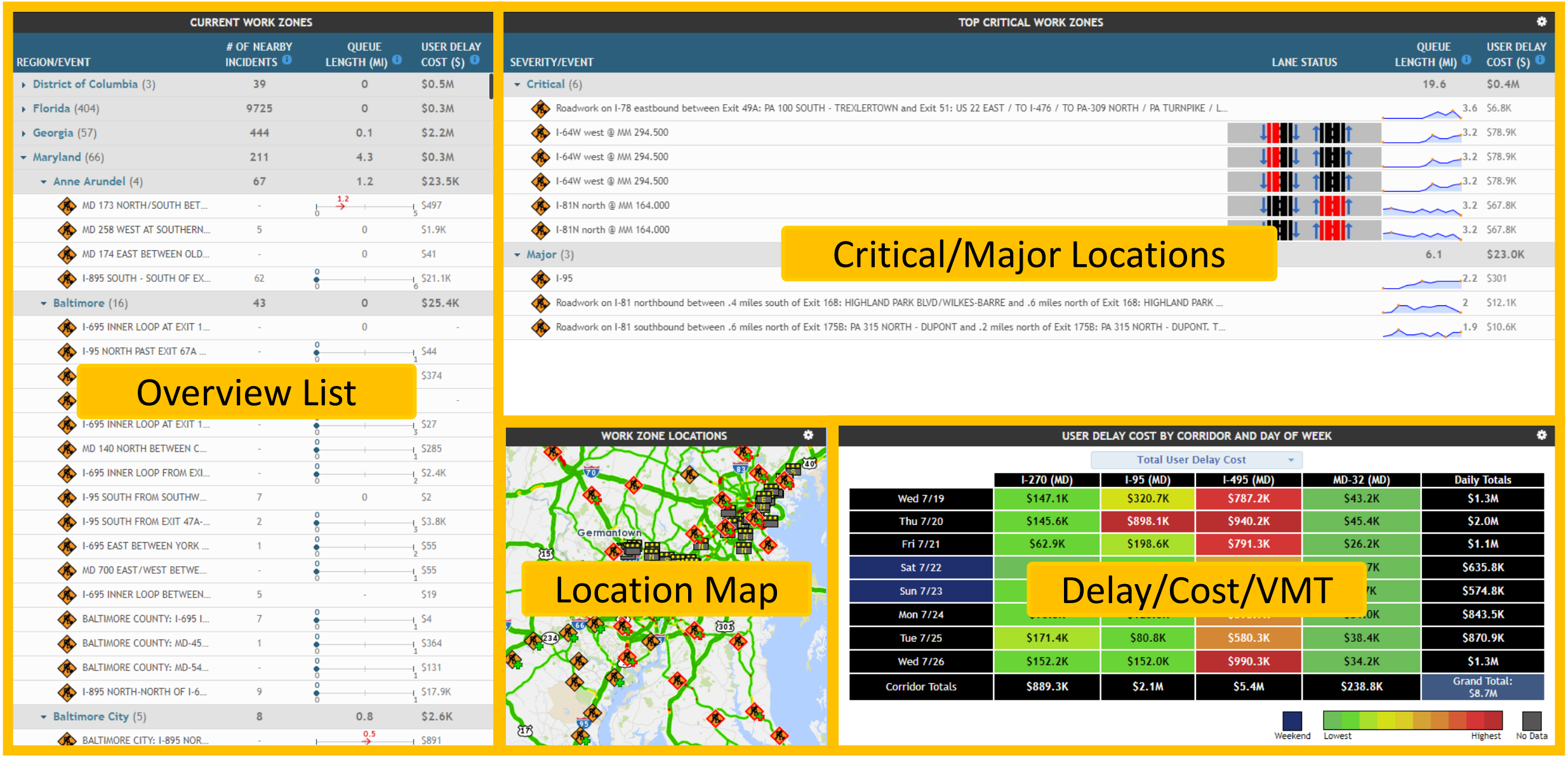
Click here to get information from past RITIS User Group meetings

Click here to learn more about RITIS

What is the Work Zone Performance Monitoring Application?

- WZPMA is a *real-time* performance monitoring tool for work zones
- It offers a simple, effective and systematic approach to assessing and managing work zone impacts of roadway projects
- It uses vehicle probe data and active work zone information

Work Zone Dashboard provides a comprehensive overview of your state's work zones



Individual Work Zone Profile provides individual work zone performance detail

Planned Closure @ I-695 INNER LOOP BETWEEN EXIT 12 MD 372 WILKENS AVE AND EXIT 13 MD 144 FREDERICK RD

Started: Thu, Apr 24, 2014 at 09:24:56 AM

SETTINGS

Data Type...
- Measured Speeds
- Comparison to Historical Average

Show...
- Work Zone Bounds
- Posted Speeds
- Associated DMS
- Nearby Cameras
- Nearby Incidents
- Lane Status
- Bottlenecks (when available)

5 miles upstream
5 miles downstream

Permit Information
Project Information
Site Details

Configure Alerts

Settings

CURRENT CONDITIONS

↓ INNER LOOP ↓ ↑ OUTER LOOP

Road

TRAVEL TIME THROUGH WORKZONE ONLY

Travel Time | Through the Work Zone | Filter Results

Queue Length
Travel Time
Speed

Performance Charts

WORK ZONE LOCATION

Map

USER DELAY COST

Total User Delay Cost

	12AM - 4AM	4AM - 8AM	8PM - 12AM	12PM - 4PM	4PM - 8PM	8PM - 12AM	Daily Totals
Thu 4/17/2014	$11.52	$183.00	$9,306.97	$16,405.23	$2,958.90	$67.58	$28,933.20
Fri 4/18/2014	$6.17	$29.46	$82.00	$221.35	$127.06	$50.00	$516.04
Sat 4/19/2014	$27.17	$7.65			$17.28	$46.01	$123.66
Sun 4/20/2014	$39.81	$24.66			$26.78	$18.42	$115.80
Mon 4/21/2014	$2.46	$48.75	$788.33	$103.20	$899.54	$131.35	$1,973.63
Tue 4/22/2014	$25.38	$264.46	$1,819.65	$8,771.39	$2,675.70	$189.00	$13,745.58
Wed 4/23/2014	$20.52	$477.24	$12,525.82	$13,993.07	$16,213.27	$80.23	$43,310.14
Hourly Totals	$133.04	$1,035.22	$24,525.89	$39,522.78	$22,918.53	$582.59	Grand Total: $88,718.06

Weekend | Lowest | Highest | No Data

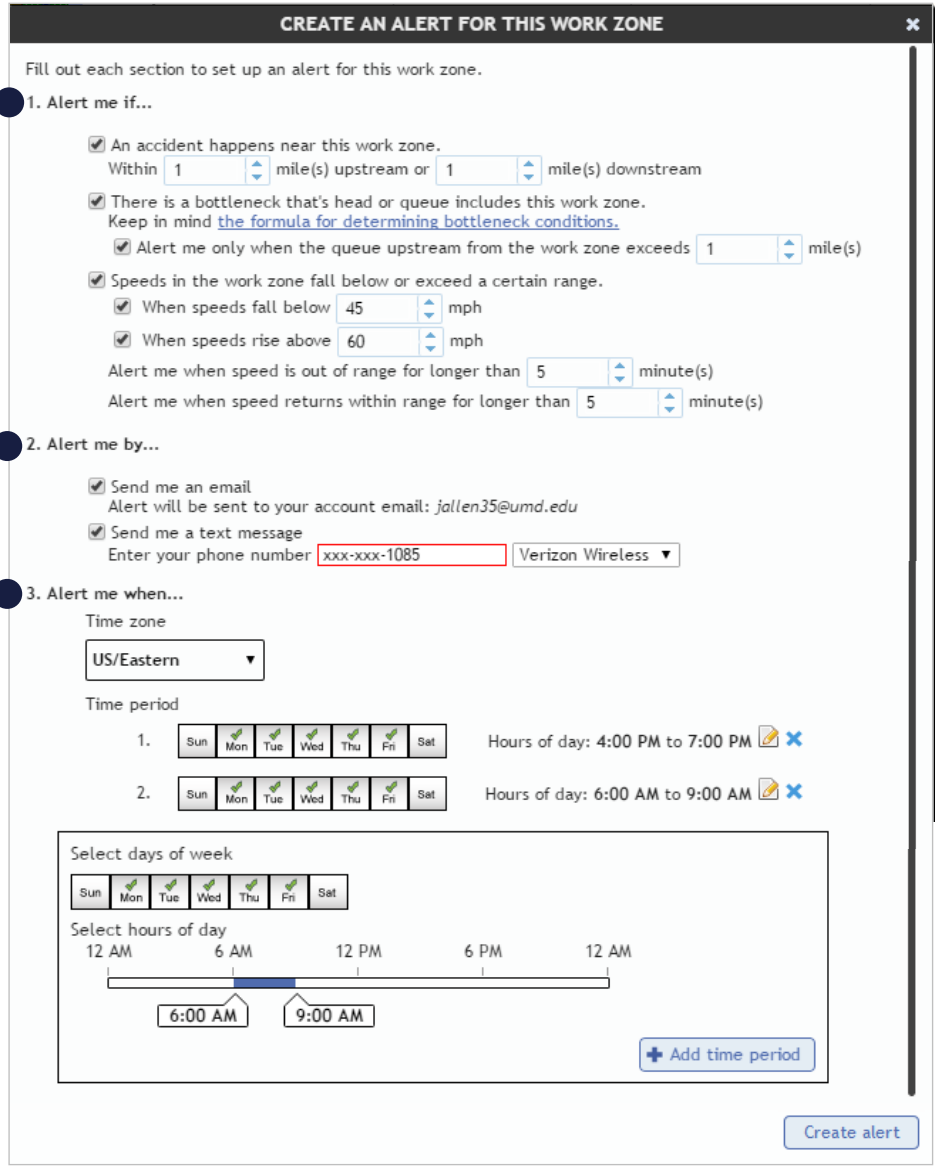
Delay/Cost/VMT

Work Zone Alerts gives you maximum flexibility in setting up personalized alerts

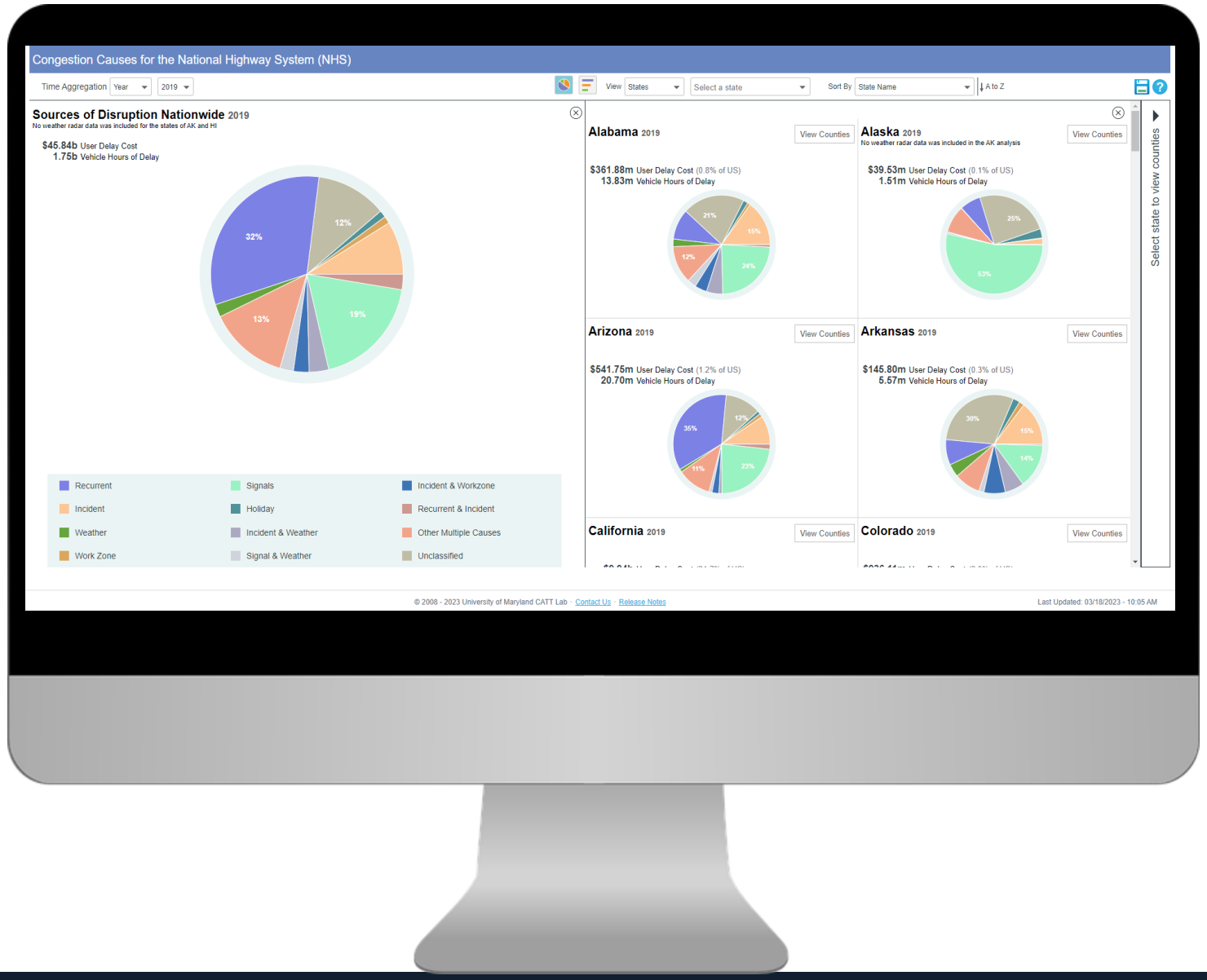
1. Event conditions

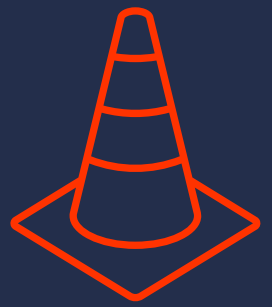
2. Alert notification type

3. Alert timeframe



Causes of Congestion Graphs live demo





Work Zone Performance Reporting

Work Zone Reporting Templates • Automated Work Zone Reporting

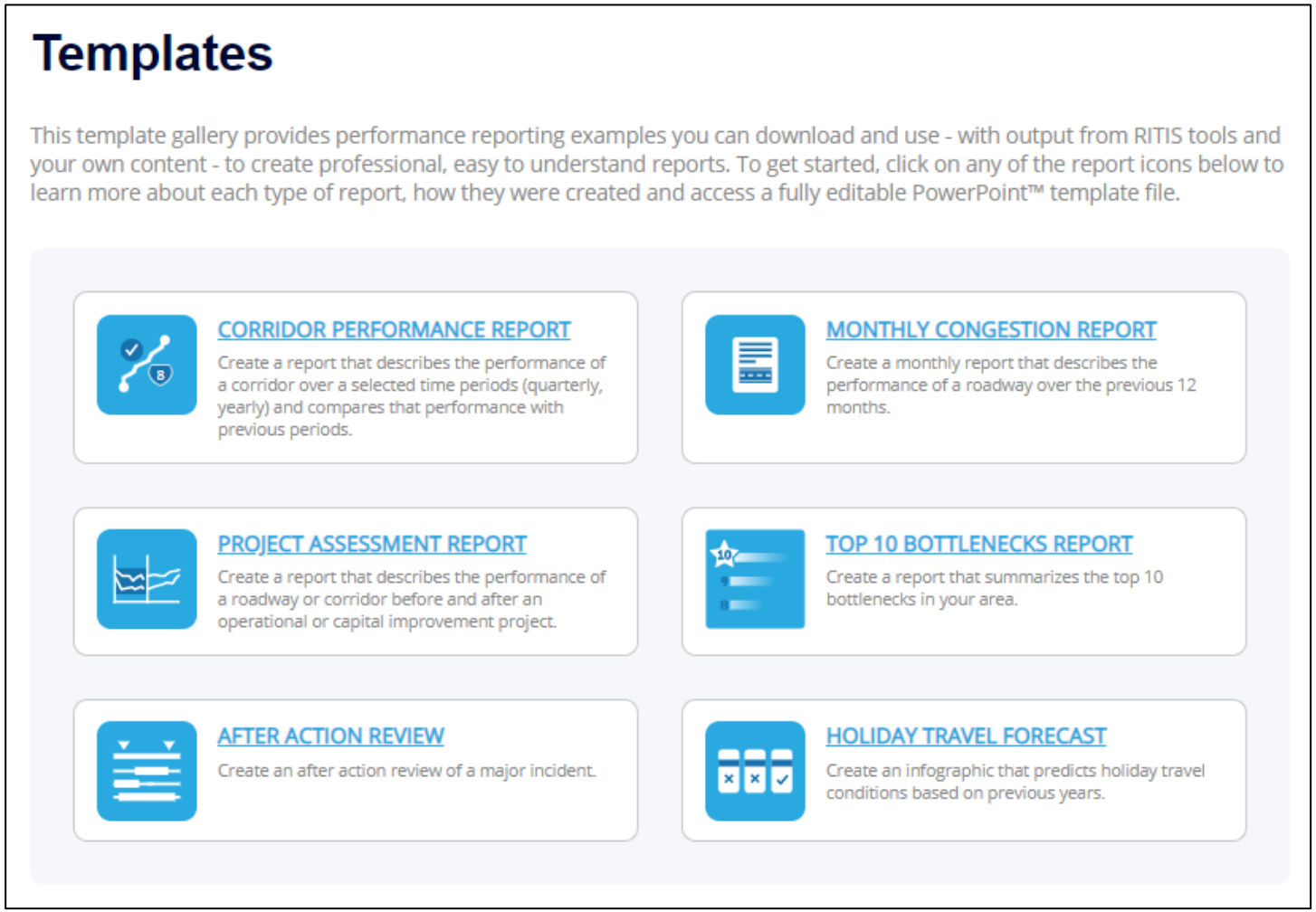
RITIS Performance Reporting Templates

The RITIS Templates page – spearheaded by the RITIS Performance Reporting Working Group – provides a gallery of performance reporting packages for a variety of agency applications.

Each report package contains:

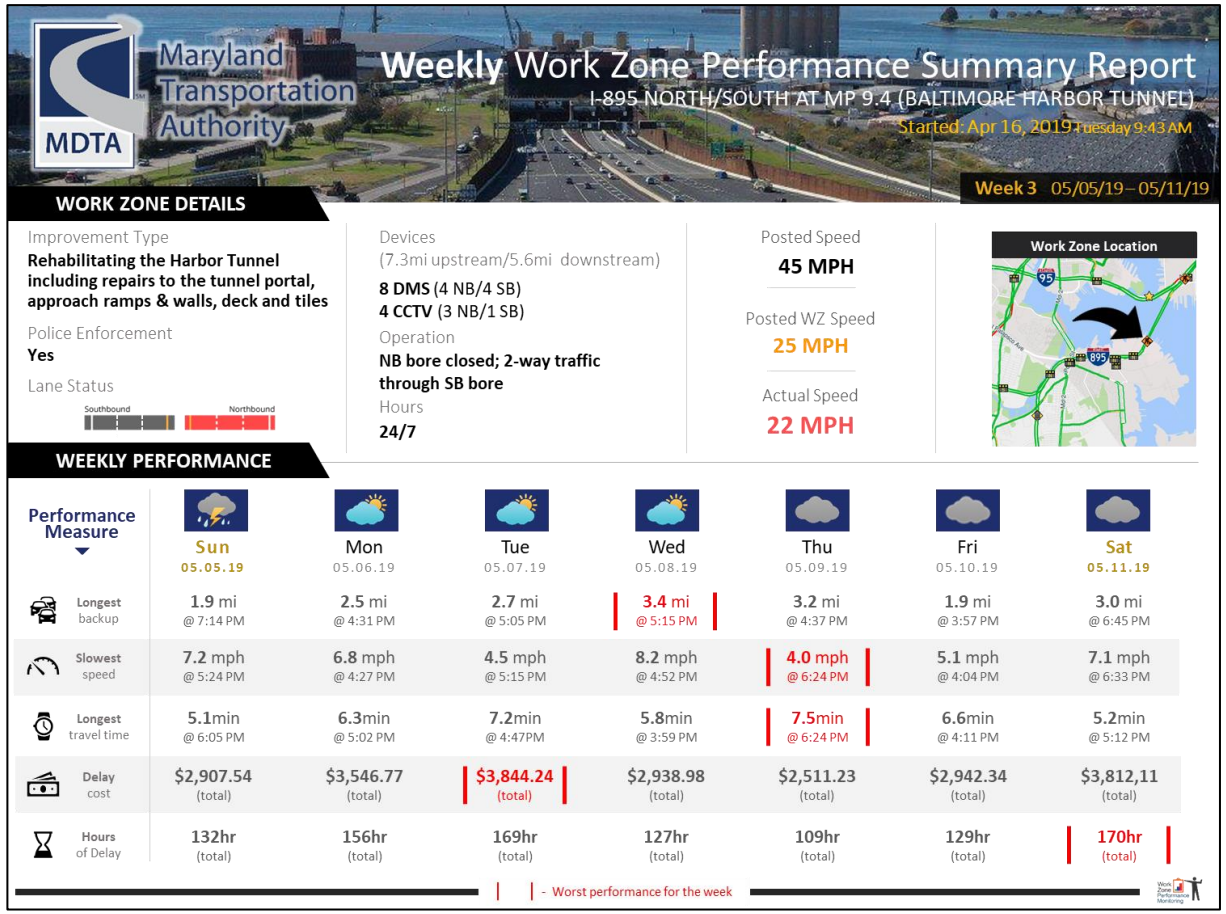
- A base template
- Design resources
- Agency use case examples
- Links to video tutorials of RITIS tools
- Design recommendations
- A step-by-step how-to guide

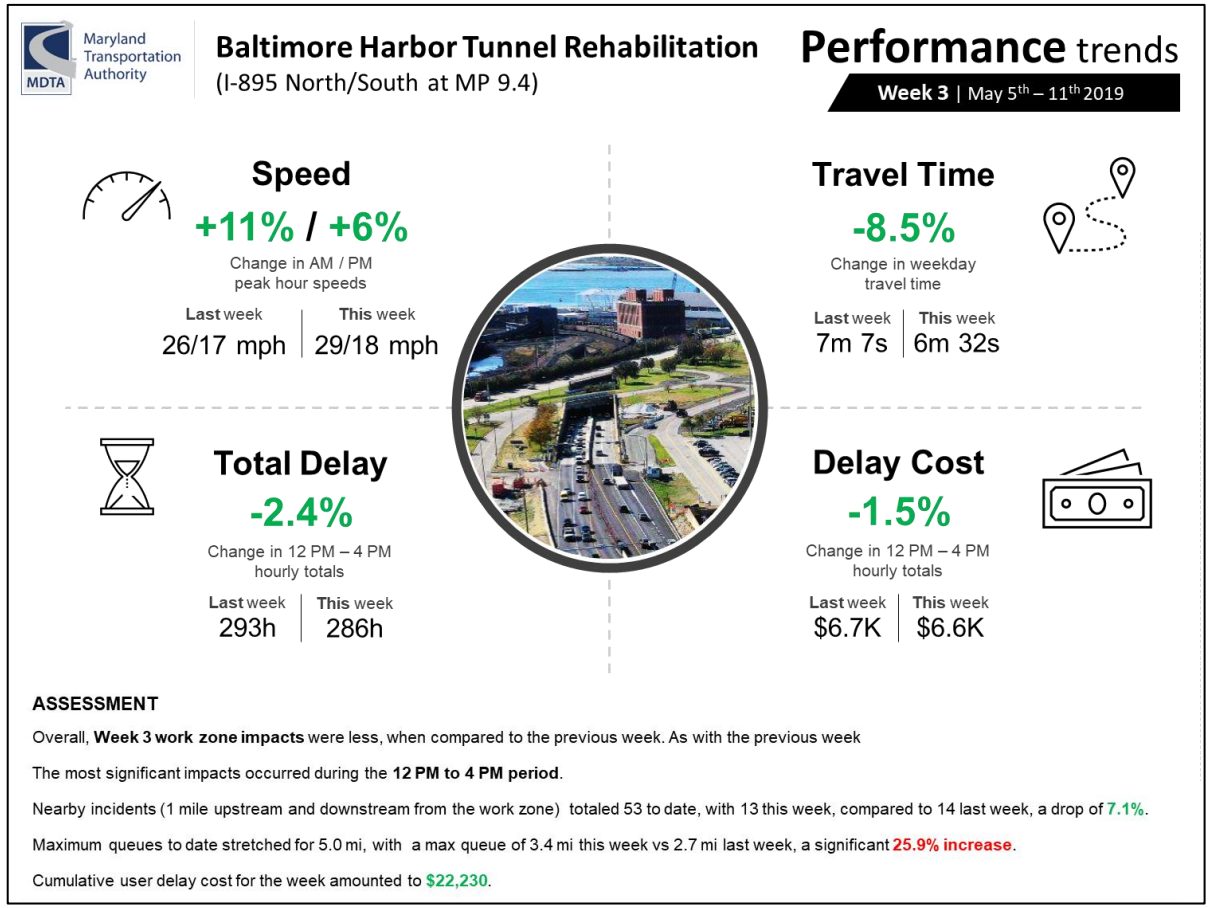
We're continually updating the gallery with new reporting packages and additional use case layouts.



RITIS Work Zone Reporting Templates

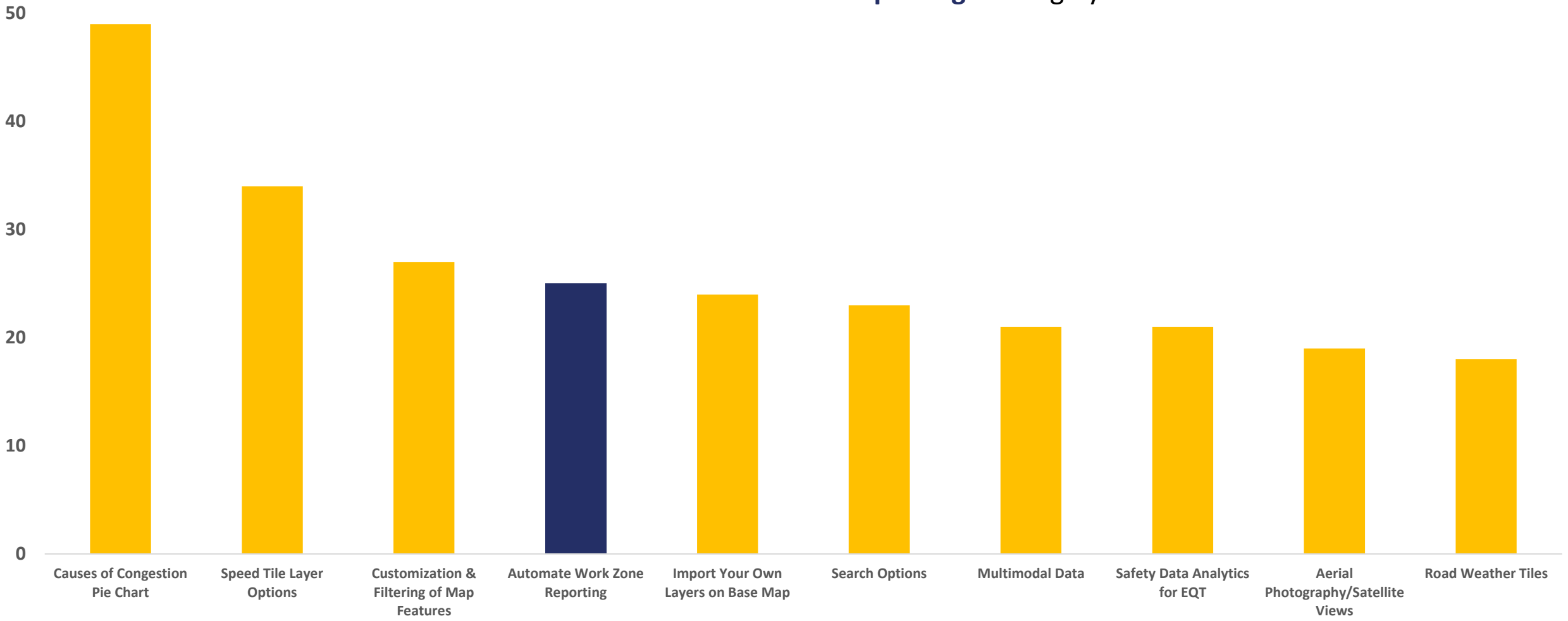
The RITIS Performance Reporting Working Group will be developing Work Zone reporting products as our next task





Top 10 **RITIS** Priorities (from a RITIS User Group survey)

The RITIS Enhancement Working Group – a pooled fund-like group formed to fund RITIS enhancements – sees **Automated Work Zone Reporting** as a highly-desired feature.

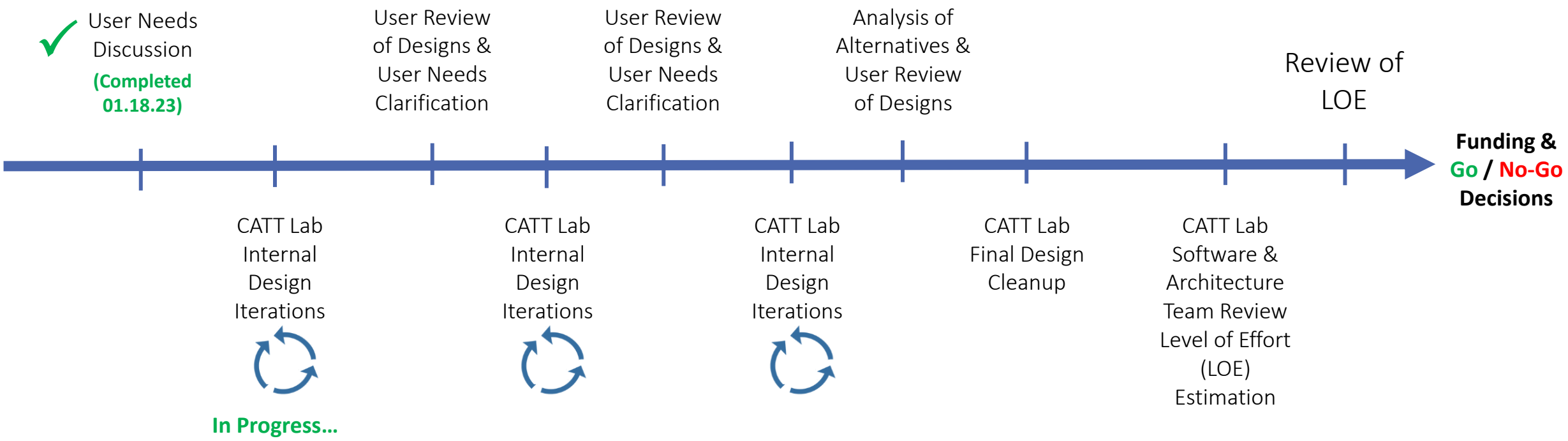


Automated Work Zone Reporting

IN PROGRESS

We've kicked off the scoping study design process w/partners from the **RITIS Enhancement Working Group** to determine the Level of Effort for AWZR:

Scoping Study Design Process



Work Zone Reporting Categories/Elements

Here are some early-on report categories & elements under consideration for both template and auto reporting:

Work Zone Profile

- **Location (Map)** in relation to the city and DMS used to message the work zone + detour routes
- **Spatial length** of the work zone
- **Duration** of the work zone (operating hours)
- **Work type** (repaving, guard rail repair, etc.)
- **Lanes** impacted
- **Types of countermeasures** deployed (barrels, arrow board, police, HAAS, etc.)

Performance Measures

- **Hourly speeds, delay**
- **Maximum and average queue length; duration**
- **Maximum and average travel time/planning time index** through work zone compared to typical
- **Cost of congestion** compared to typical cost of congestion

Safety

- **Number and type of incidents/fatalities** within work zone
- **Number and type of incidents/fatalities** within queue (may not be possible)

Agency-added/Misc.

- **A block for a brief explanation** of key aspects (trends, operation, special event) of the work zone
- **Weather-related** information
- **Crash-related** information
- **Daily, Weekly, Monthly and/or Life of Work Zone** reporting periods

Thank you!

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Agency Efficiency

Why is it important to measure agencies' efficiency in implementing work zones?

- Transportation agencies invest considerable resources to design, plan, and implement work zones to improve motorist safety and access on their roadways.

- Evaluating and quantifying the efficiency of the work zone agencies in implementing the work zones in comparison to the agency goals and policies will enable the work zone agencies to gauge and drive investment decisions.

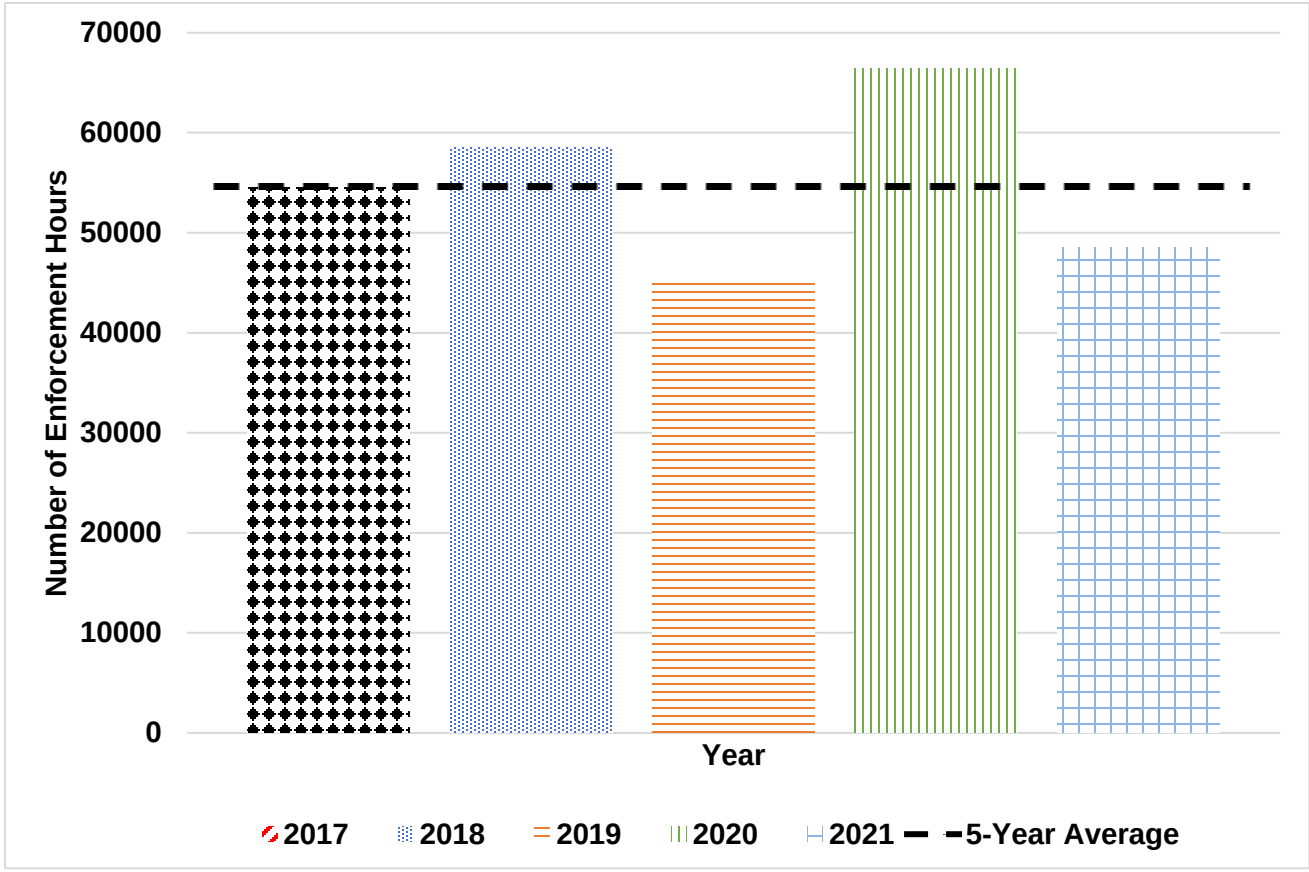
Agency Efficiency Performance Measurement Examples (slide 1/2)

Work Zone Traffic Control Strategy	Category	Interstate		U.S. and Iowa Route		County Road		City Road	
		2018	2019	2018	2019	2018	2019	2018	2019
Lane Closure	Ballasting	✓	✓	✓	✓	✓	✓	✓	✓
	Cleanliness	✓	✓	✓	✓	✓	✓	✓	✓
	Crashworthiness	✓	✓	✓	✓	✓	✓	✓	✓
	Sheeting		✓	✓	✓			✓	✓
	Positive Closure	✓							
	Location/Spacing	✓							
	General Condition		✓	✓			✓		
	Retroreflectivity			✓	✓	✓			
Dynamic Message Sign	Appropriate Messages						✓		
	Display		✓	✓	✓		✓	✓	✓
	Lateral Offset	✓	✓	✓	✓		✓	✓	✓
	Location	✓	✓	✓	✓		✓		
	Proper Operation		✓				✓	✓	✓
	Visibility	✓	✓	✓	✓		✓		
	Warranted	✓		✓	✓			✓	✓

Work zone traffic control strategies receiving an exceptional or acceptable rating for more than 75% of reviews

Source: Iowa Department of Transportation

Agency Efficiency Performance Measurement Examples (slide 2/2)

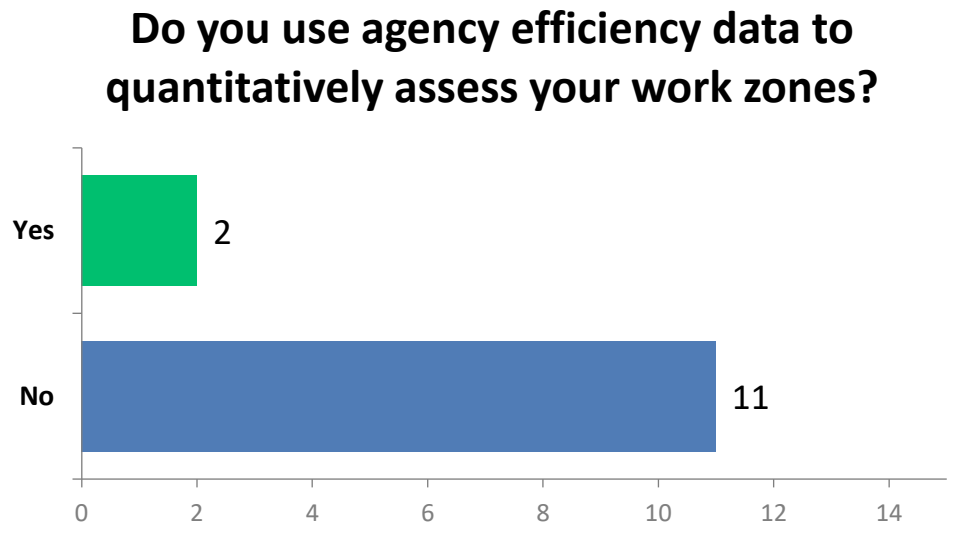


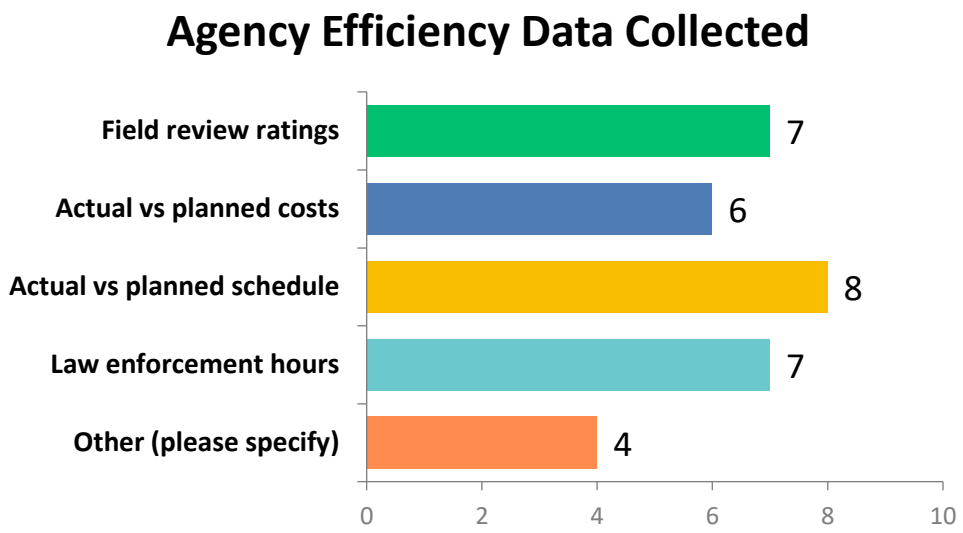
Number of enforcement hours in Illinois work zones
Source: Illinois Department of Transportation

Agency Efficiency

- Measures:
  - Work zone field review ratings (acceptable versus unacceptable)
  - Project completions on schedule
  - Project costs (actual versus planned)
  - Number of enforcement hours per work zone

Survey Responses: Agency Efficiency Performance Area (slide 1/2)





11 out of 13 respondents indicated that their agencies do not use agency efficiency data to quantitatively access work zones.

THANK YOU!

Questions?

Additional Resources

- **Federal Highway Administration Work Zone Management Program**
  - https://ops.fhwa.dot.gov/wz/

Contact Information

Jawad Paracha

FHWA Office of Operations

Work Zone Management Program

jawad.paracha@dot.gov