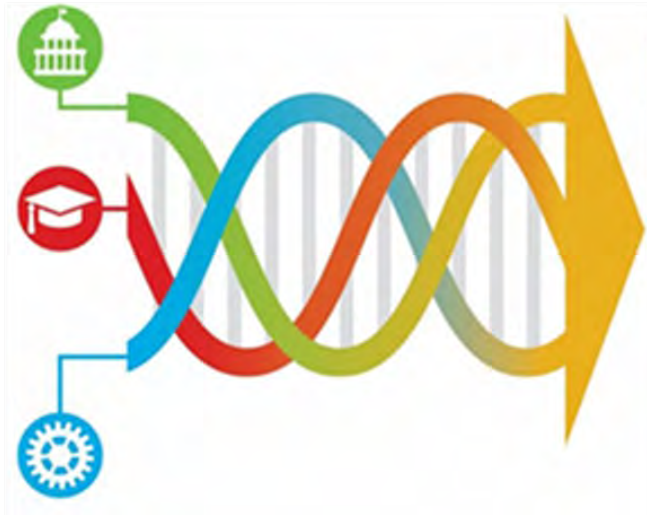


# Work Zone Monitoring: Hard Braking and Implementation

Government

Academia

Industry



## IMPACT

*Darcy Bullock*

*Purdue University*

[darcy@purdue.edu](mailto:darcy@purdue.edu)



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# Extended Team



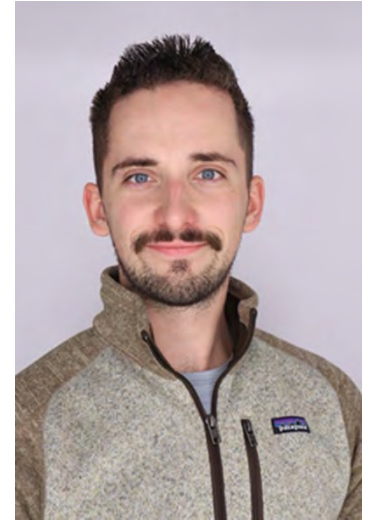
Darcy Bullock



Jairaj Desai



Rahul Sakhare



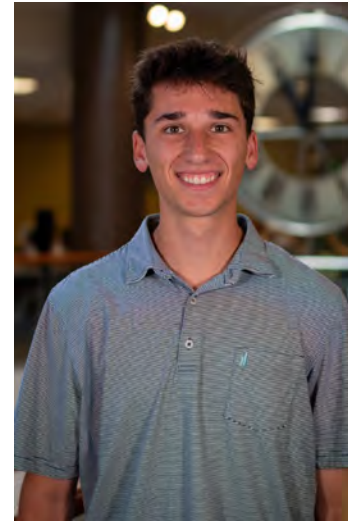
Myles Overall



Chris Gartner



Justin Mukai

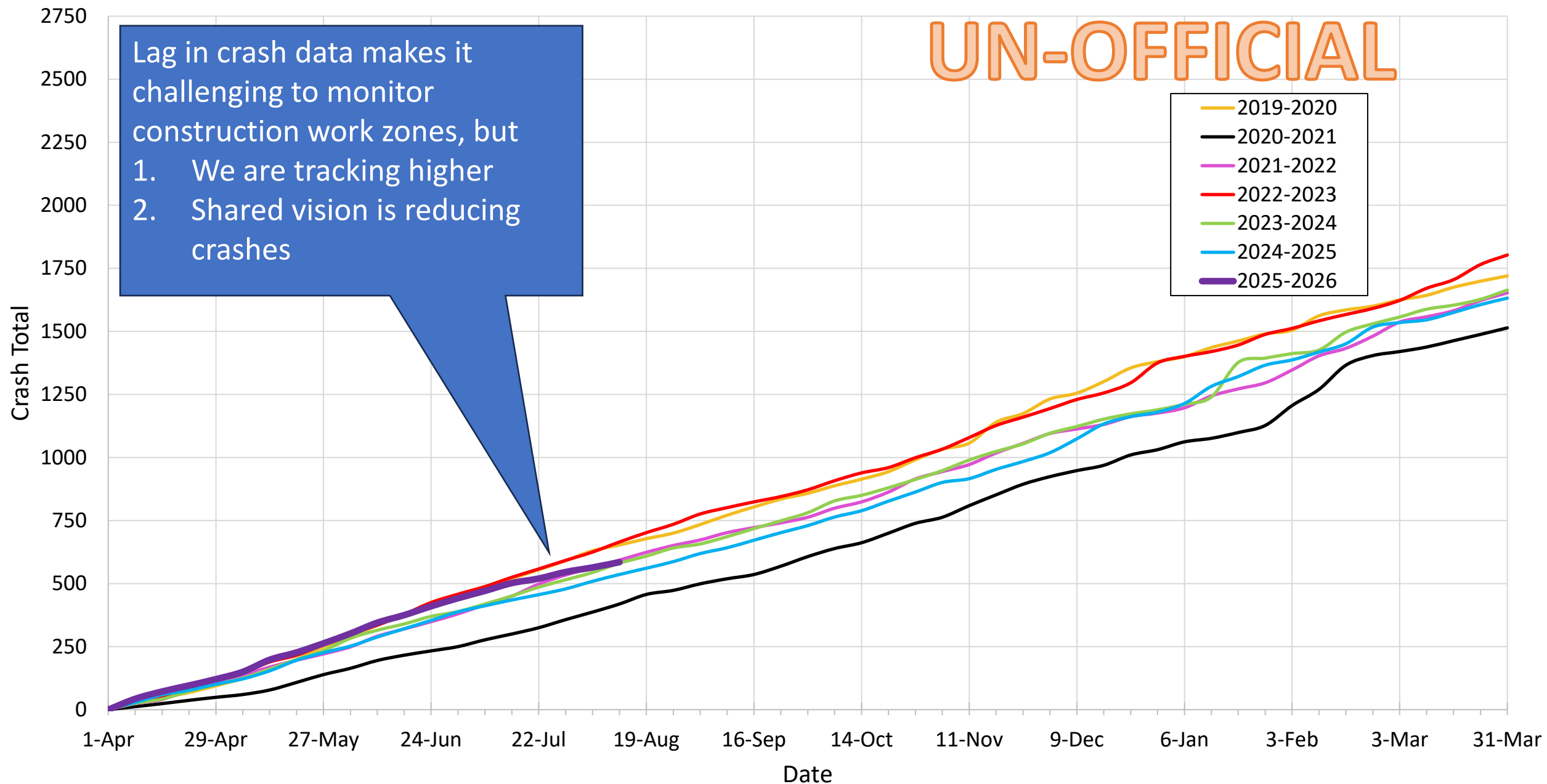


Thomas Driscoll



Debbie Horton

# Cumulative Interstate Crashes by Year in Crawfordsville District



# High Level Message

- MOT in Work Zones is a Team Sport
- MOT in Work Zones is Hard
- Approach
  - Weekly Performance Measures
  - After Action Case Studies
  - What have we/are we learning?





# MOT in Work Zones is a Team Sport

- Scoping
- Designers
- INDOT Construction Engineers
- Contractors
- MOT Sub-contractors
- Public Safety
- Local Communities

MOT in Work  
Zones is Hard

Why this slide ?





# Sid Gillman – The Innovator of Football Film Study

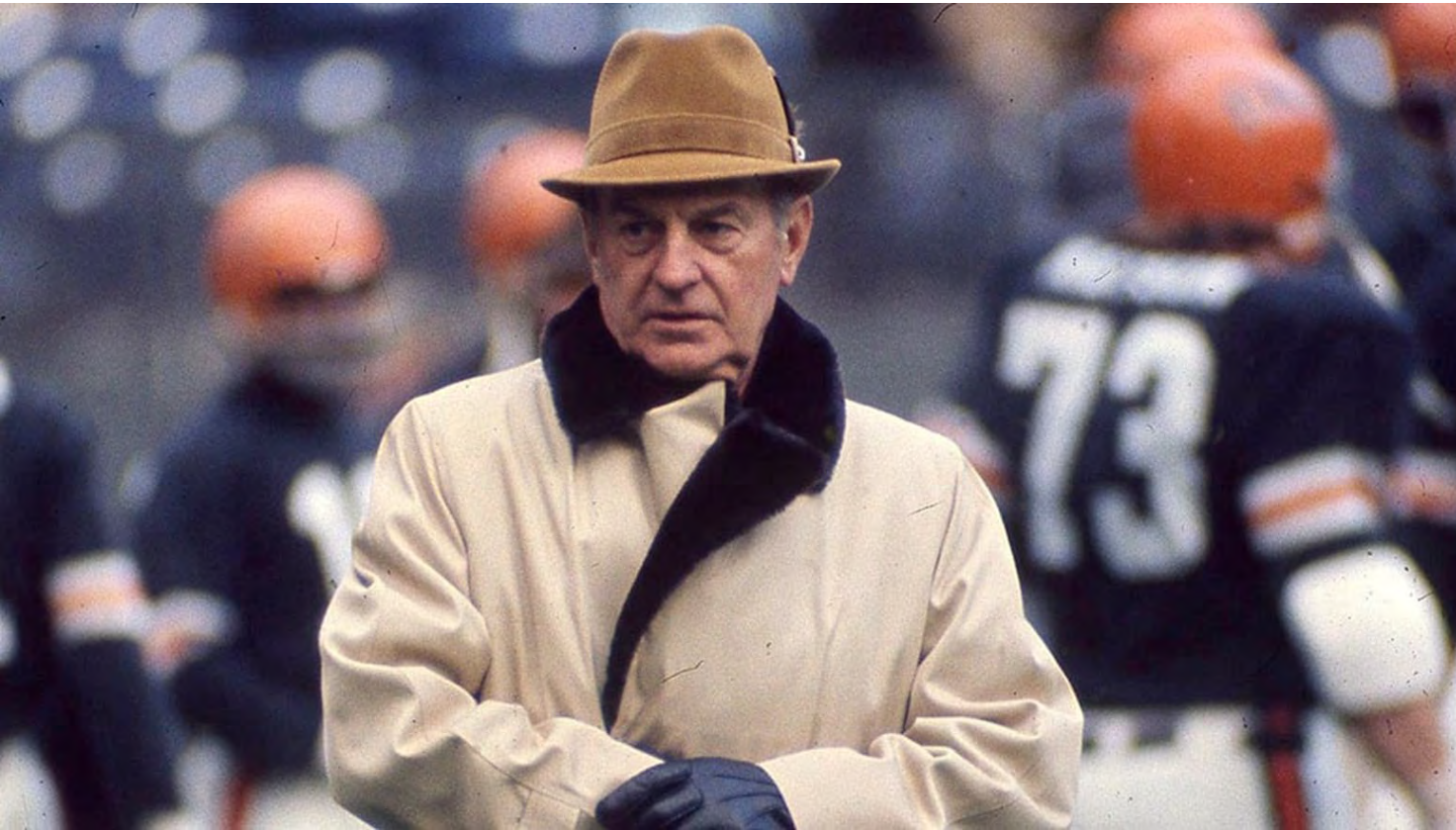
*Regarded as the first coach to systematically use game films to study players and formations*





# Paul Brown – Formalized Film Study in the 1960s

*Starting filming live game play  
specifically for evaluation purposes*



Cleveland Browns, Nov. 7, 1965



And now to pick teams







And a little help  
from our friend  
ChatGPT



Can you rotate this picture so I am looking at the seats straight on



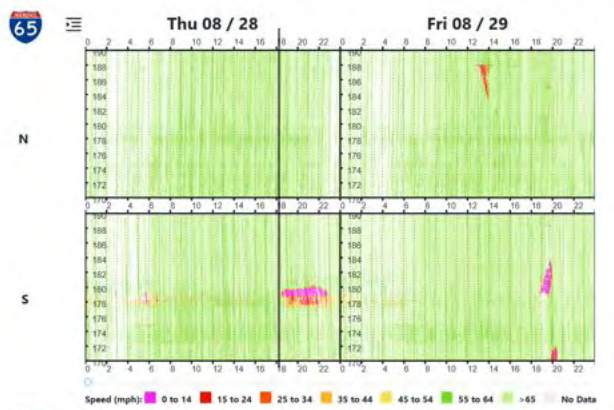
And now for the controversial slide



# PURDUE FOOTBALL







# I-65/178.3 SR 43



2025-08-28 18:30:28

SW



But, we can do better than tapes~

# Approach

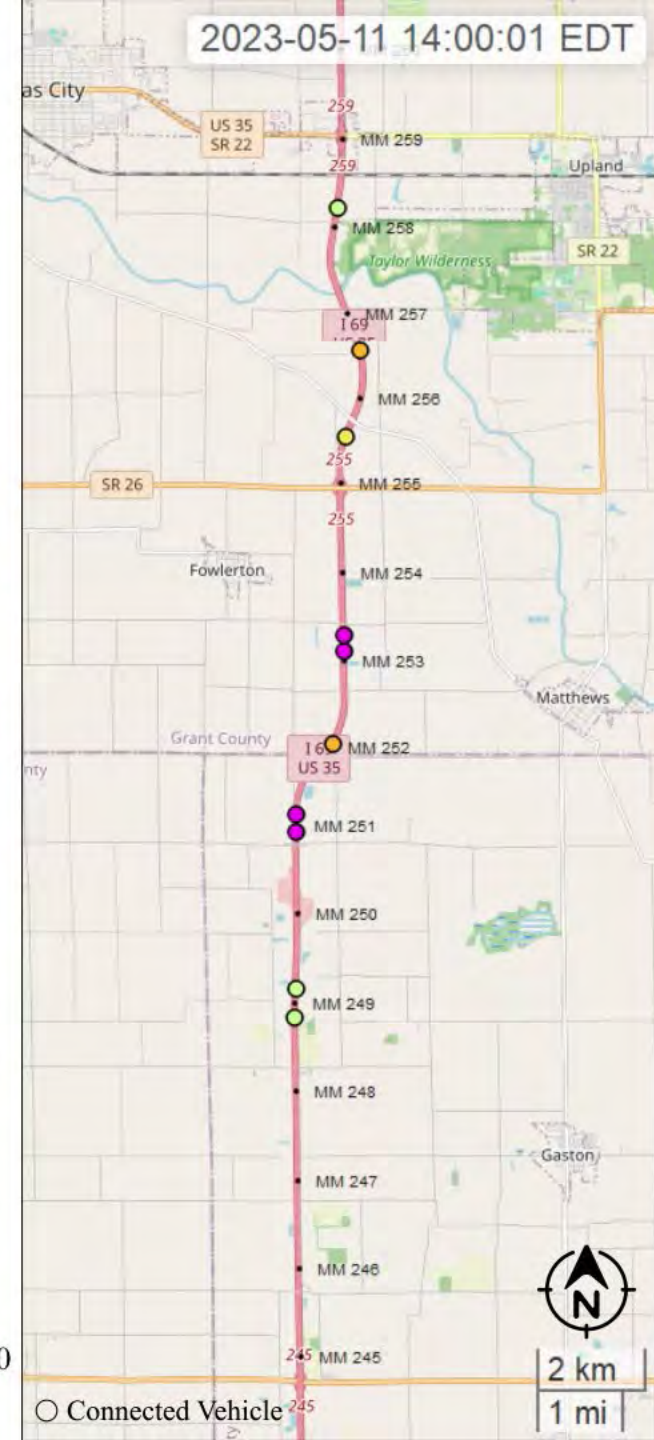
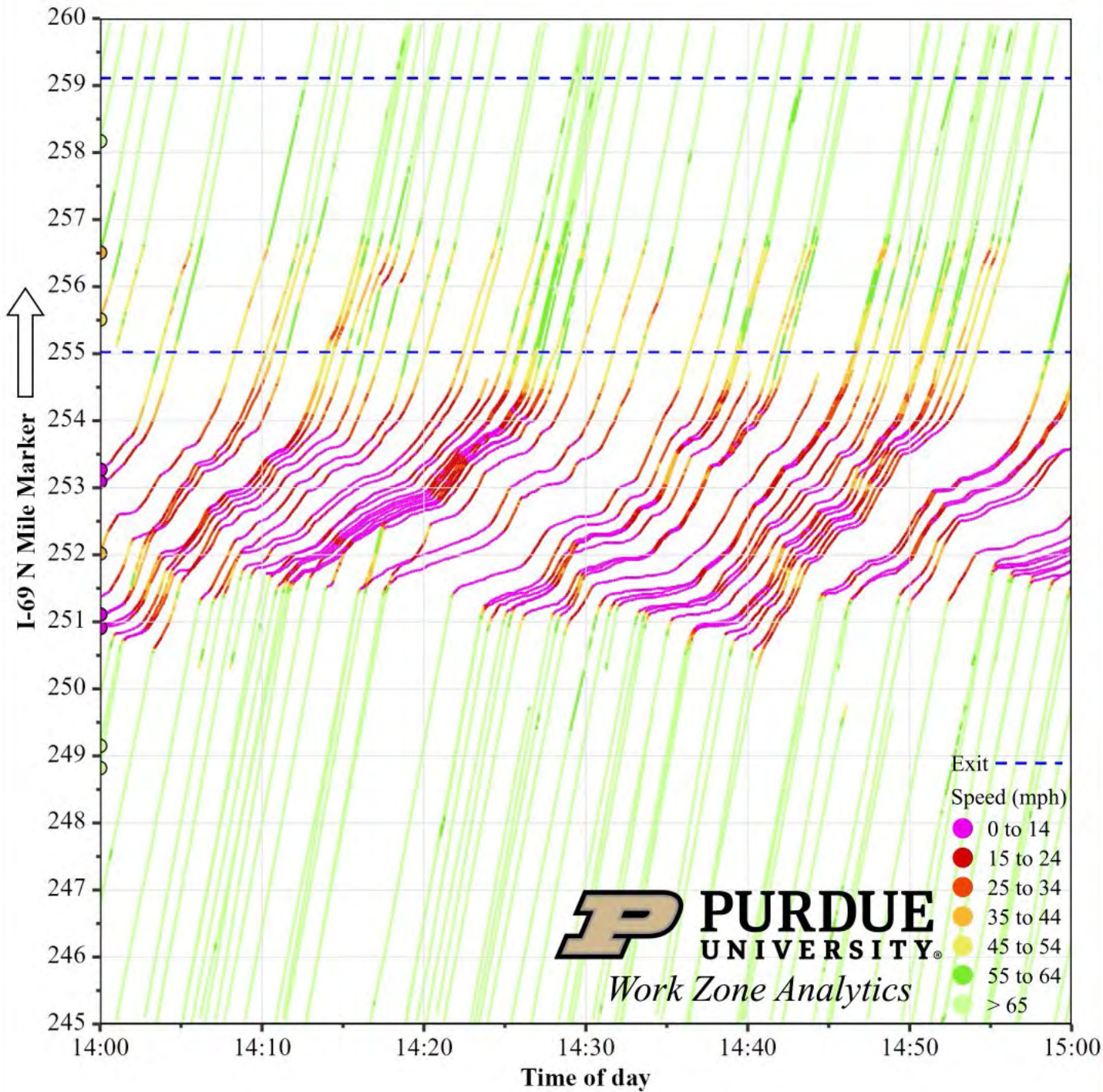
- What gets measured gets done  
(or at least looked at)
- Weekly Performance Measures
- Selected After Actions

# Examples of Weekly Performance Measures

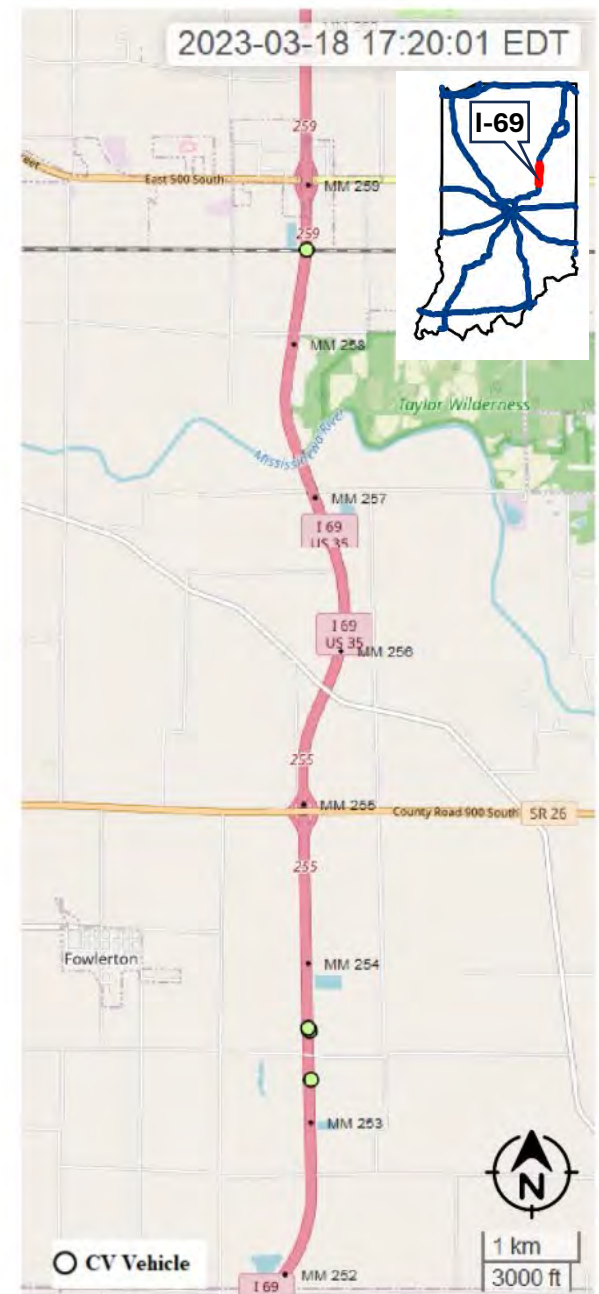
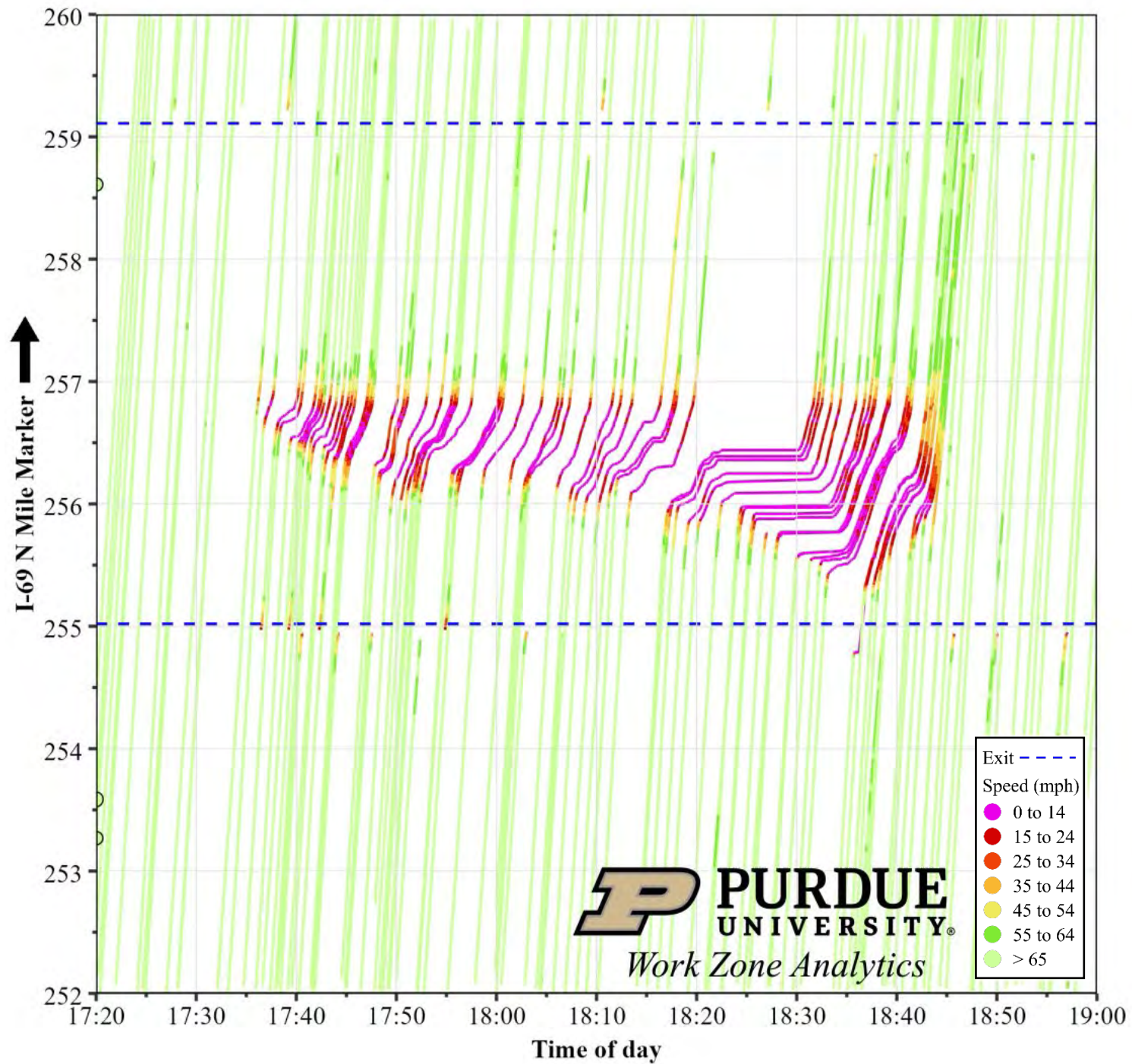
- Crashes
- Queues (miles, duration)
- Sometimes Travel Times
- Hard Braking

# What have we/are we learning?

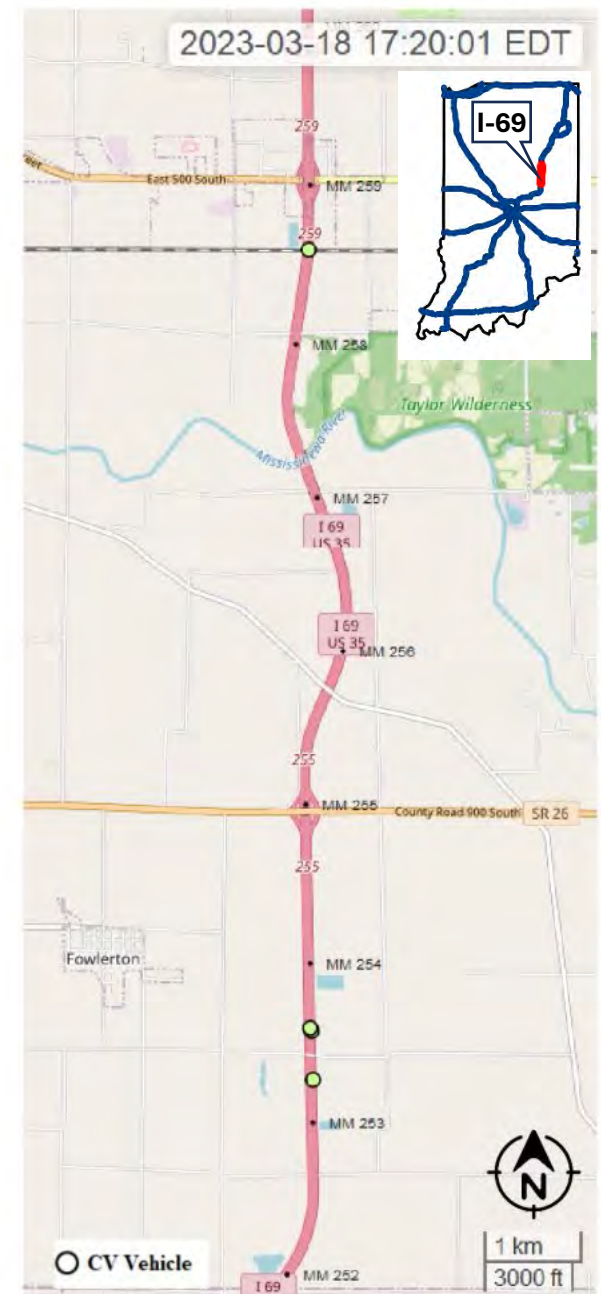
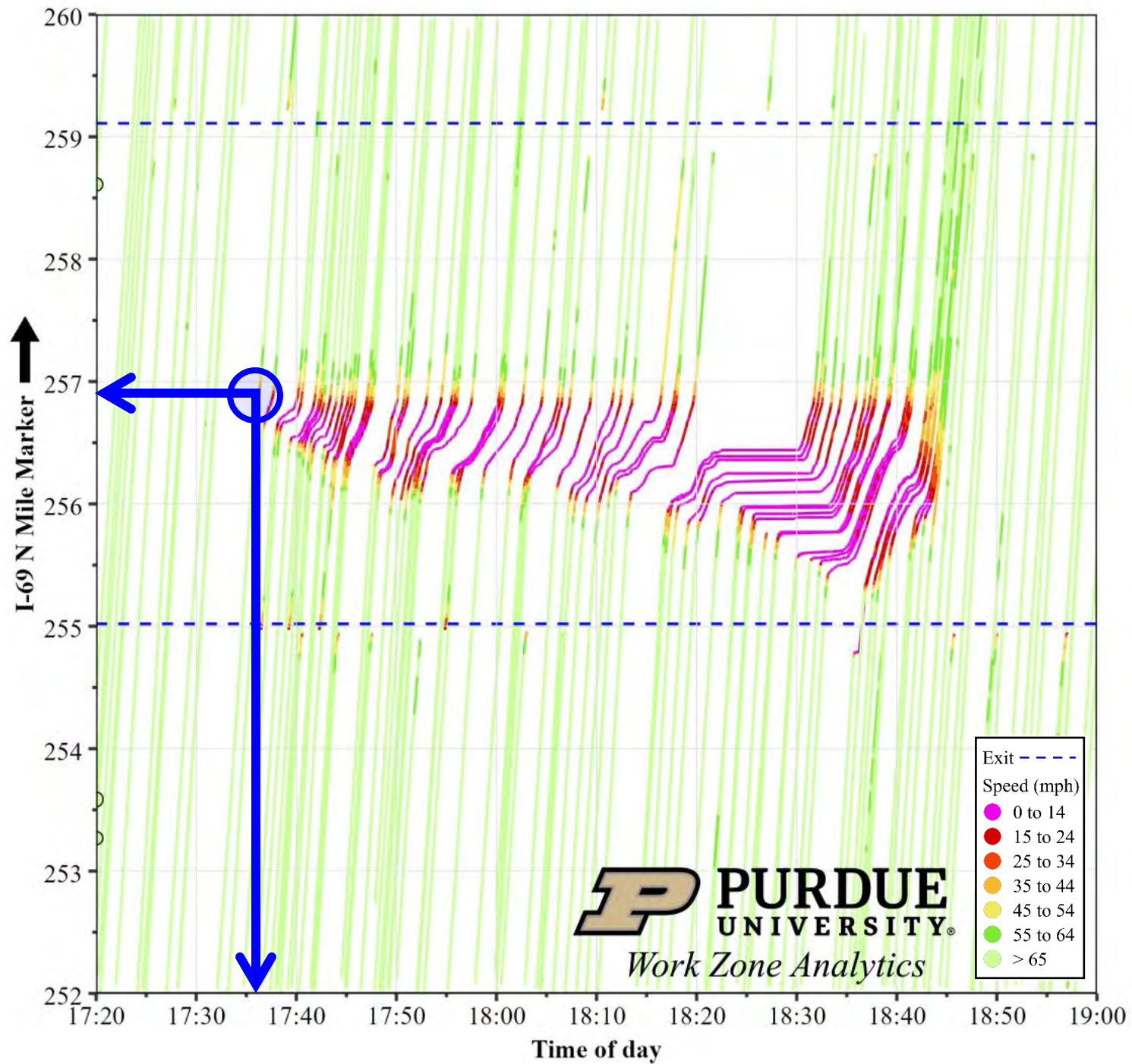
1. Hard Braking is powerful tool for monitoring crash risk.
2. Opportunities to mitigate back of queue crashes with queue trucks and in vehicle alerts.
3. Close proximity to unpaved shoulders should be avoided.
4. Hour of day is strong indication of queuing.
5. Connected Vehicle Data combined with past projects is particularly valuable for forecasting queues.
6. In-Vehicle Alerting is an important supplement to traditional construction signs and message boards.
7. Motorists follow Google/Apple/Waze more than our signs. We need to partner with them



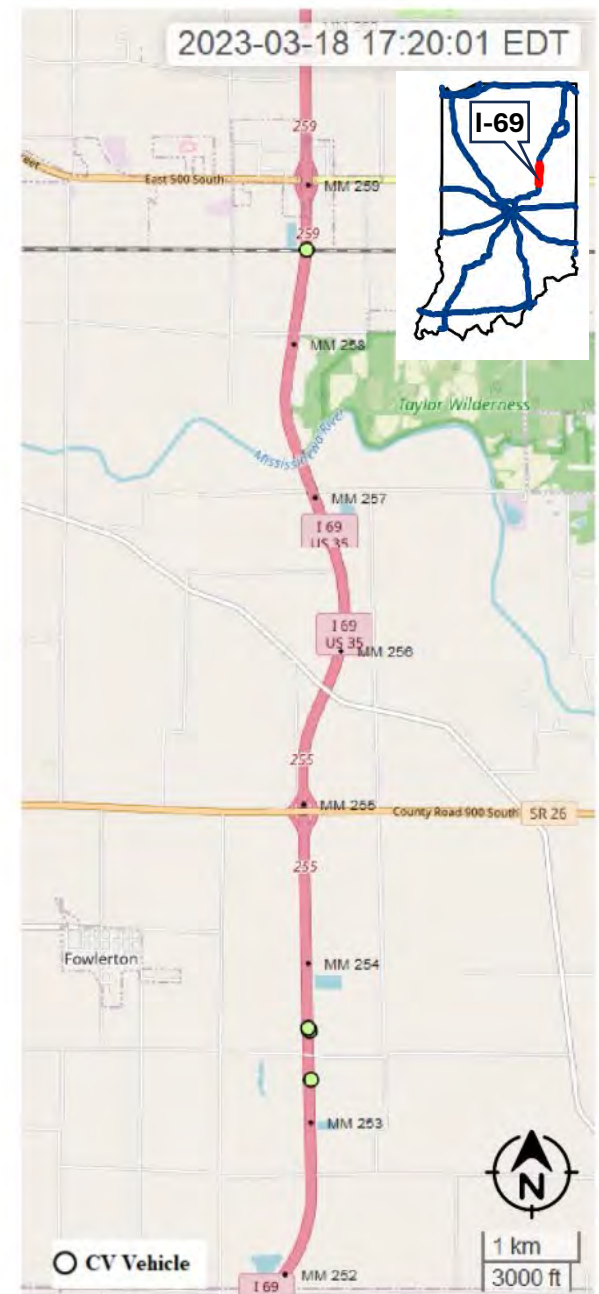
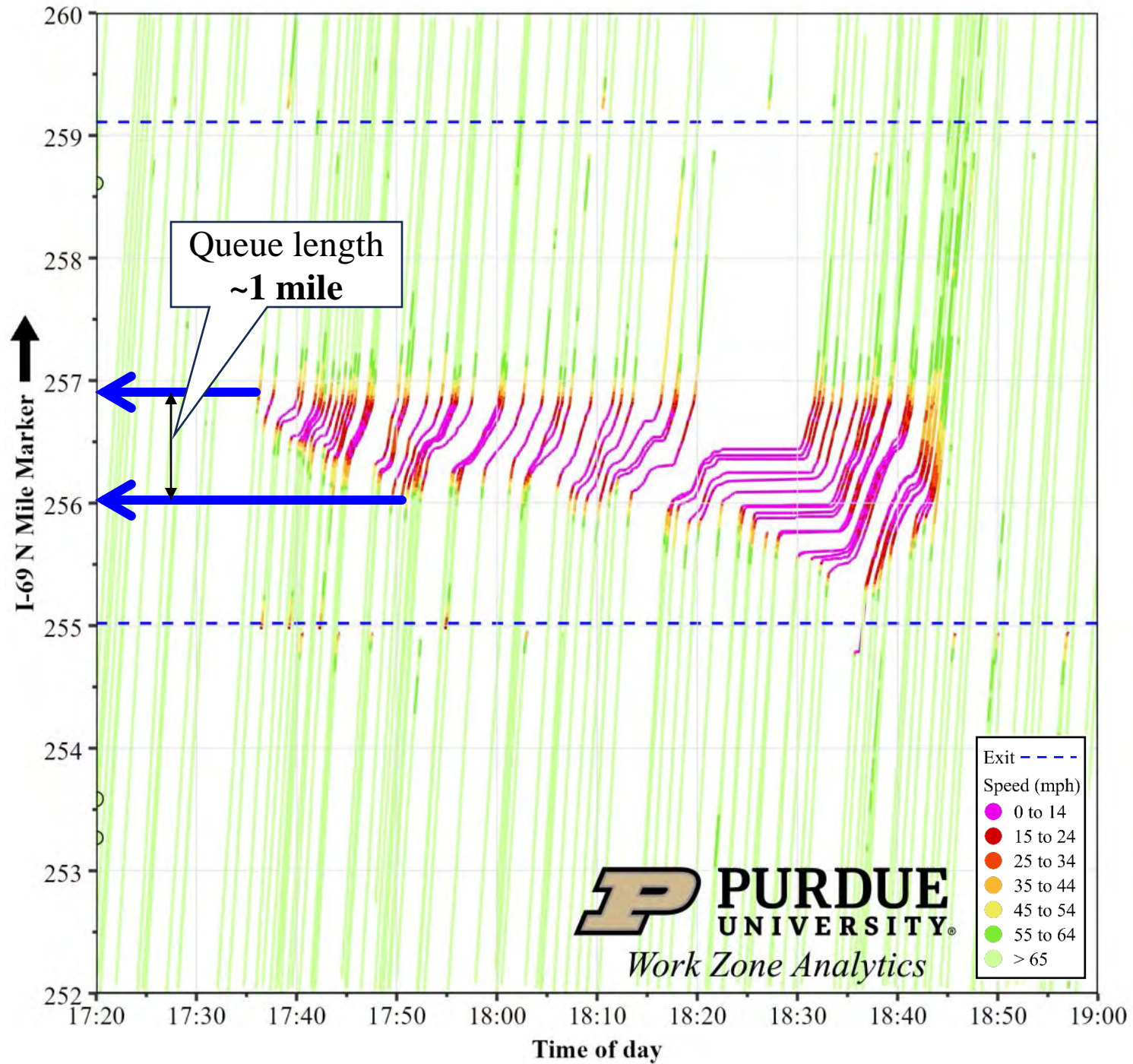




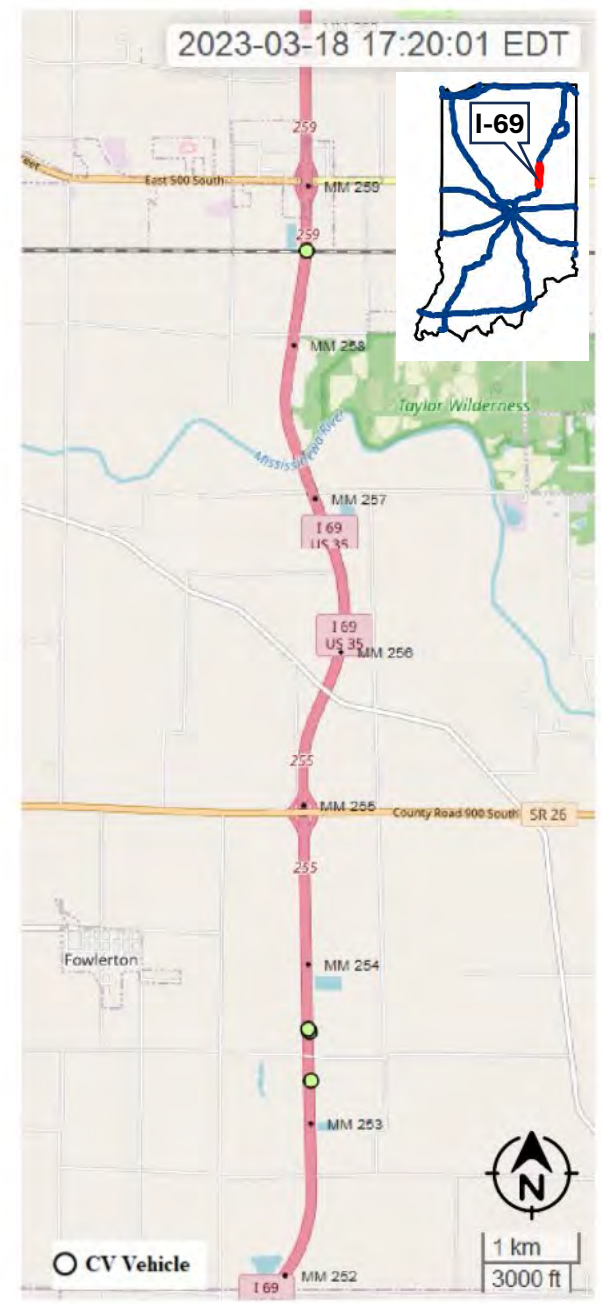
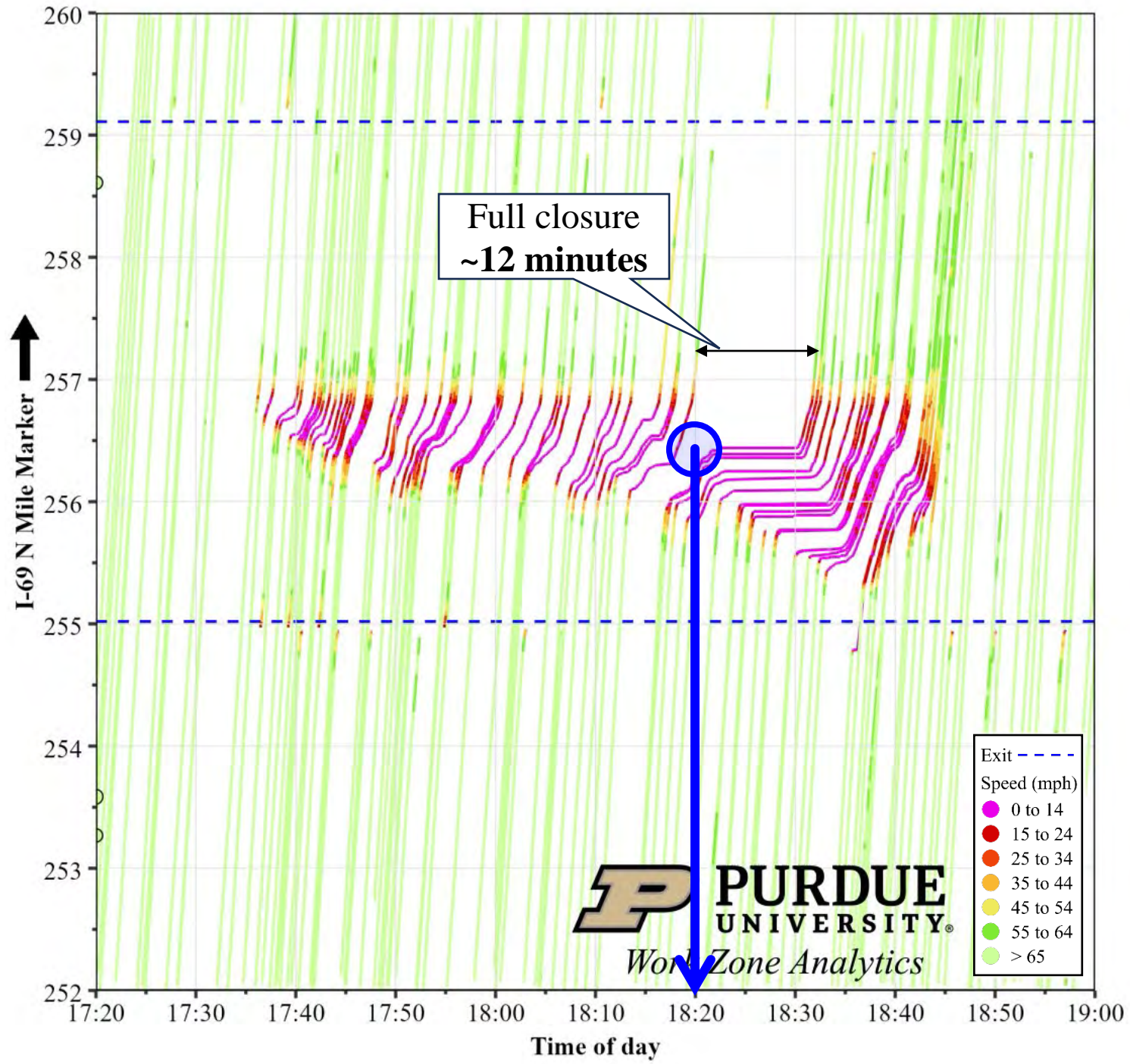




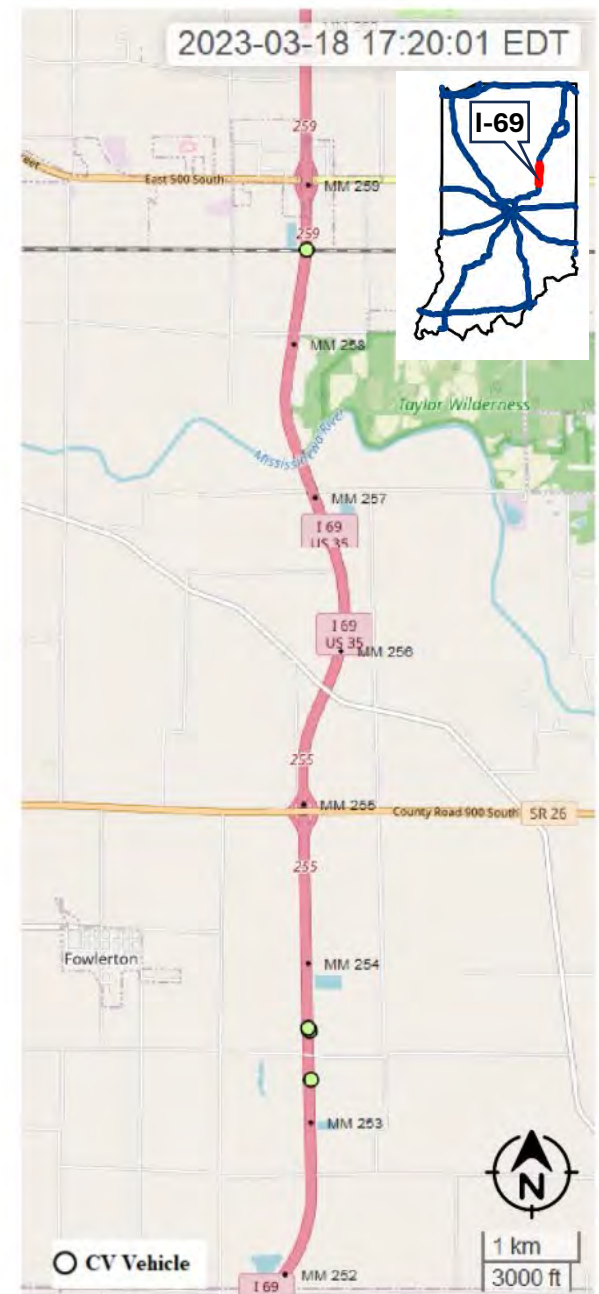
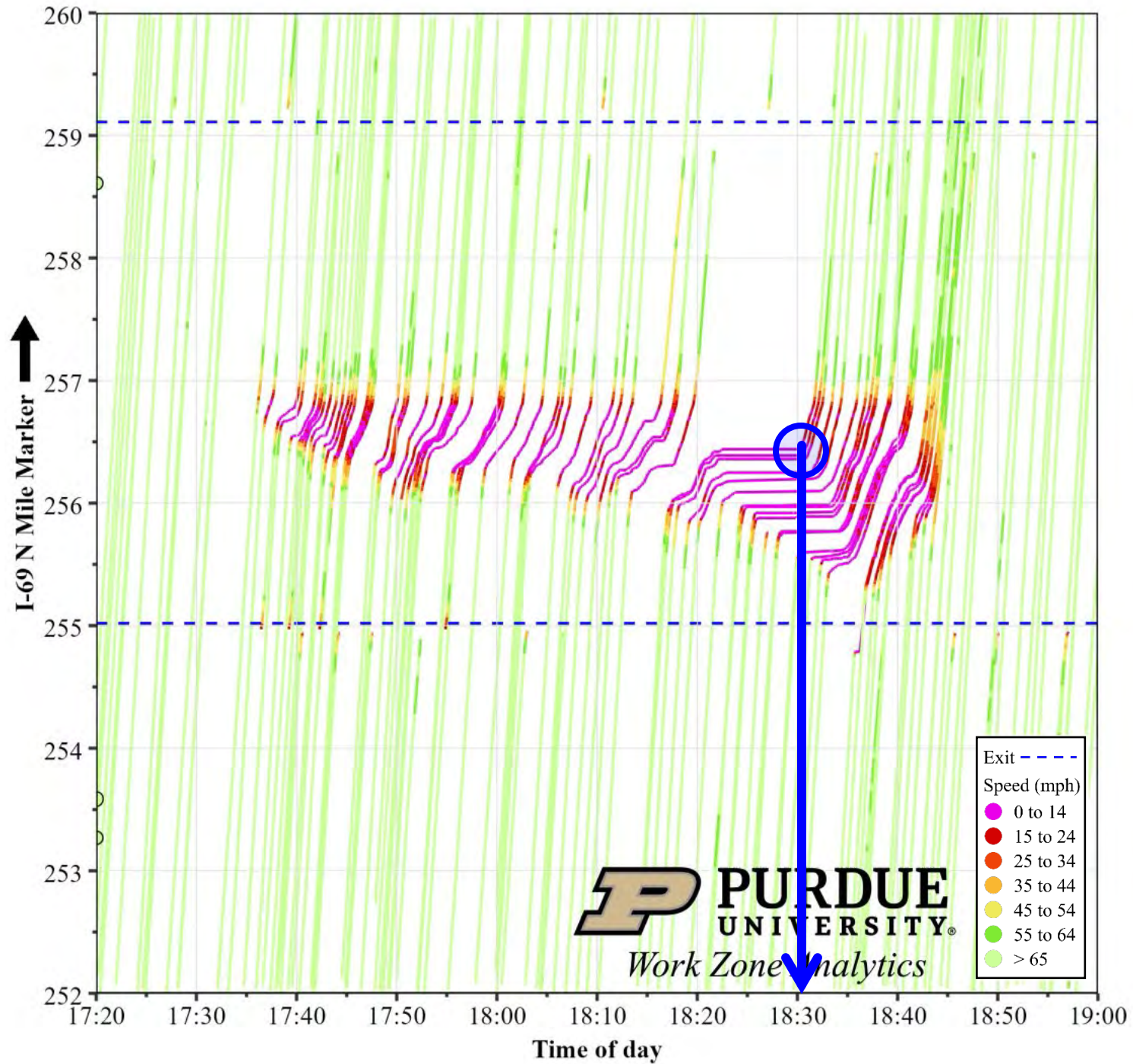




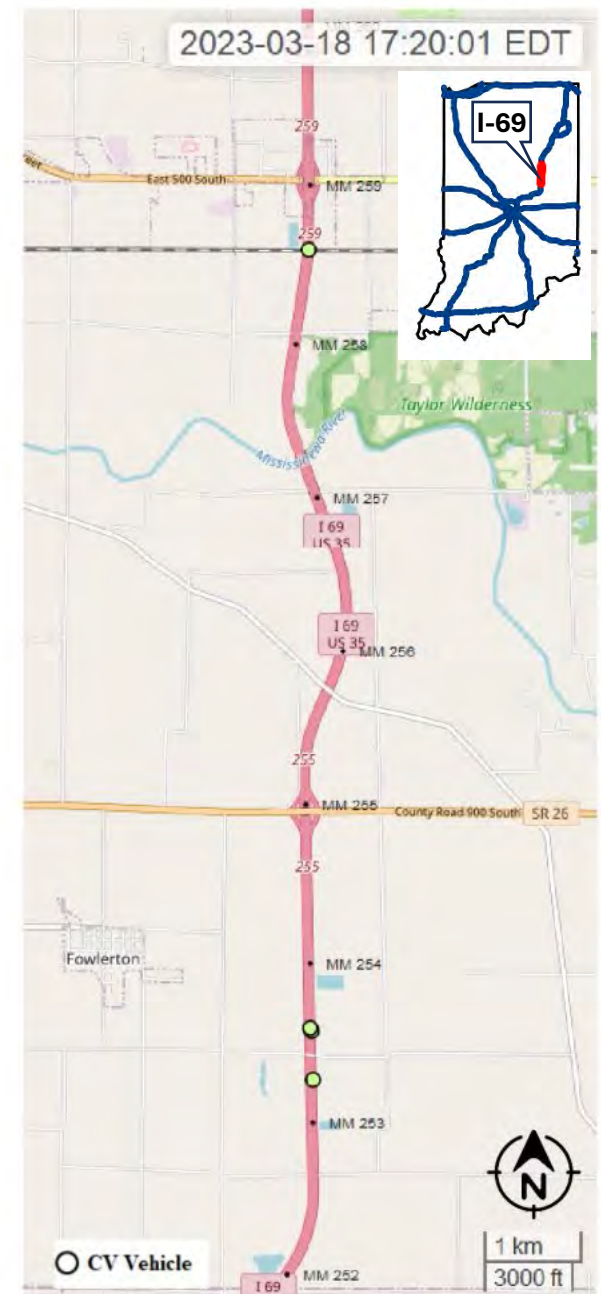
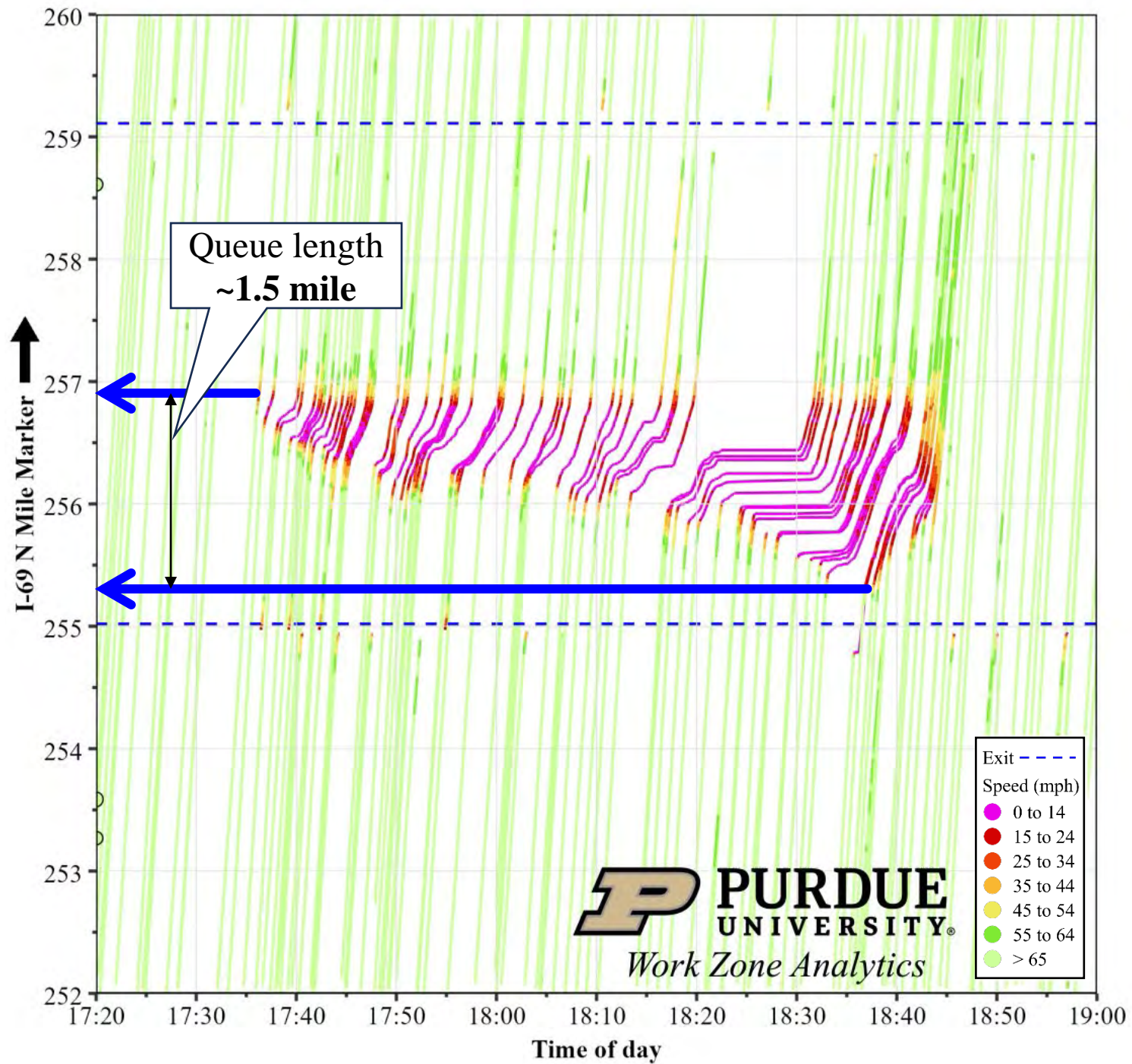




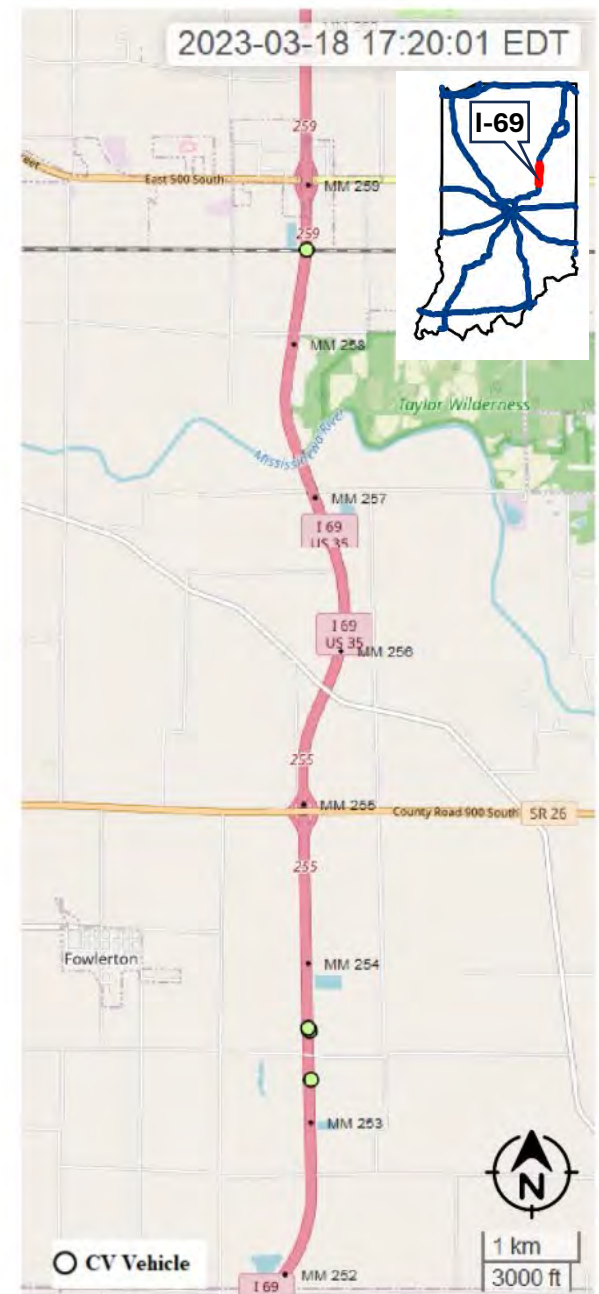
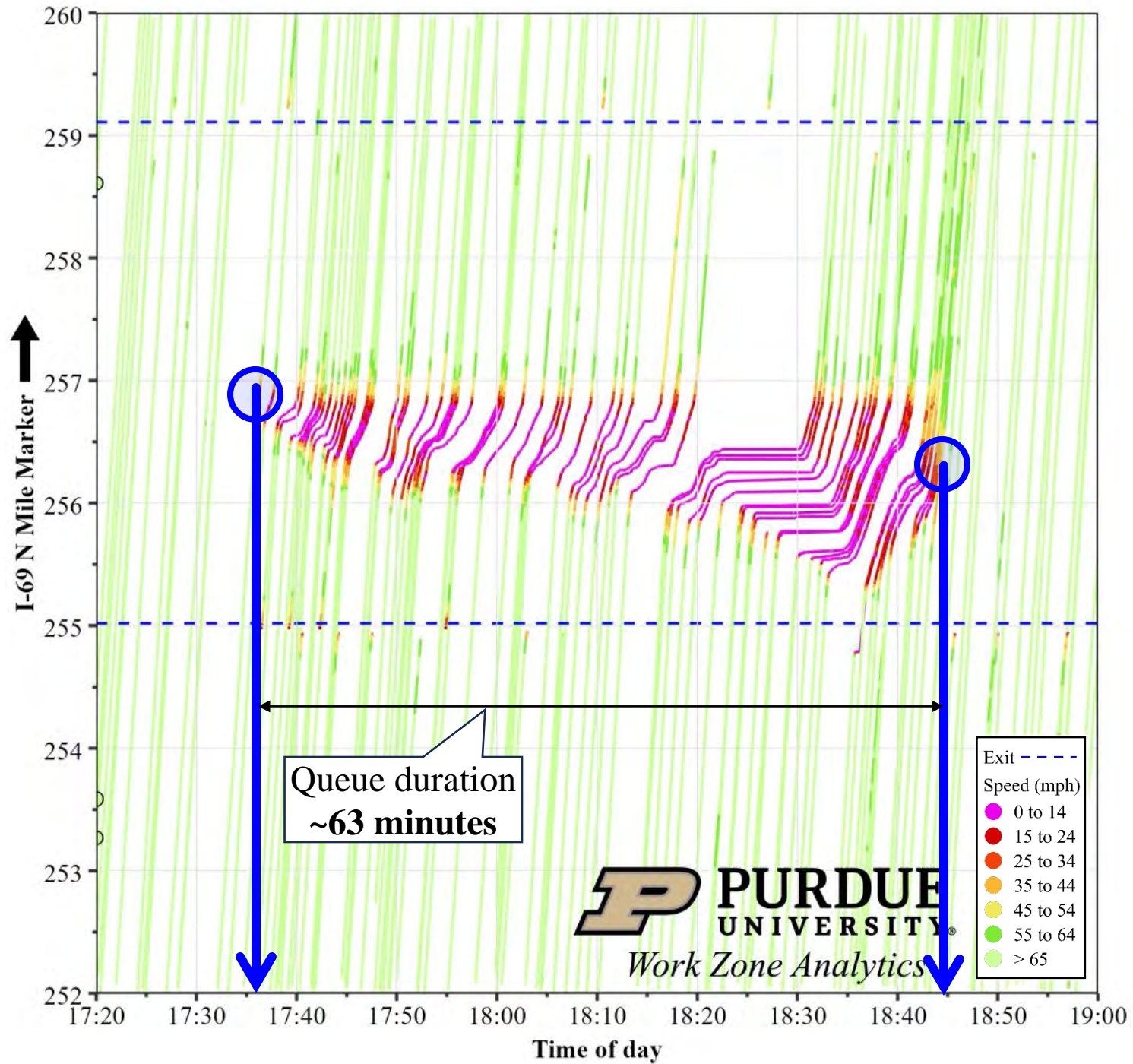




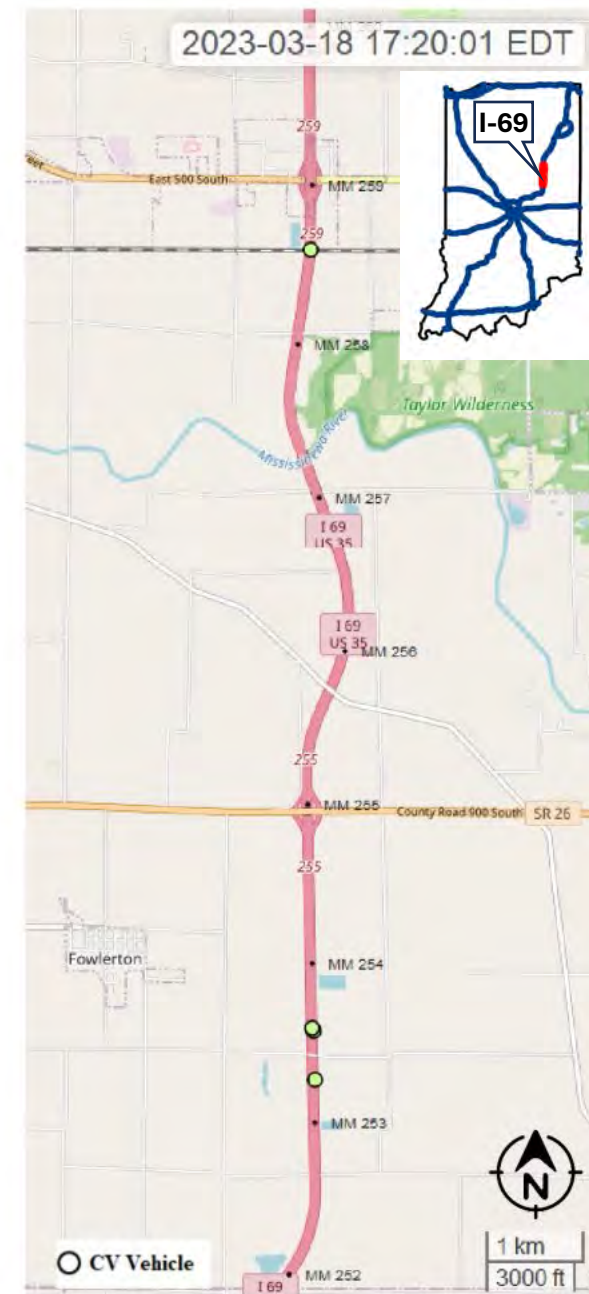
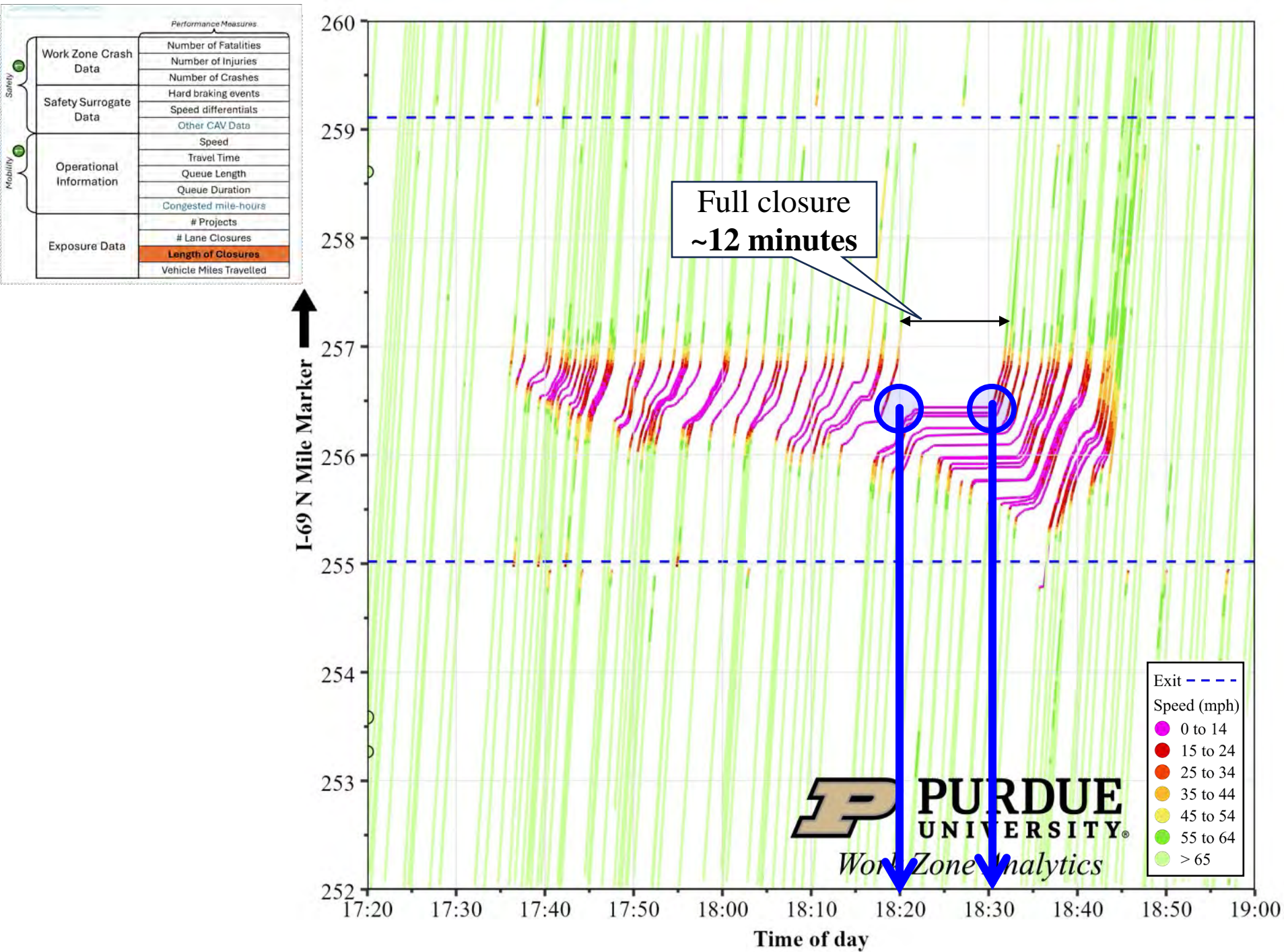




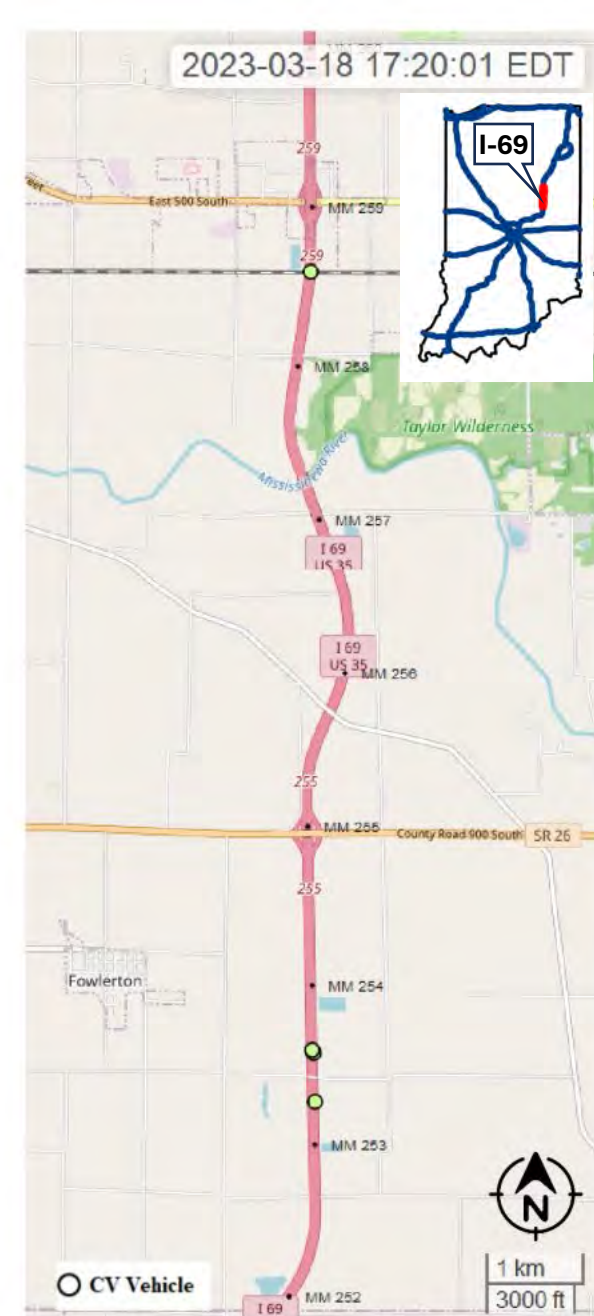
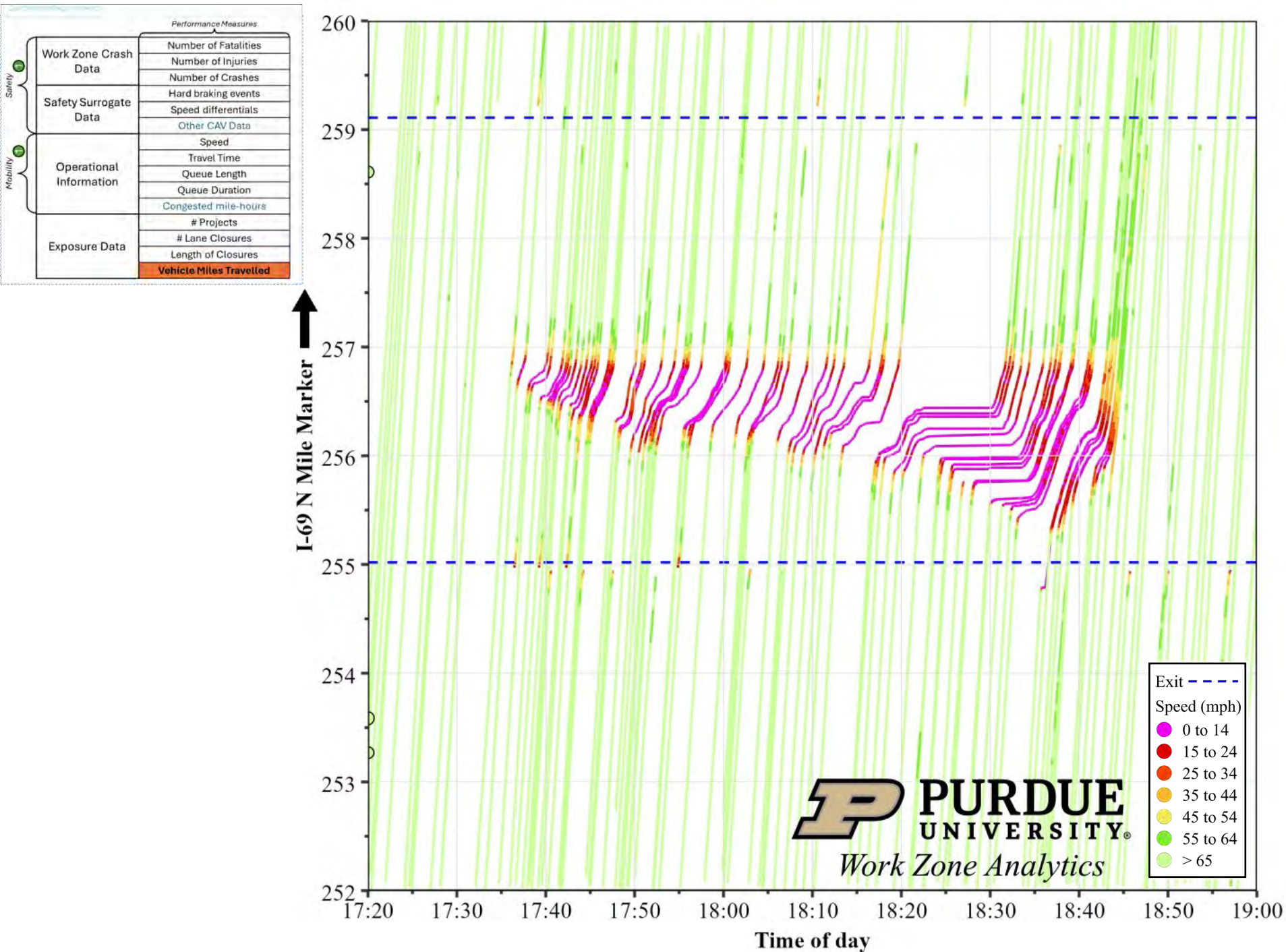












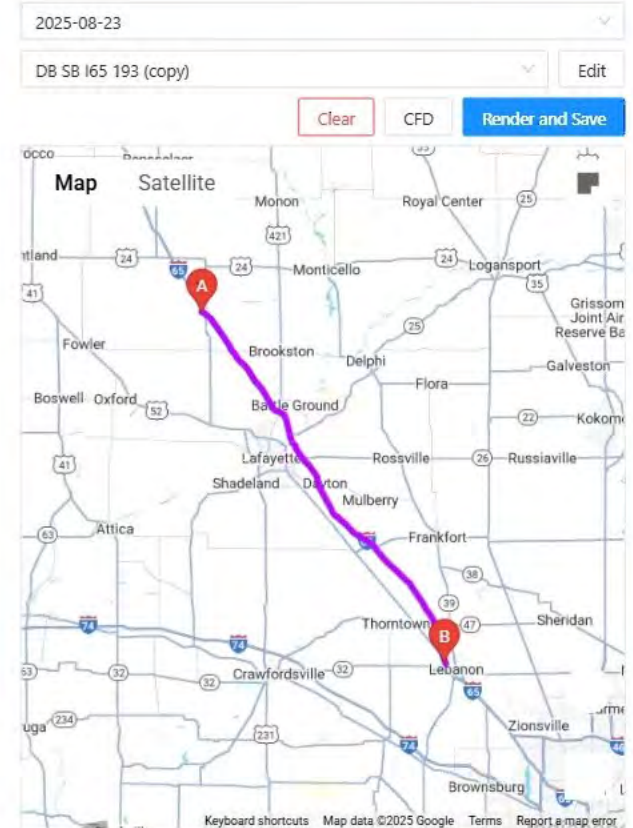
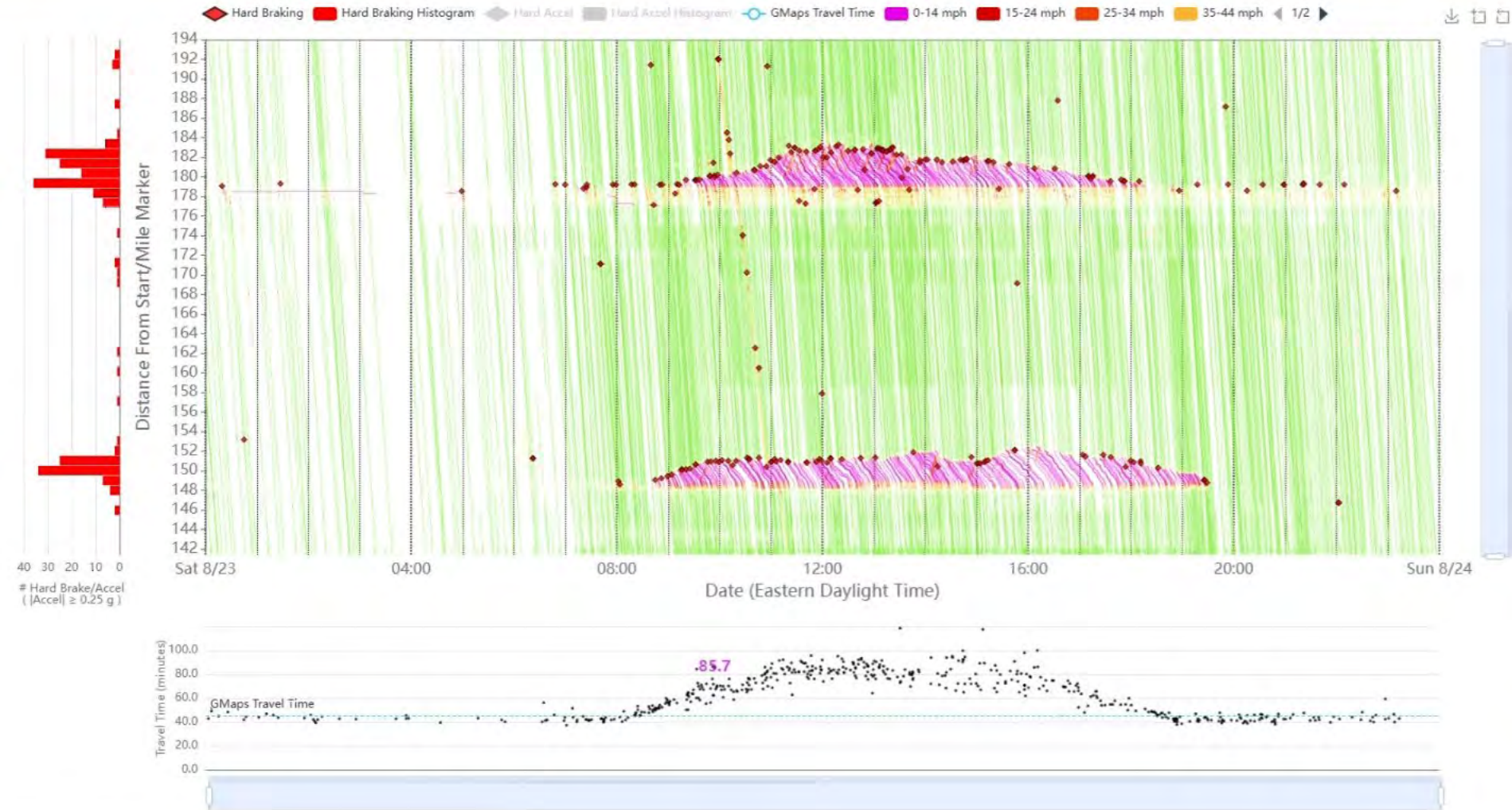


# August 23, 2025 SB I65

## Trajectory Heatmap

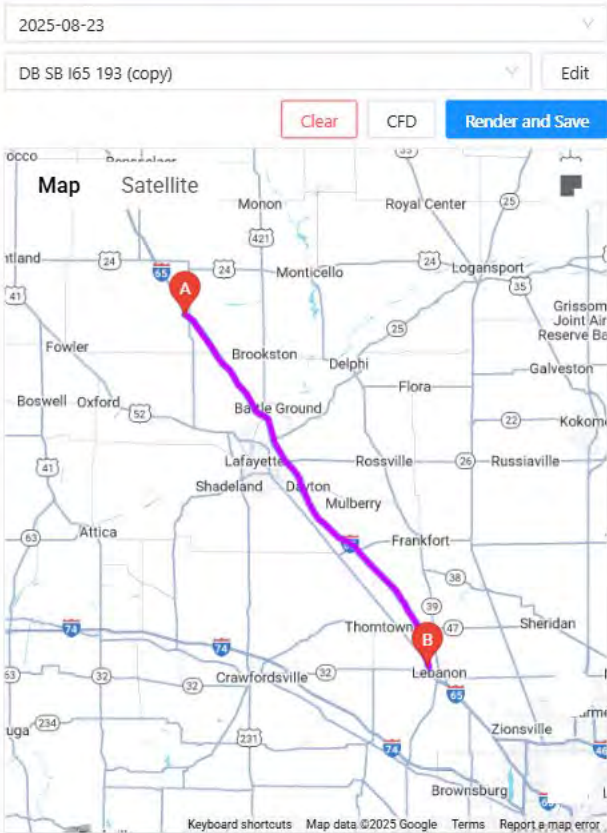
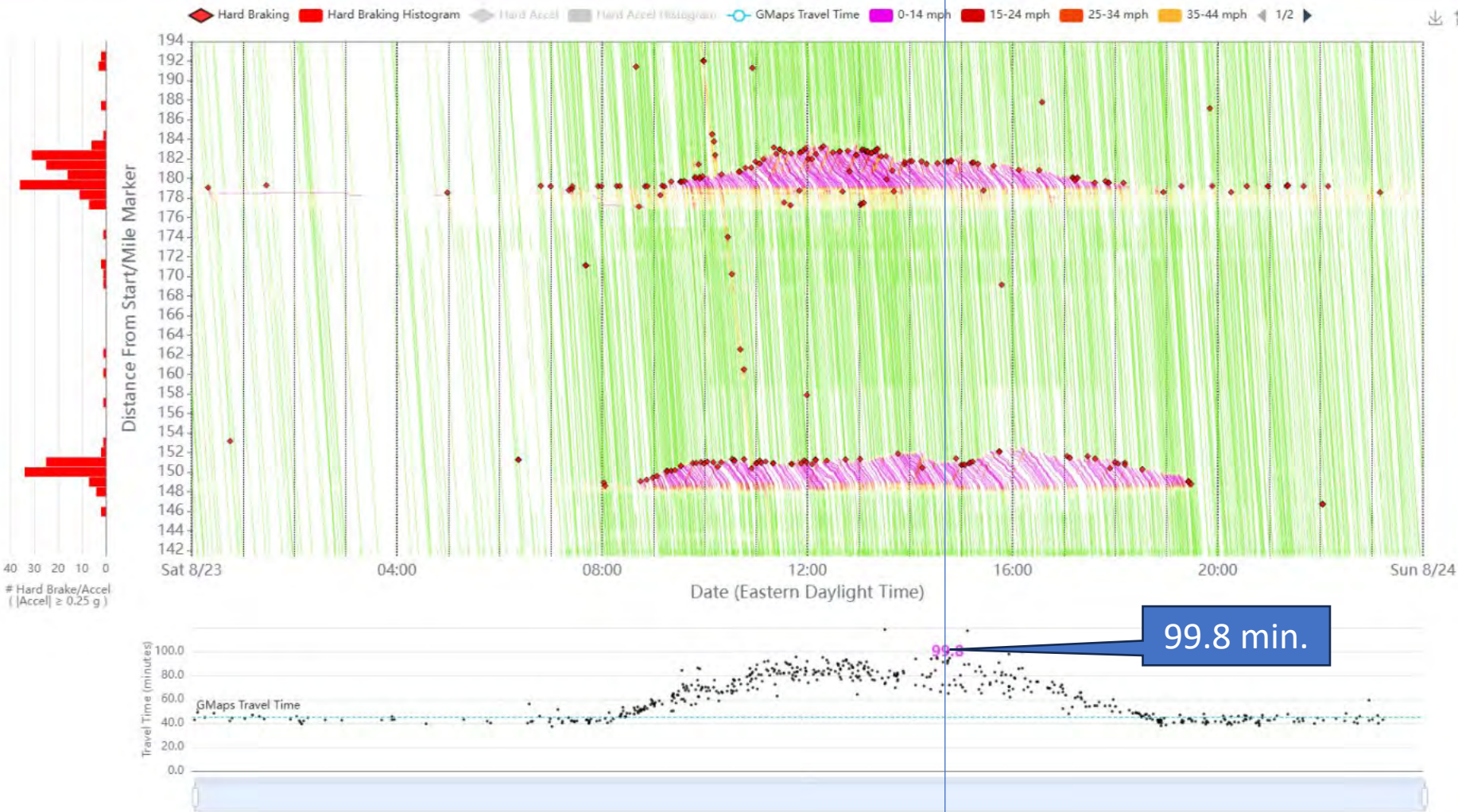
Testing version! [Go to a more stable version](#)

[Report Bug](#) [Feedback](#) [Help](#) [T](#)





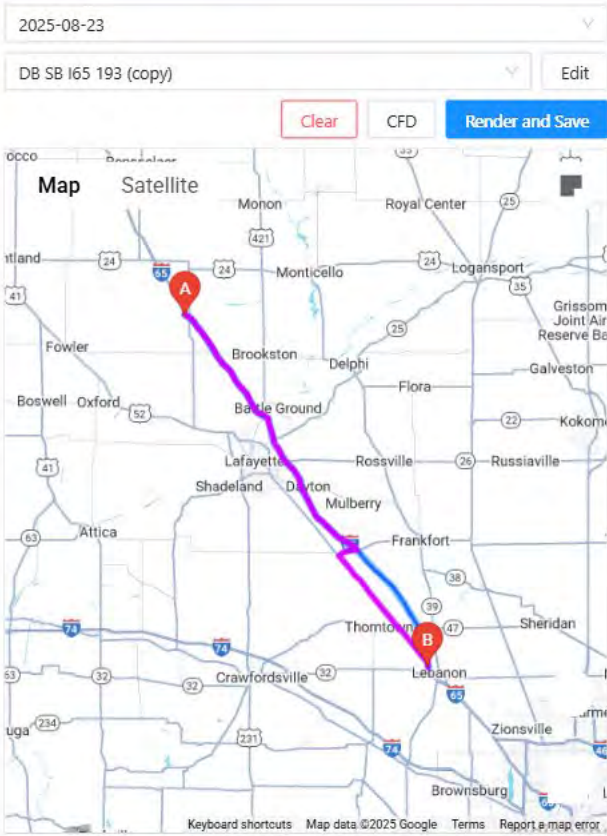
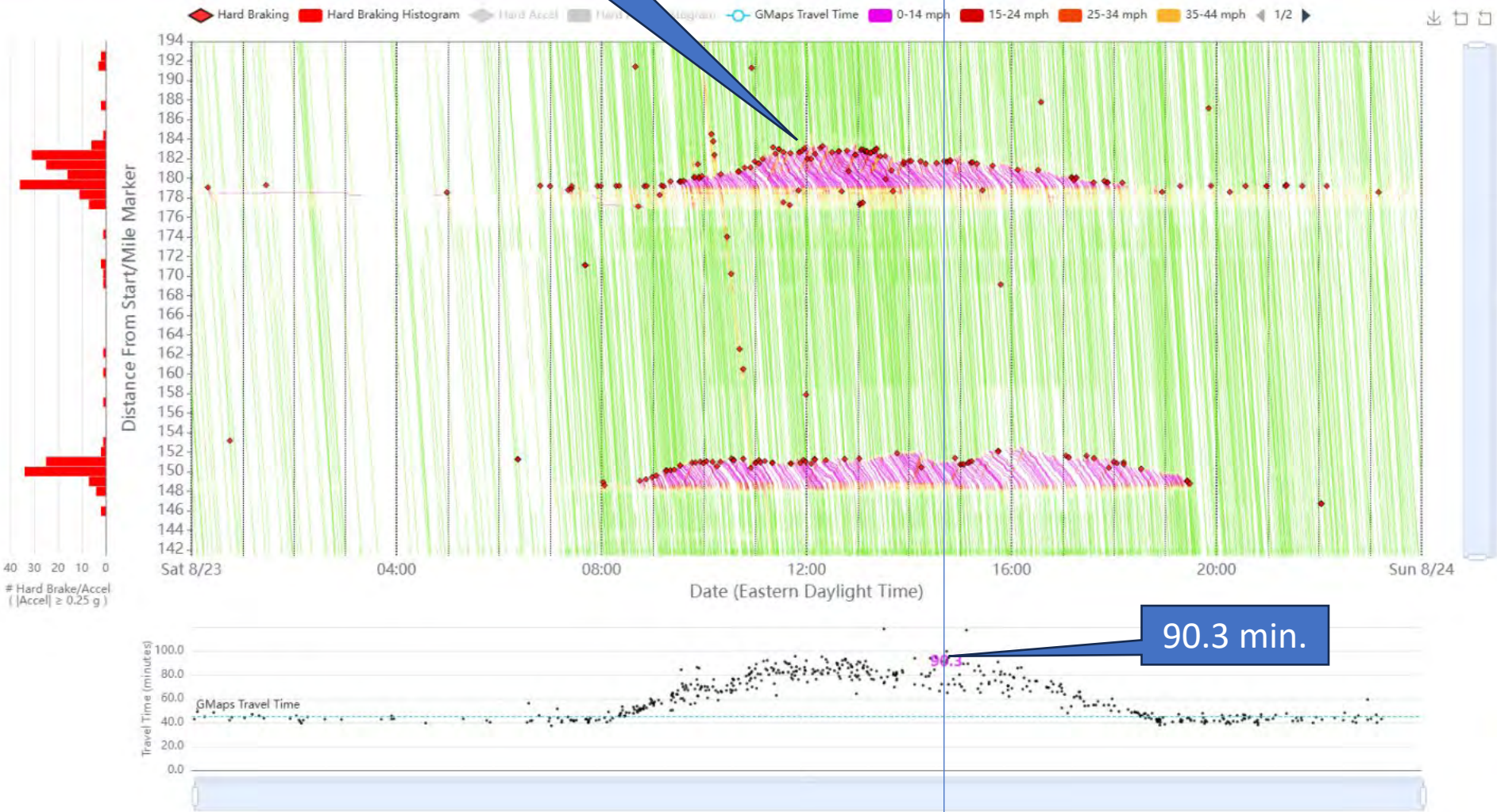
# Trajectory Heatmap



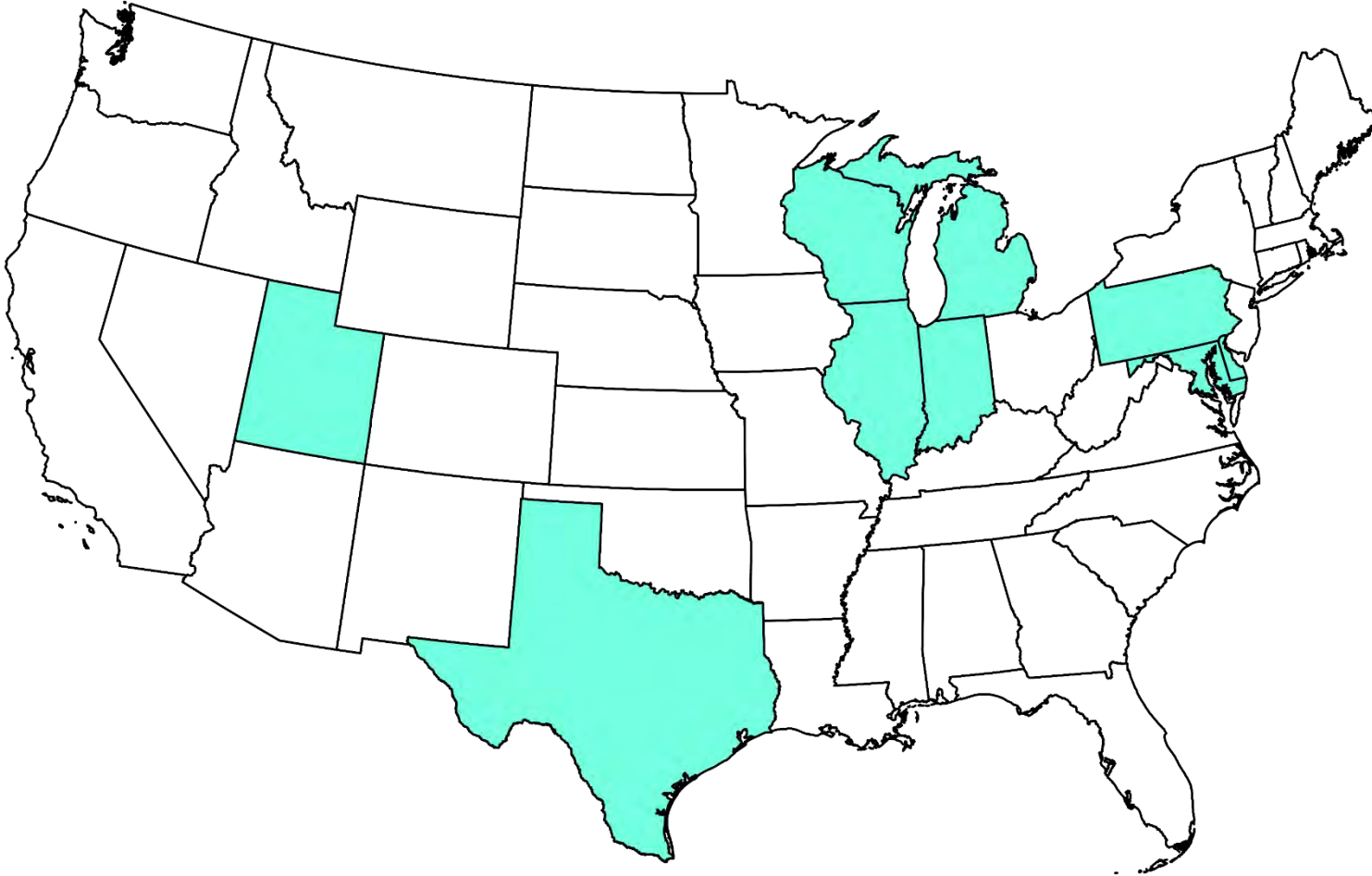


What are these diamonds?

# Trajectory Heatmap



# TPF-5(514) Work Zone Analytics



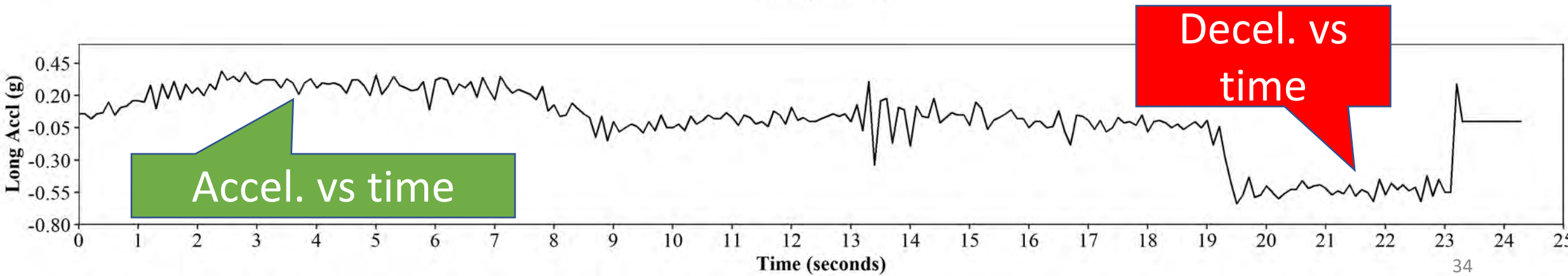
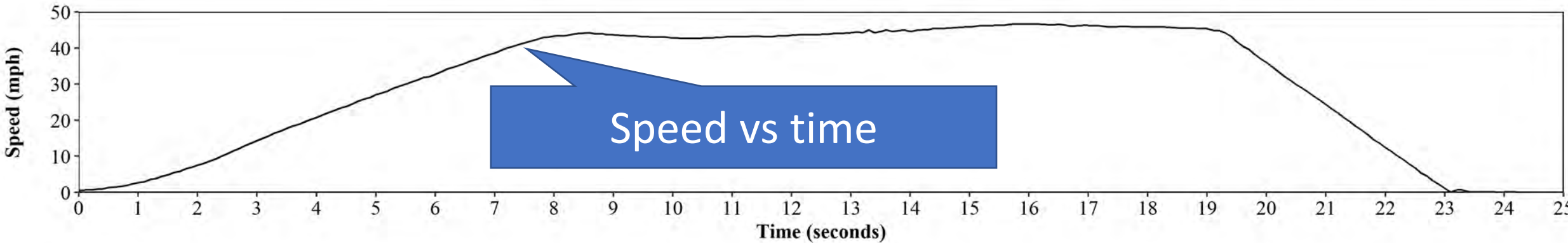
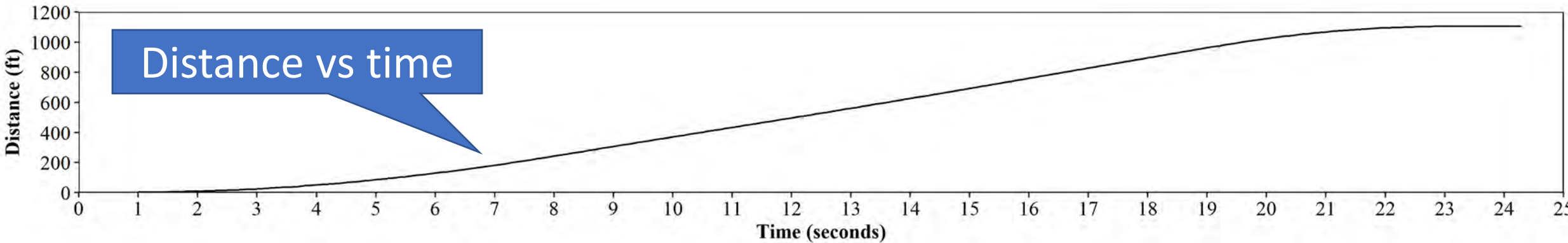
**Partners: FHWA, DE, IL, IN, MD, MI, PA, TX, UT, WI**



# Hard Braking is a replacement for old school skid marks



# Kinematics Fundamentals





# Hard Braking/ g force context









- ~0.54 g



We use  $\sim 0.27\text{g}$  from CV Data



# AASHTO g force for Stopping Sight Distance

**TABLE 6.11** Stopping sight distances for different design speeds

Design Speed (mph)	Reaction Time (sec)	Reaction Distance (ft)	Coefficient of Friction	Braking Distance on level terrain (ft)	Computed Stopping Sight Distance (ft)
20	2.5	73	0.40	33	107
25	2.5	92	0.38	55	147
30	2.5	110	0.35	86	196
35	2.5	128	0.34	120	249
40	2.5	147	0.32	167	314
45	2.5	165	0.31	218	383
50	2.5	183	0.30	278	462
55	2.5	202	0.30	337	538
60	2.5	220	0.29	415	635
65	2.5	238	0.29	487	725
70	2.5	257	0.28	585	841

# Hard Braking correlates well with Interstate Crashes

Journal of Big Data Analytics in Transportation (2021) 3:27–41  
https://doi.org/10.1007/s40421-020-00024-z

ORIGINAL PAPER



## Correlating Hard-Braking Activity with Crash Occurrences on Interstate Construction Projects in Indiana

Jairaj Desai<sup>1</sup> · Howell Li<sup>1</sup> · Jijo K. Mathew<sup>1</sup> · Yi-Ting Cheng<sup>1</sup> · Ayman Habib<sup>1</sup> · Darcy M. Bullock<sup>1</sup>

Received: 4 August 2020 / Revised: 23 October 2020 / Accepted: 27 October 2020 / Published online: 16 November 2020  
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### Abstract

The Federal Highway Administration (FHWA) reported between 2016 and 2017, fatal crashes in work zones increased by 3%, while fatal crashes outside of work zones decreased by 1.5%. The FHWA also reported that work zones account for approximately 10% of the nation's overall congestion and 24% of unexpected interstate delays. This paper reports on a study of 23 construction work zones that covered approximately 150 centerline miles of Indiana interstate roadway in the summer of 2019. Approximately 50% of all interstate crashes for the period of May to September 2019 occurred within or in an approach upstream or downstream of one of these work zones. Commercially available vehicle hard-braking event data is used for the study and geofenced to the work zone approaches and limits. This research examined 196,215 hard-braking events over a 2-month period in the summer of 2019 and 3132 crashes over the same 2-month period in 2018 and 2019 for the 23 interstate work zones. The study found there were approximately 1 crash/mile for every 147 hard-braking events in and around a construction site. The  $R^2$  was approximately 0.85. The paper concludes by recommending that hard-braking event data be used by agencies to quickly identify emerging work zone locations that show relatively large number of hard-braking events for further evaluation.

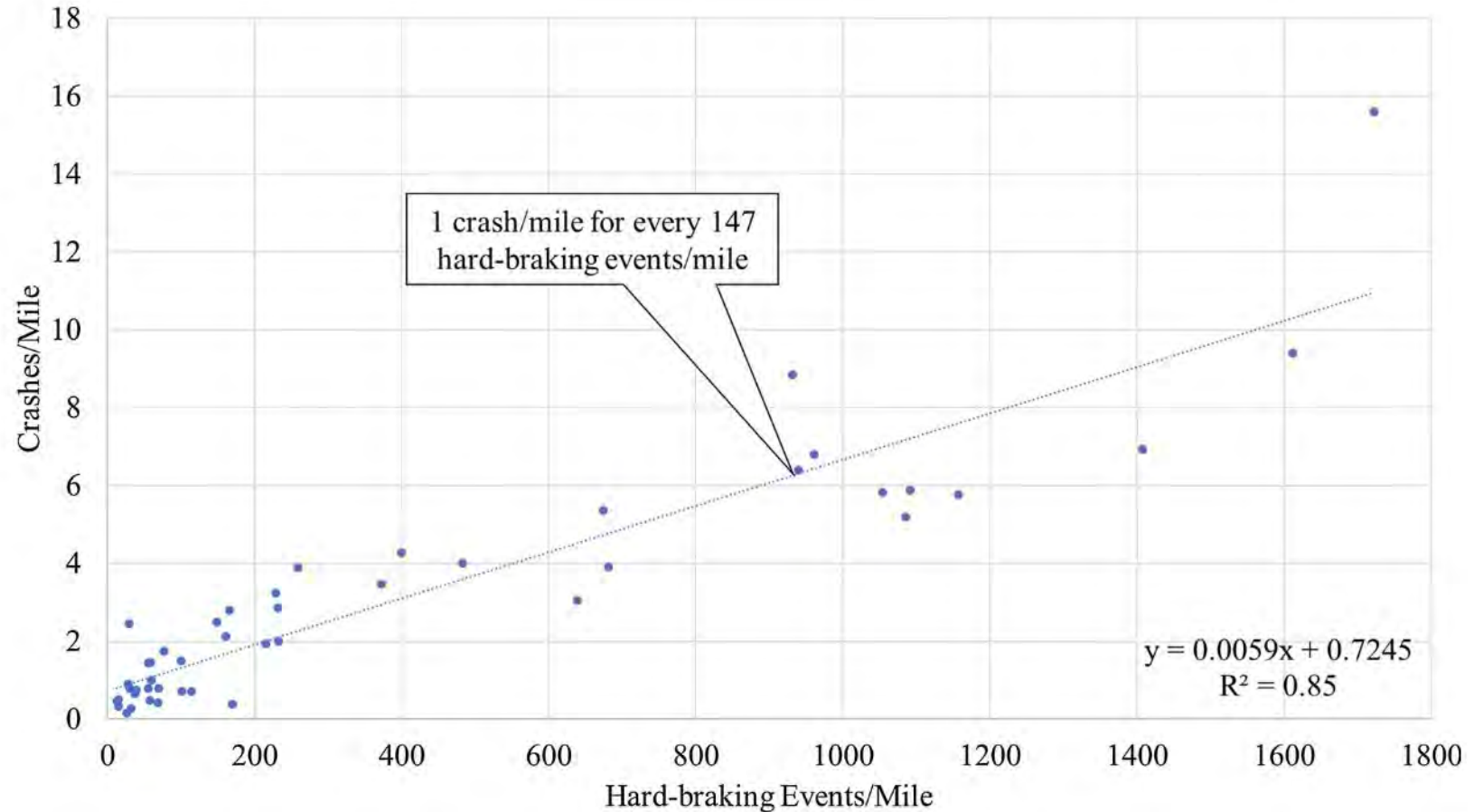
**Keywords** Braking · Crash rate · Highway safety · Vehicle probe data

### Introduction

#### Motivation

There are approximately 800 fatal work zone crashes in the US annually, most of which occur in the summer and fall, and over 25% of those crashes involve large trucks or

buses (FHWA, 2018). The Federal Highway Administration (FHWA) reported between 2016 and 2017 (FHWA, 2018) fatal crashes in work zones increased by 3%, while fatal crashes outside of work zones decreased by 1.5%. The FHWA also reported that work zones account for approximately 10% of the nation's overall congestion and 24% of unexpected interstate delays (FHWA 2018). Historically, crash report data has been used to identify opportunities to improve the design of future construction zones. However, the infrequency of crashes and the time it takes for personnel to read crash narratives makes it difficult and infeasible to use crash data for tactical monitoring of work zones. Furthermore, crash reports are often reported with a time delay due to associated investigation time, and the exact location and time reported in the crash reports varies by investigating agency. In contrast, hard-braking event data can be obtained daily from commercial providers with a precise timestamp and geo-location information. This paper investigates the feasibility of using hard-braking event data to identify opportunities to improve the safety and operating efficiency of construction work zones.



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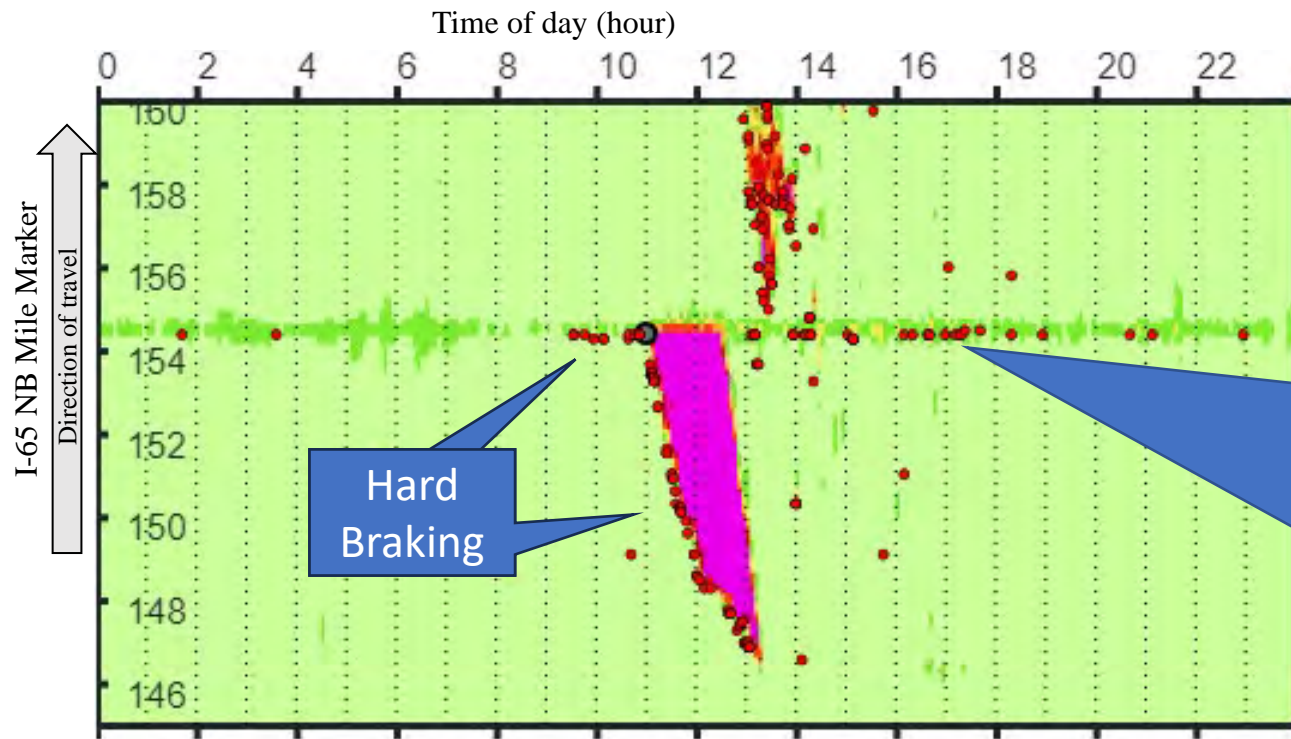


Watch for “Dots” on next slide



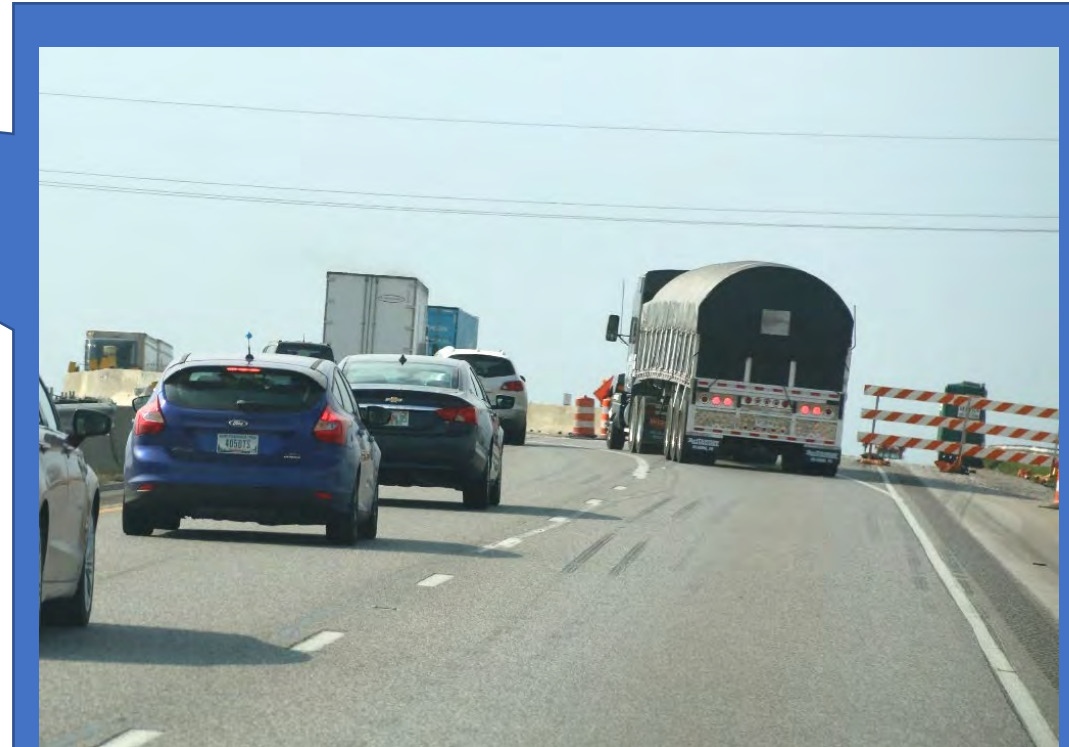
# Crash incidents during the lane shift on interstate

Sunday, 4 April 2021



Speed (mph): 0 to 14 15 to 24 25 to 34 35 to 44 45 to 54 55 to 64 > 65 No Data

• Hard braking events ○ Crash incident





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



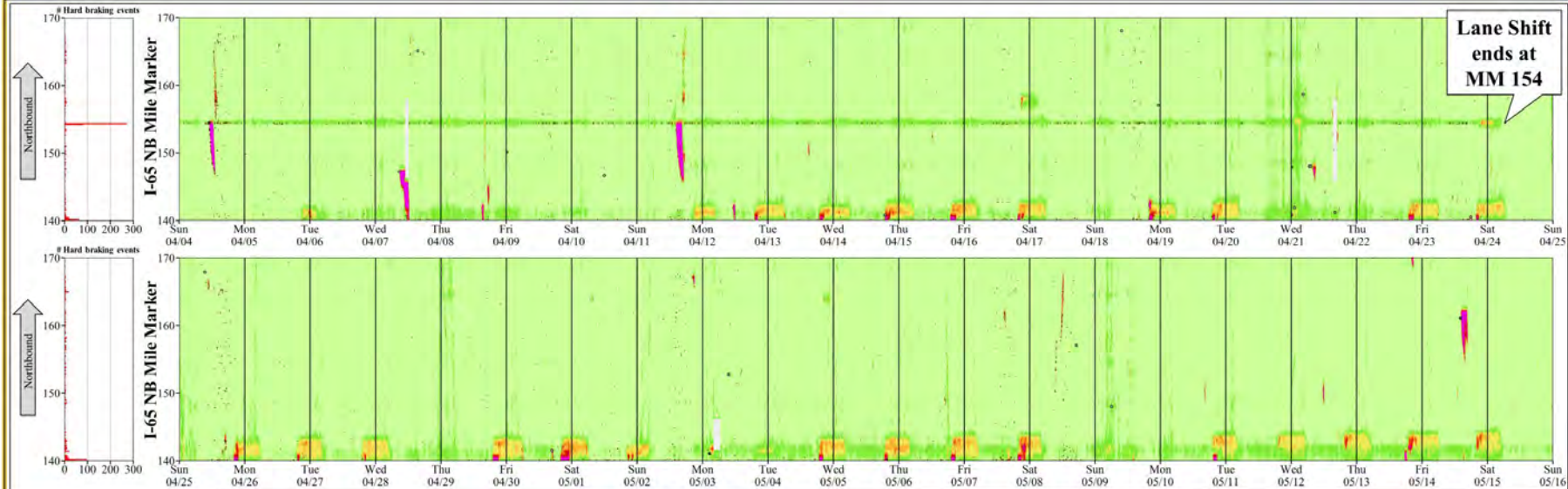


# Lane Shift Impact on Hard Braking Events

## Manson Colfax, I-65 MM 154

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### ➤ 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

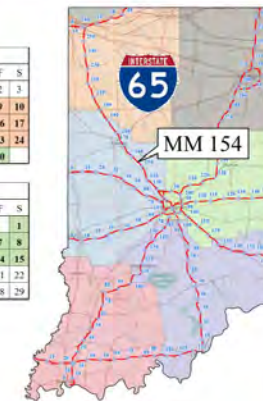
- Hard braking events reduce to near **0** and no crashes

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	

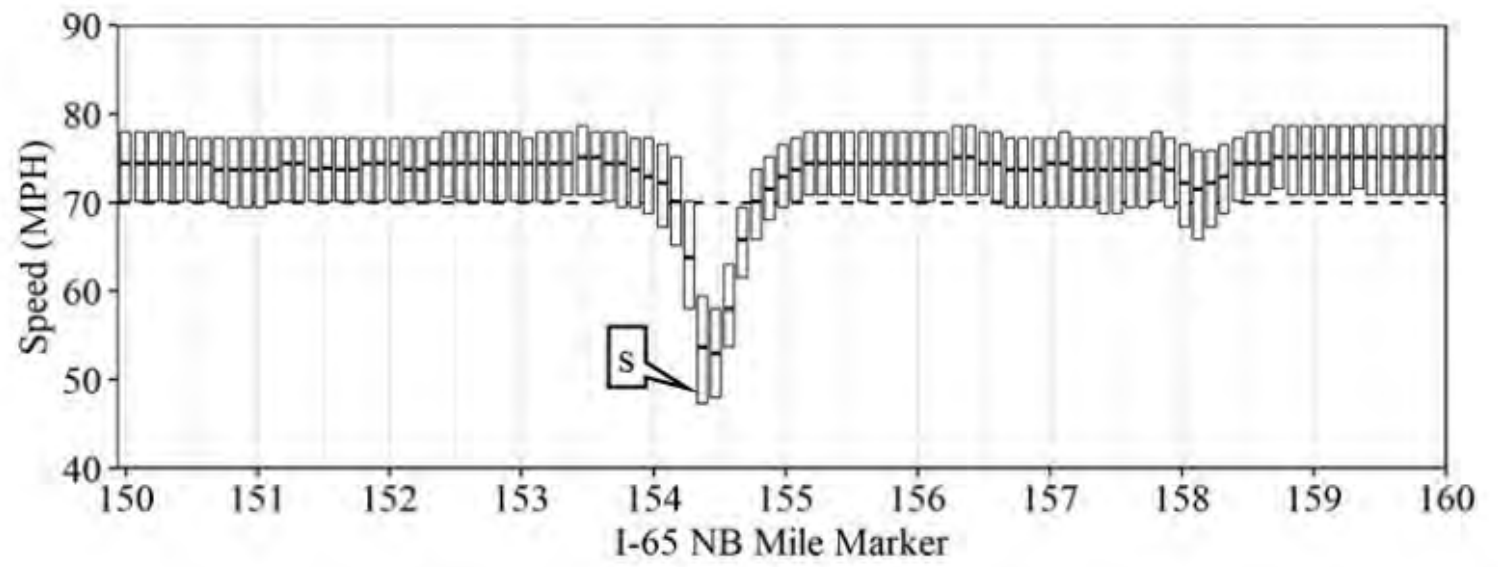
May 2021

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

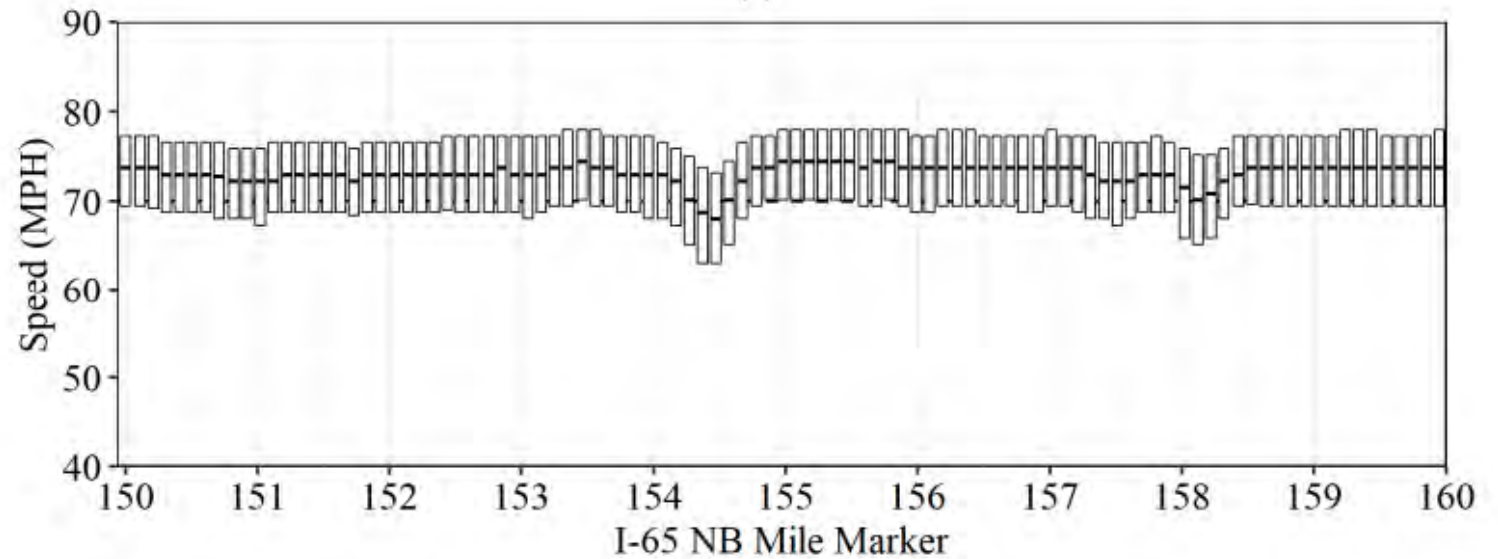




## Connected Vehicle Speeds During and After the Lane Shift



(a)

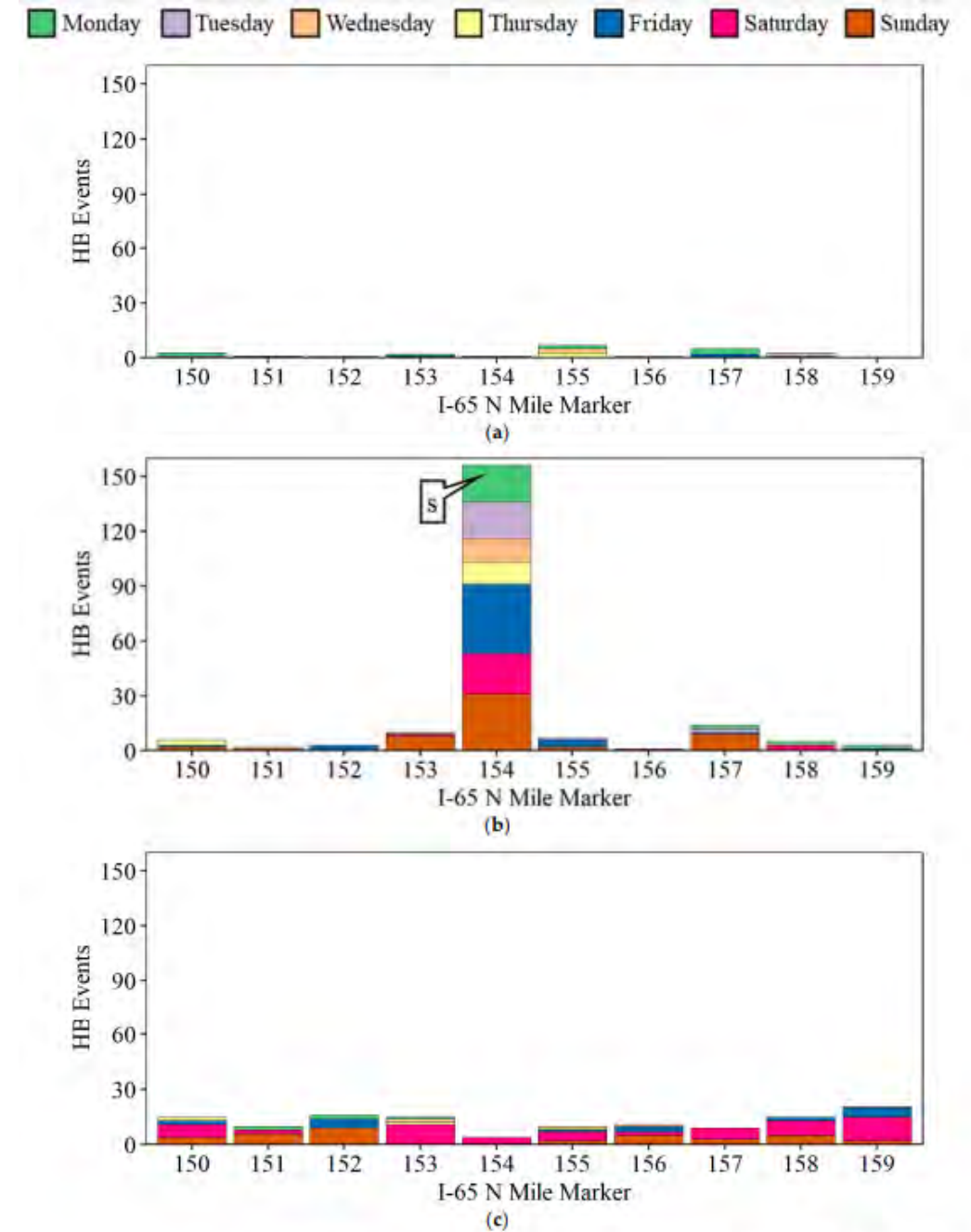


(b)

**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).



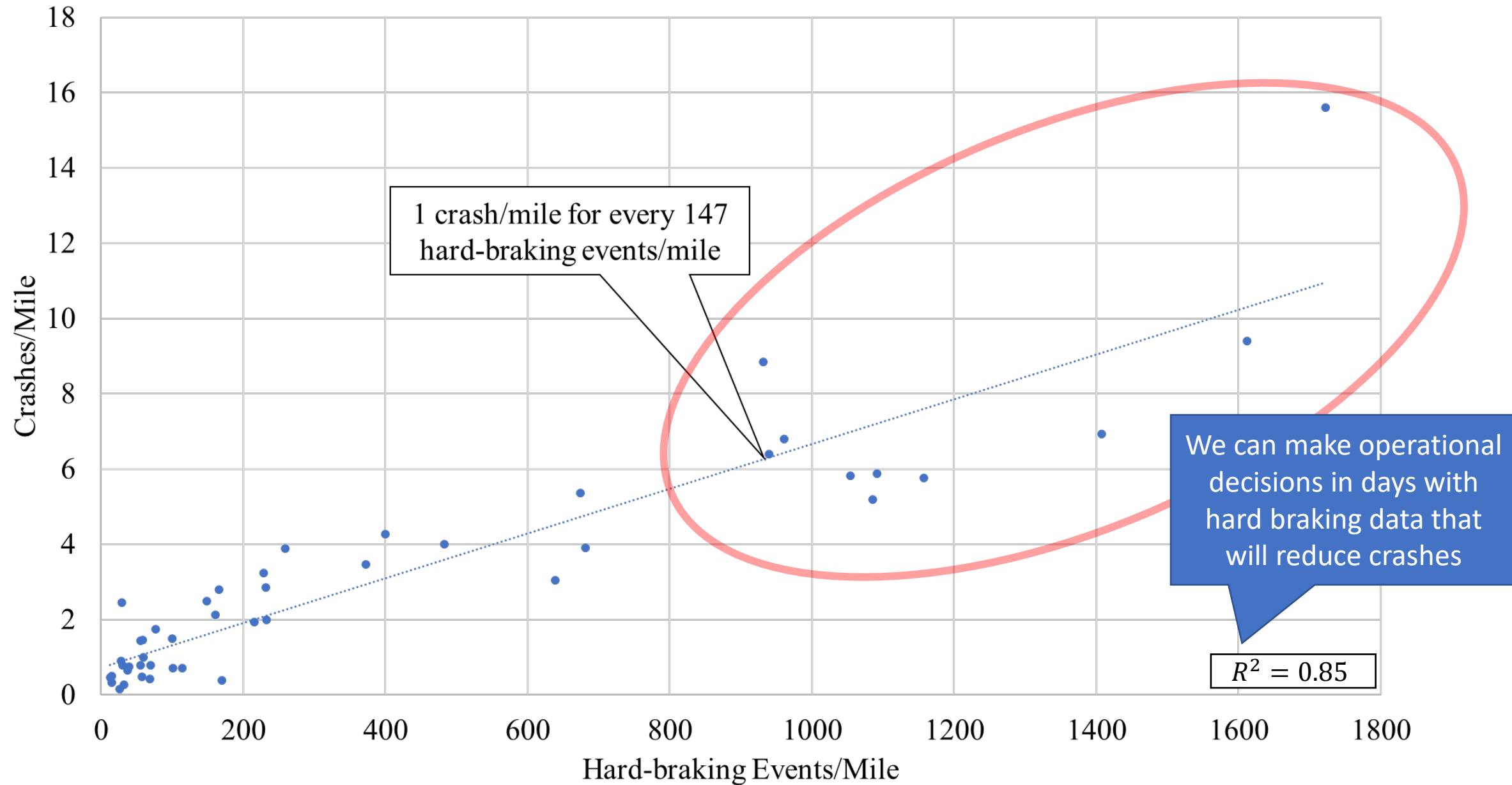
## Hard-braking Events in Region of Lane Shift By Mile Marker



**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







Example of Why Hard  
Braking is Good Predictor

# Location of 47 Primary Crashes on Indiana Interstates Analyzed in Study

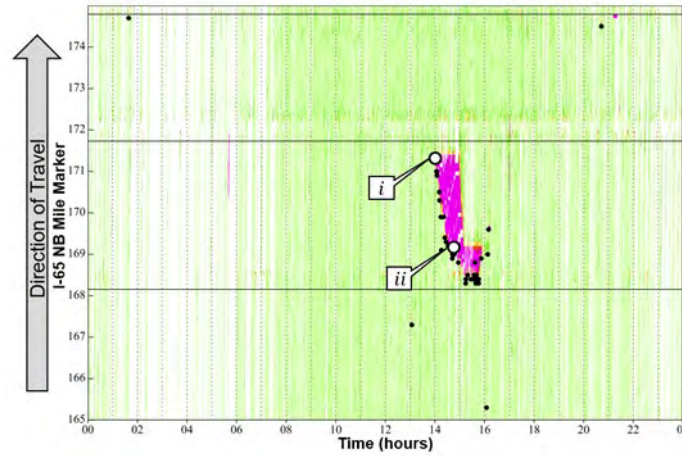
Curated to exclude  
weather &  
congestion



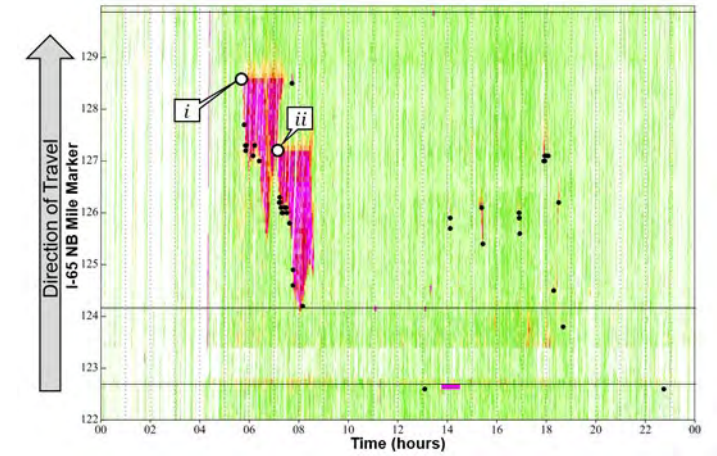




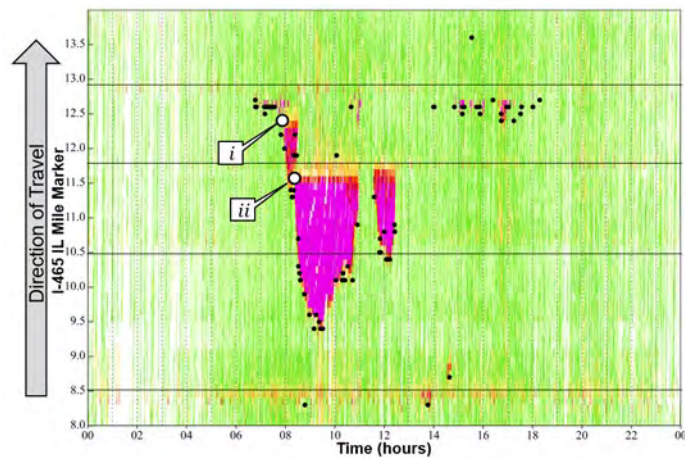
# Selected Examples with secondary crashes



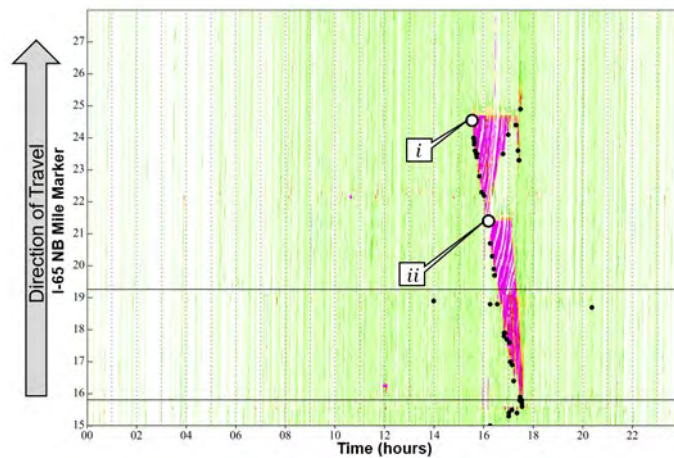
(b) I-65 NB, September 07, 2024



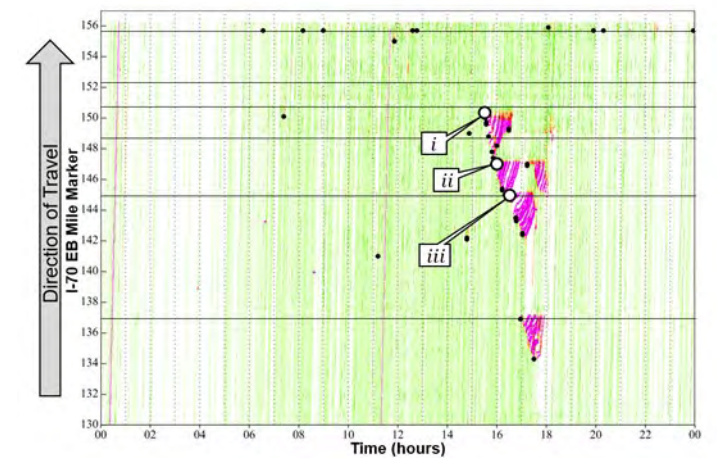
(c) I-65 NB, July 16, 2024



(d) I-465 IL, October 31, 2024



(e) I-65 NB, October 08, 2024

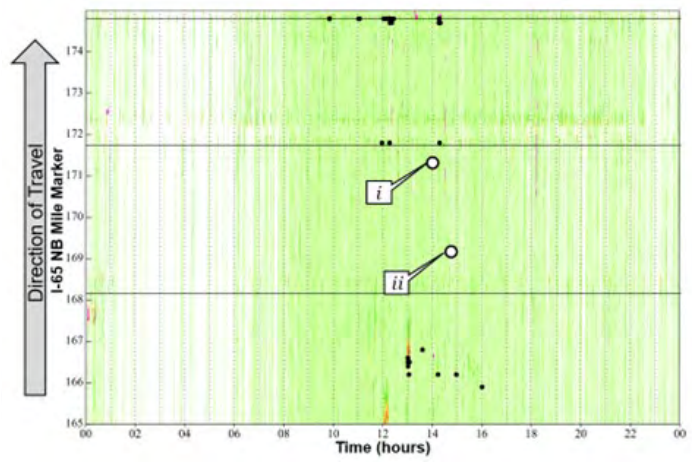


(f) I-70 EB, August 08, 2024

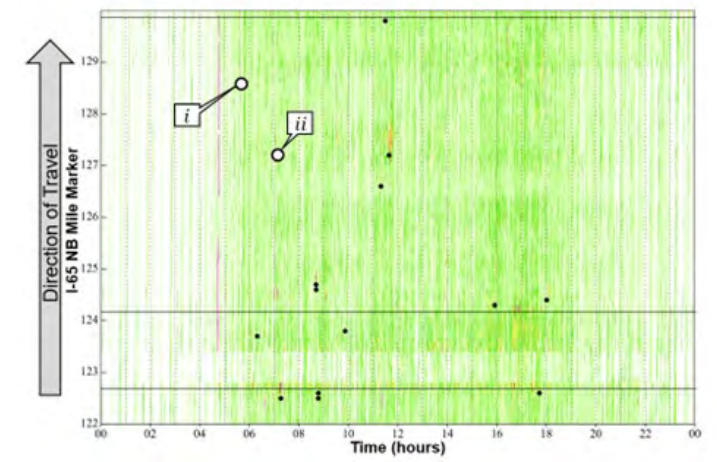




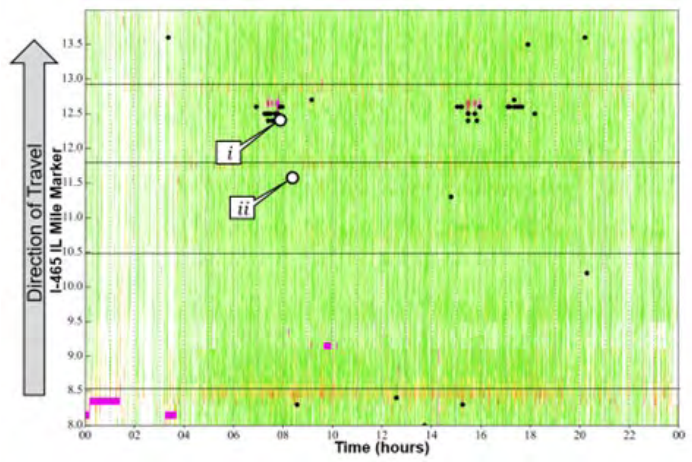
# Selected Examples week before or after crash event



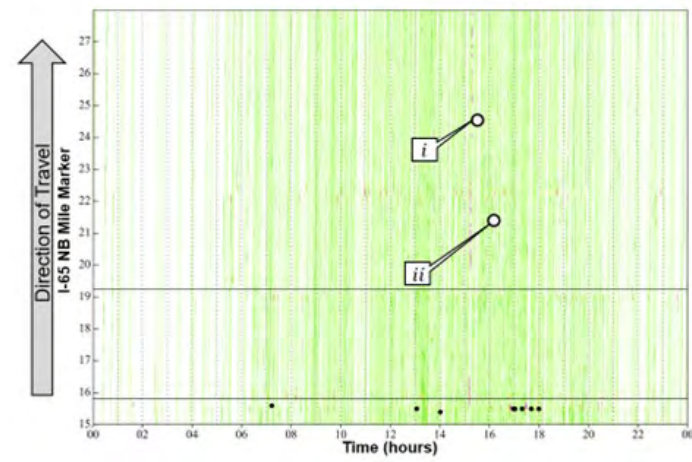
(b) I-65 NB, September 14, 2024



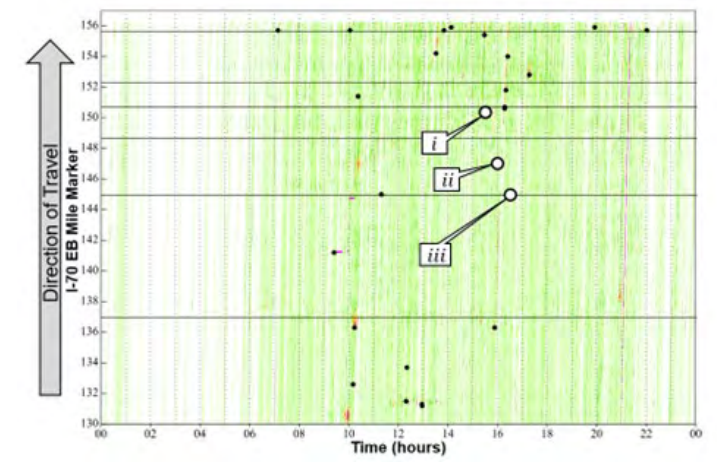
(c) I-65 NB, July 23, 2024



(d) I-465 IL, November 07, 2024

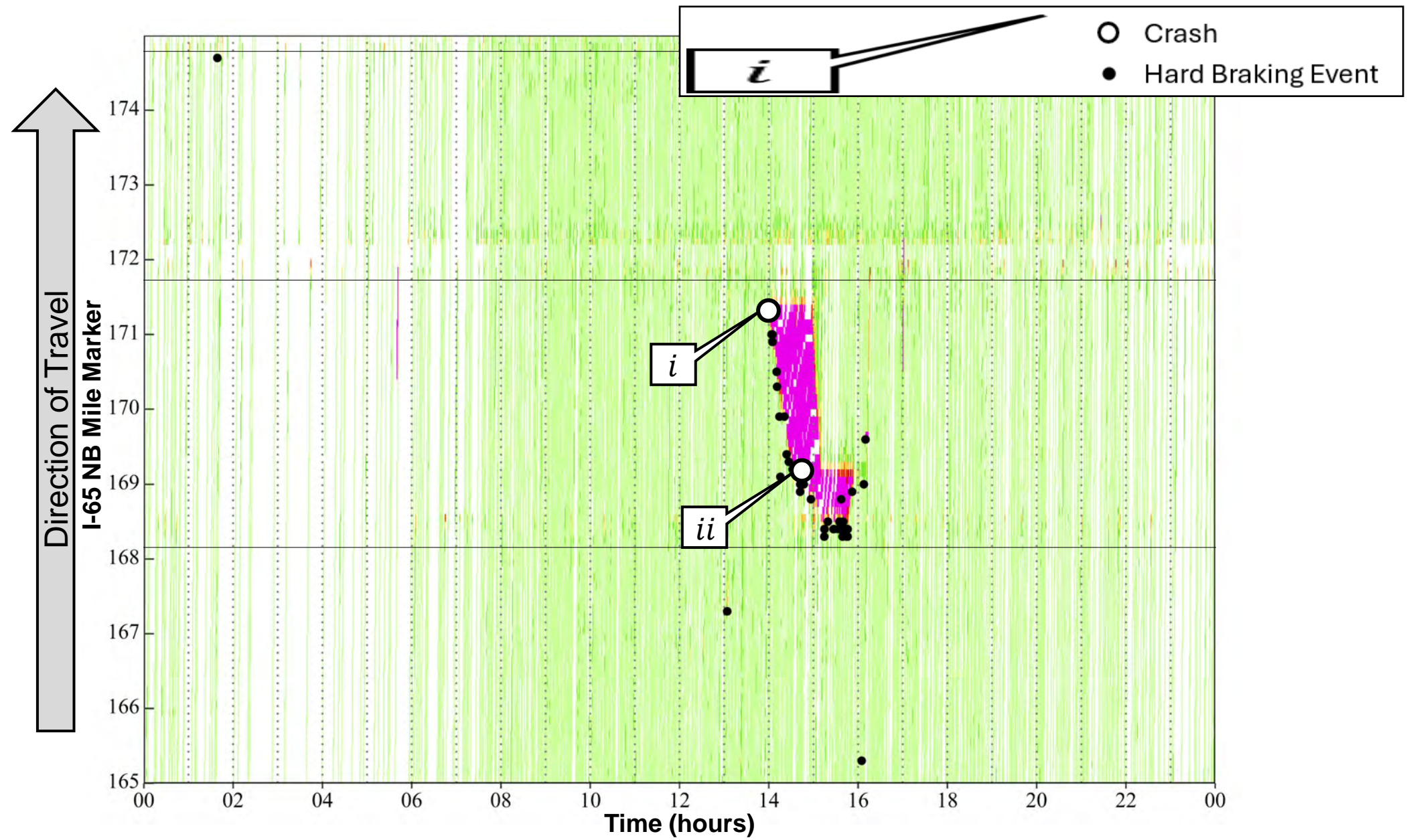


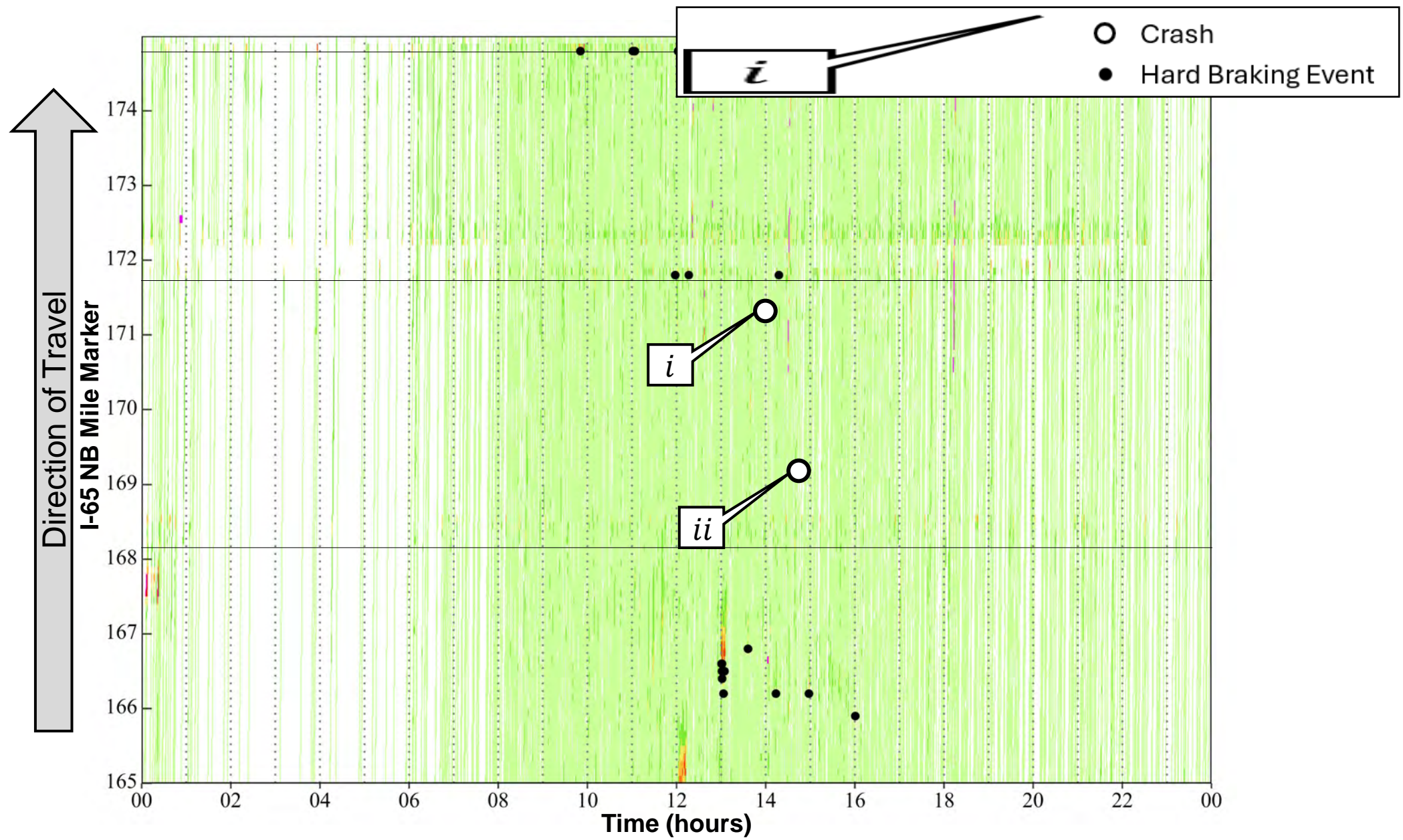
(e) I-65 NB, October 15, 2024



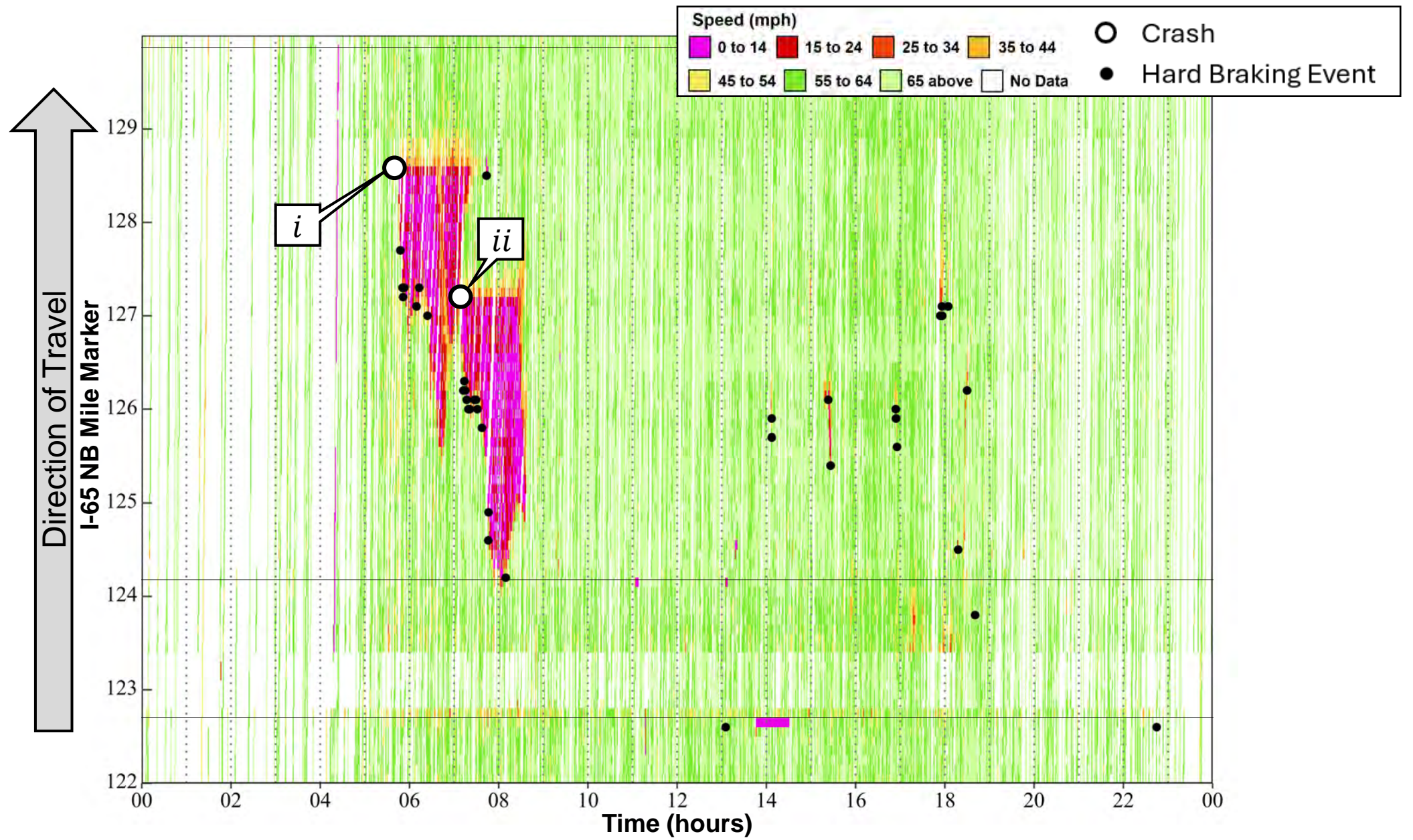
(f) I-70 EB, August 15, 2024



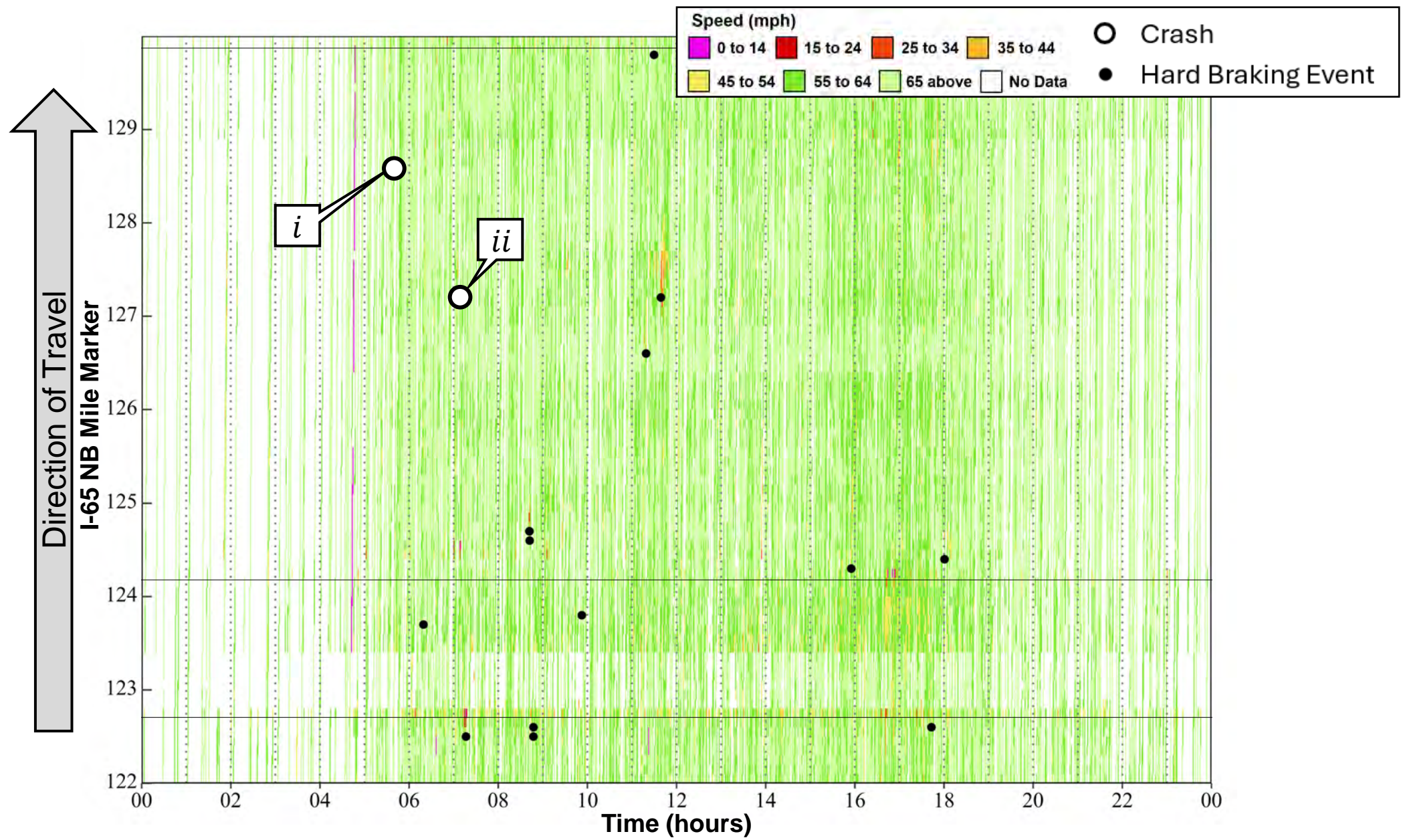




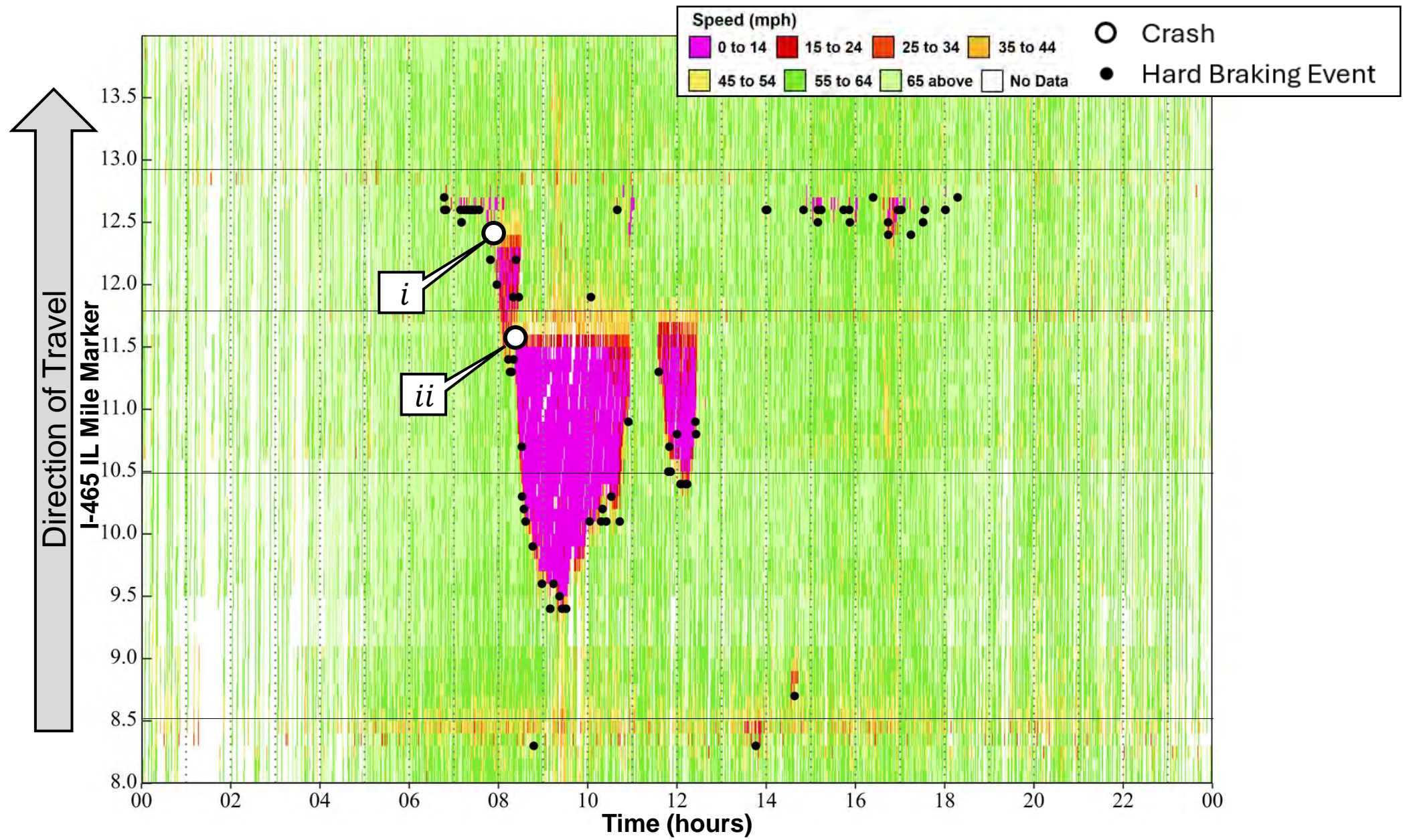




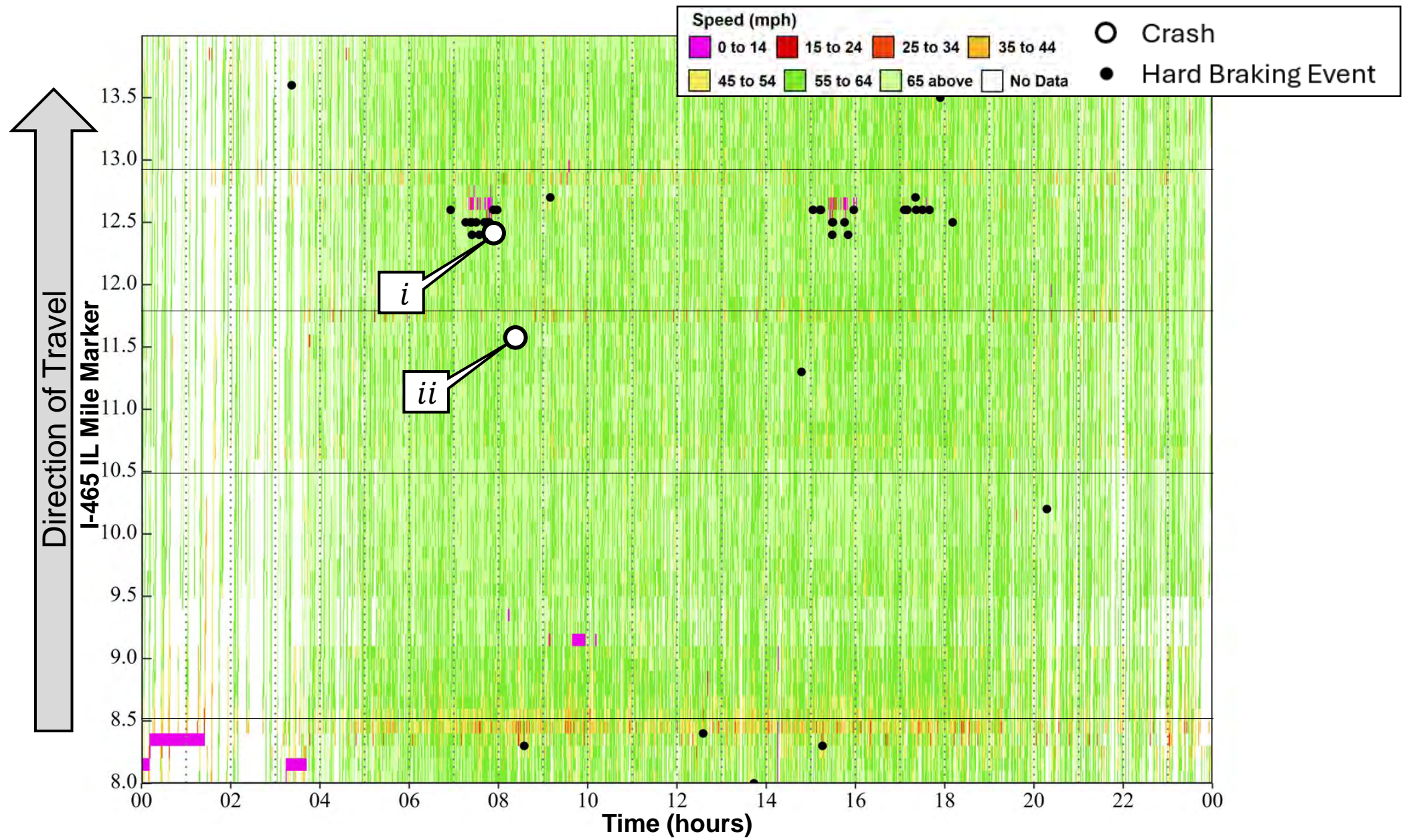




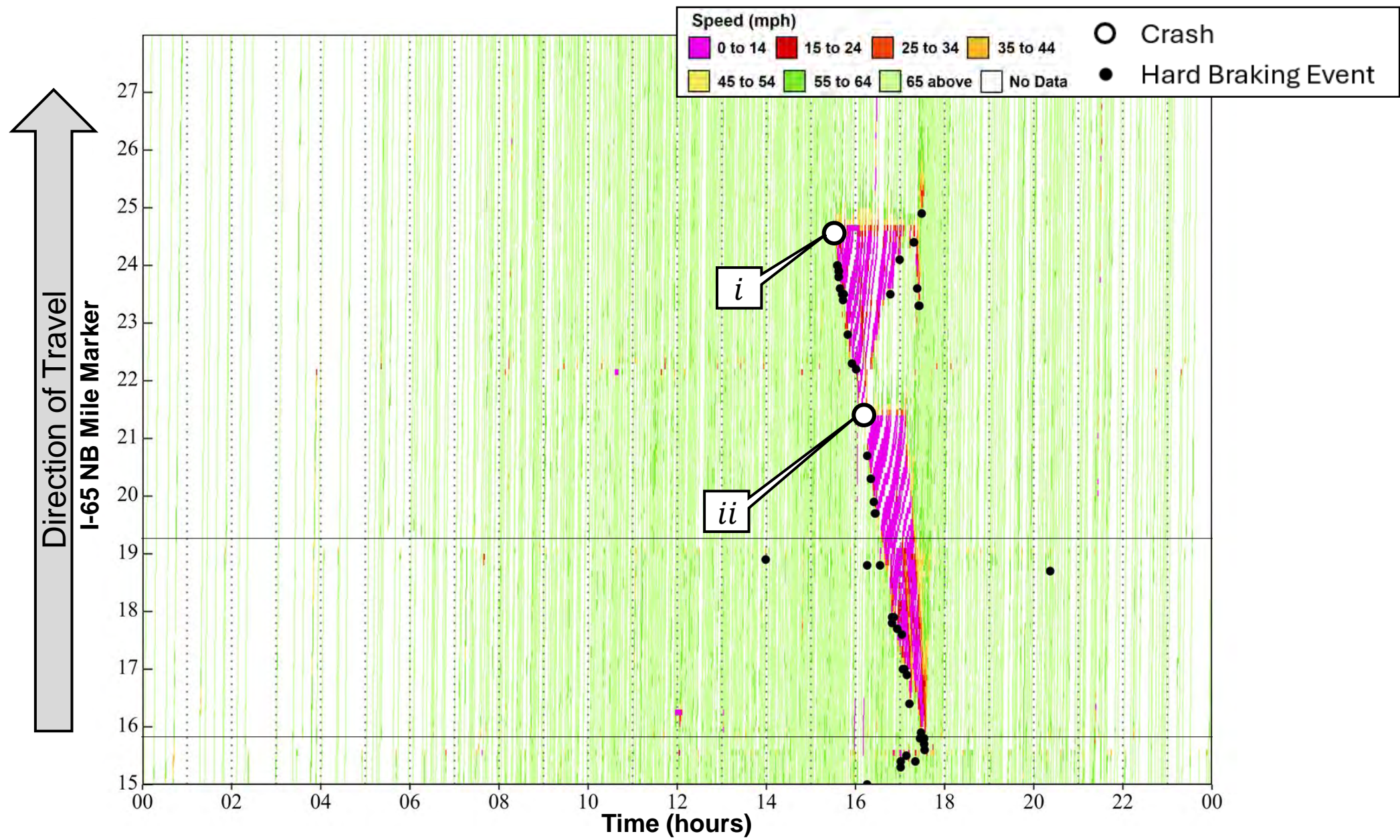




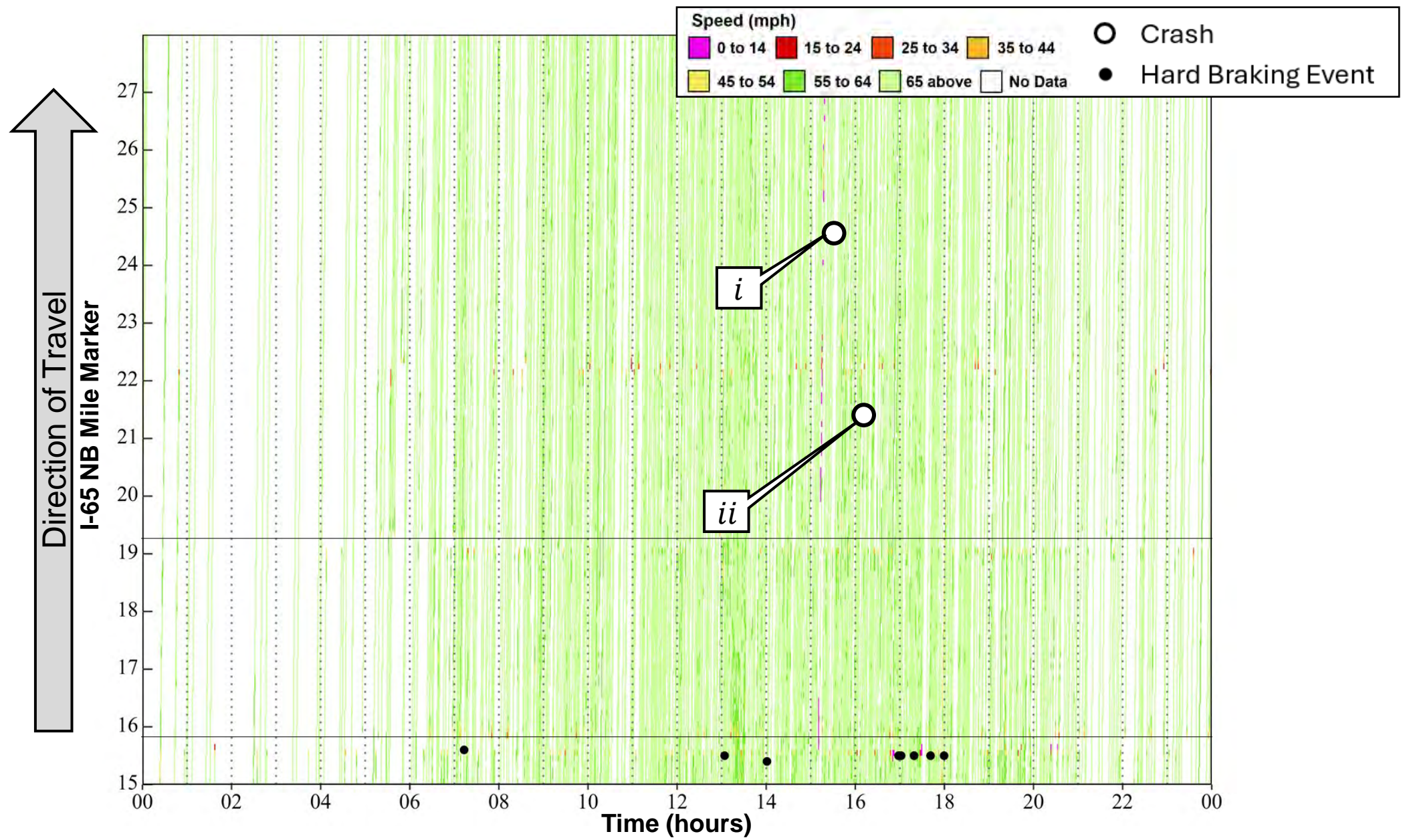




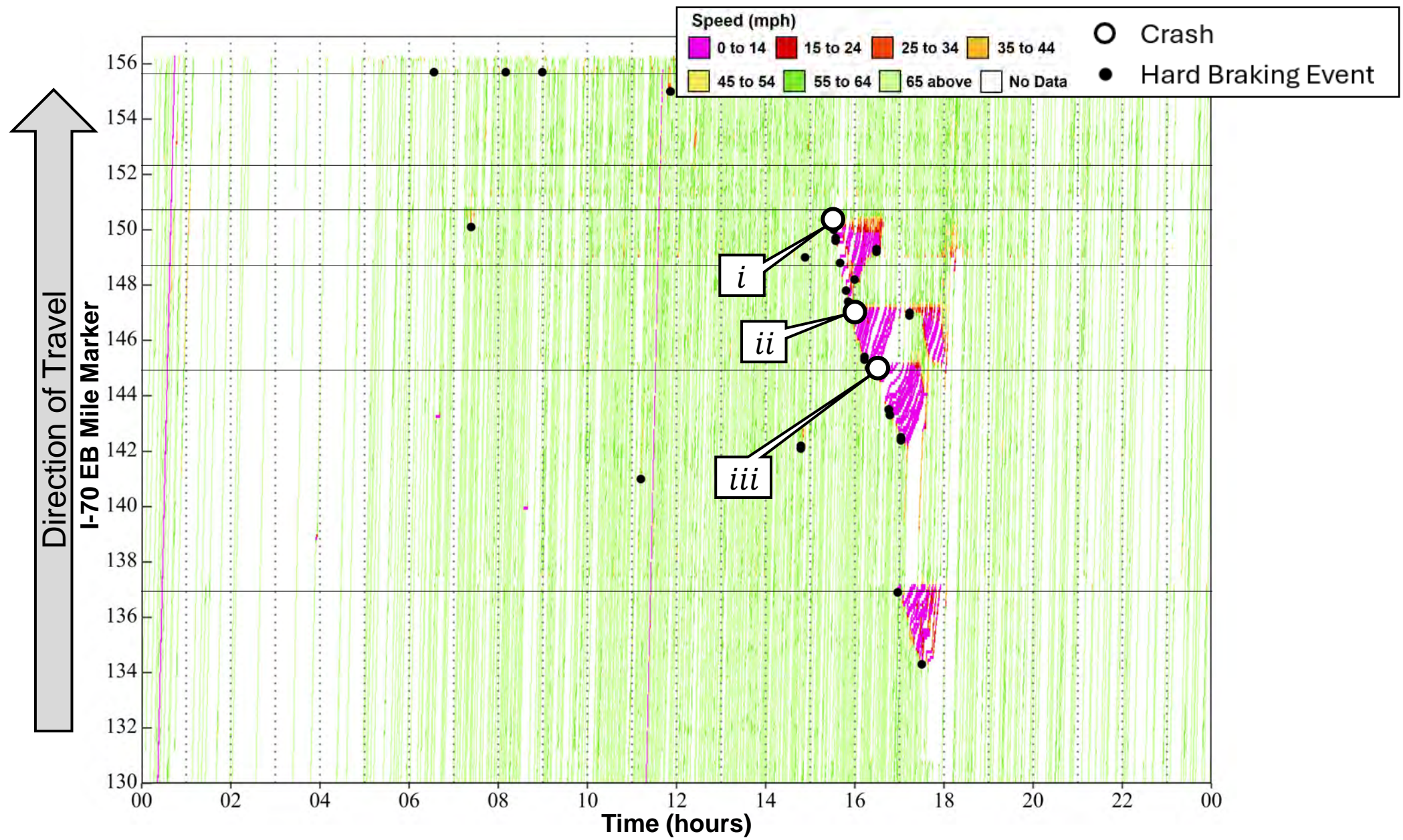




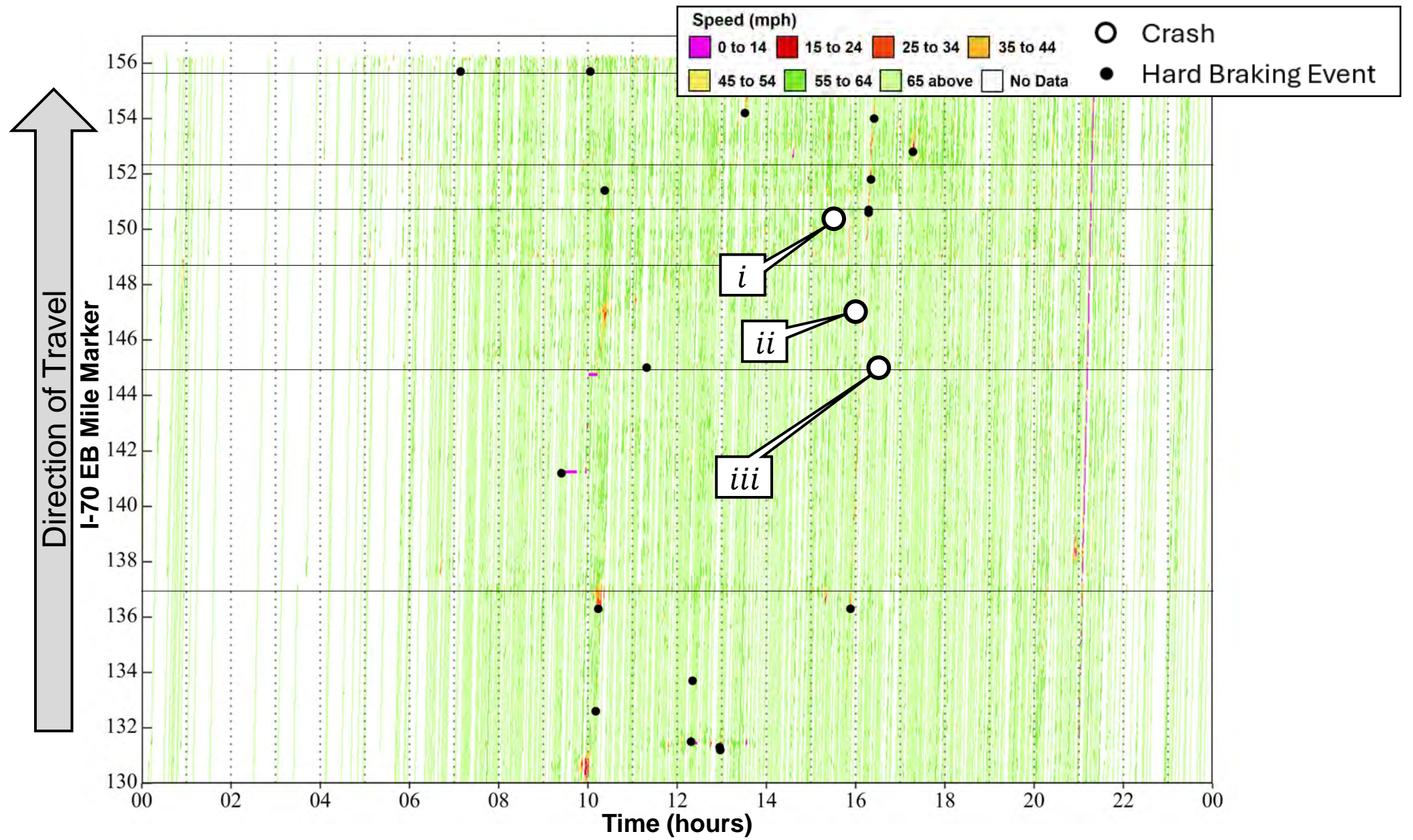






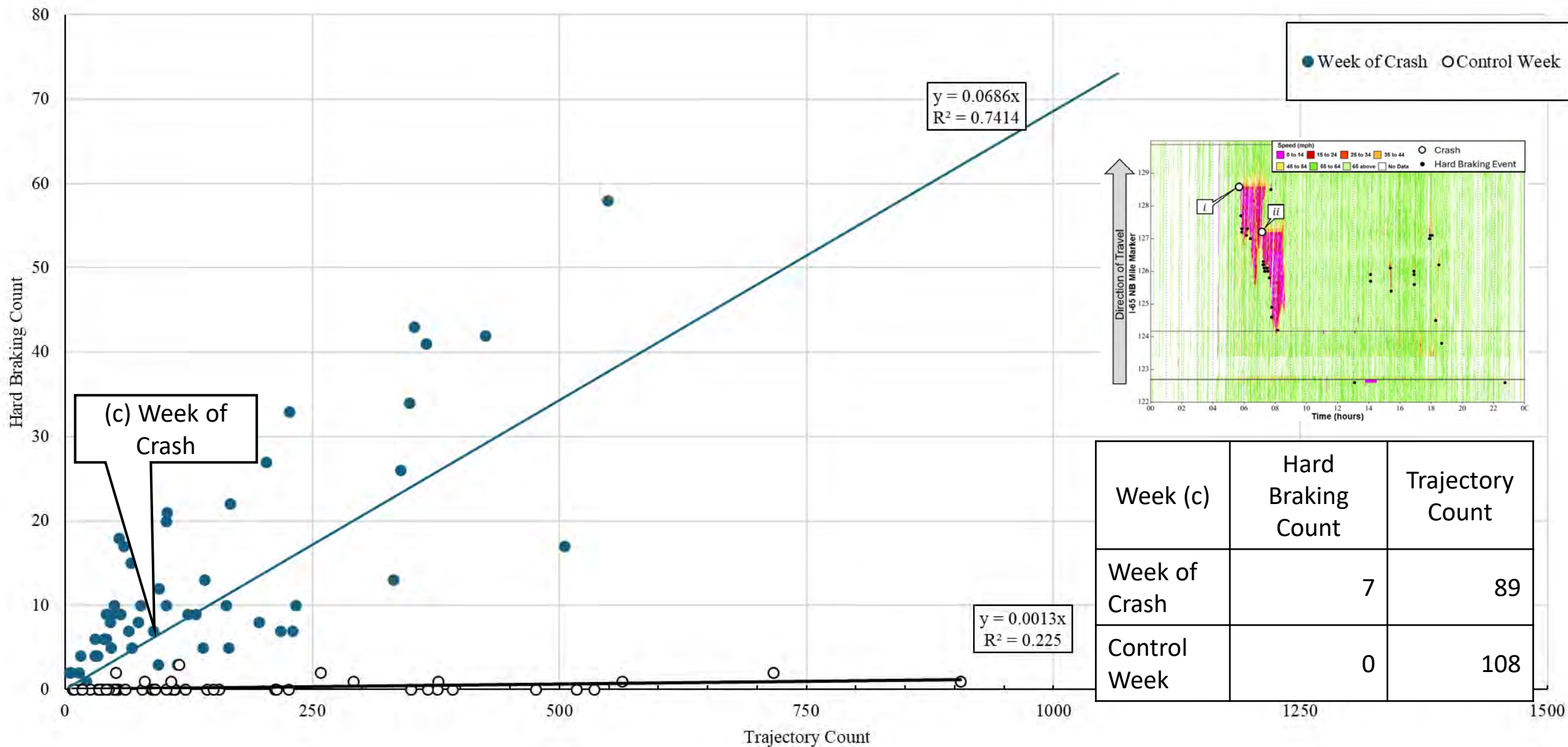




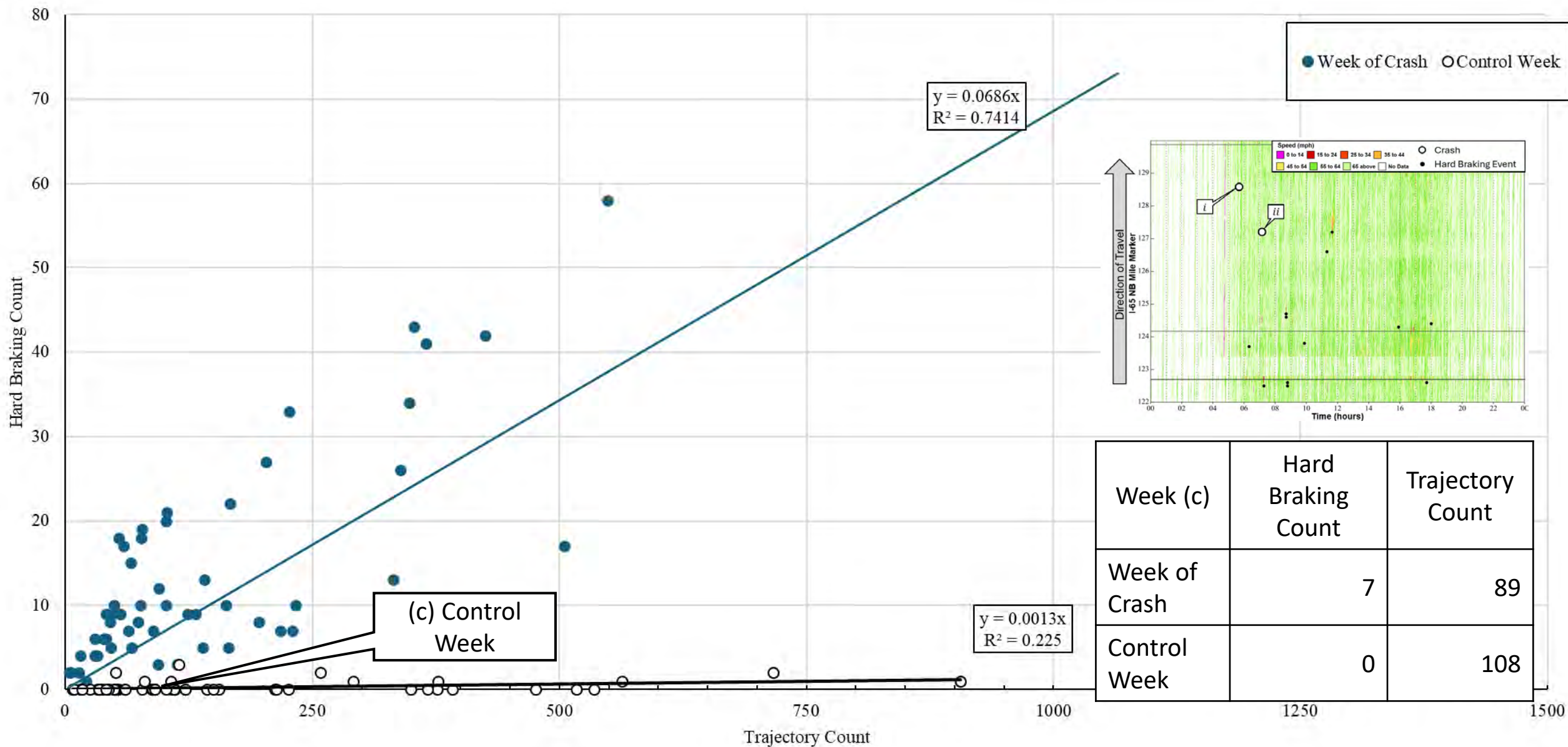




# HB against Trajectory

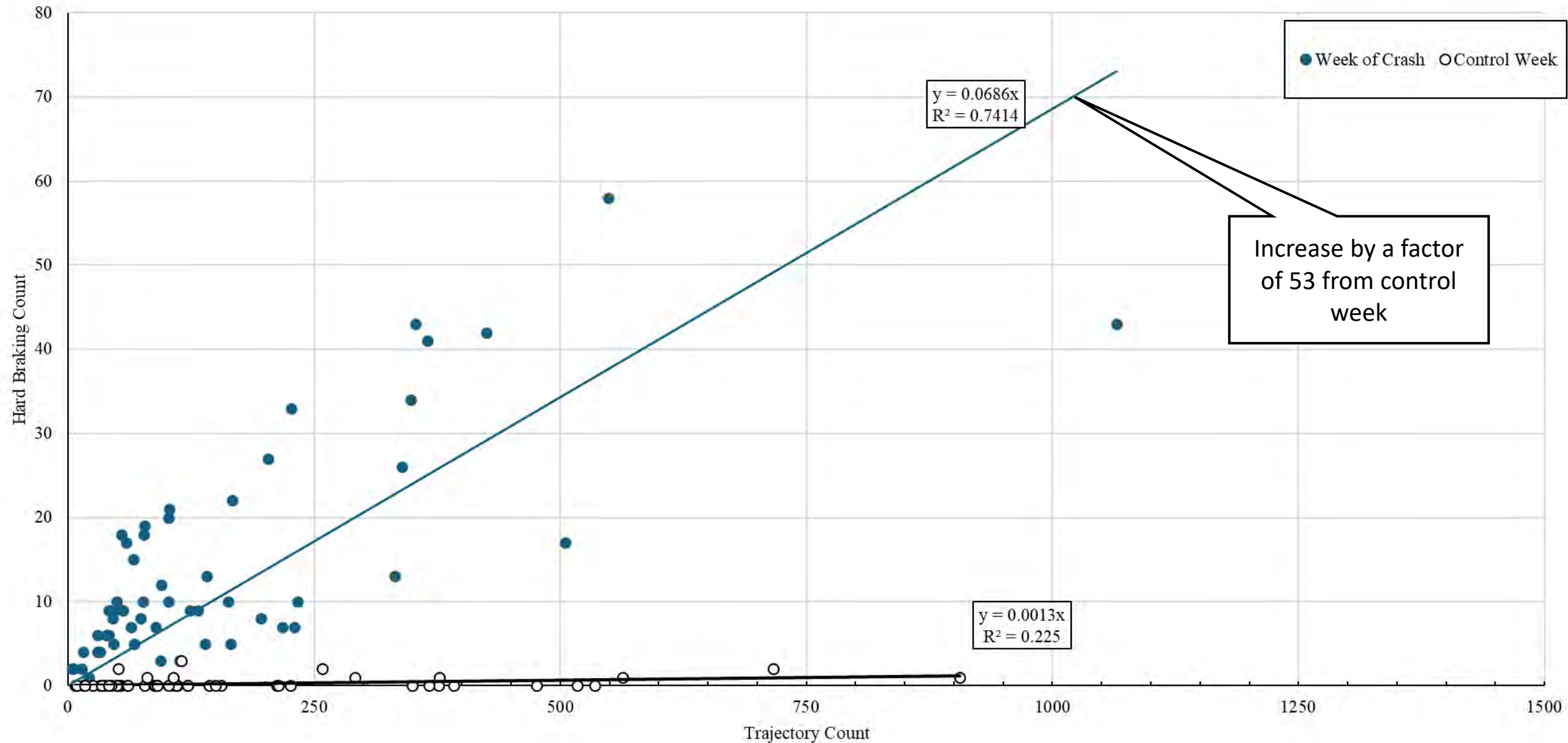


# HB against Trajectory





# HB against Trajectory



MM 236 July 2025







Mon 04 / 28

Tue 04 / 29

Wed 04 / 30

Thu 05 / 01

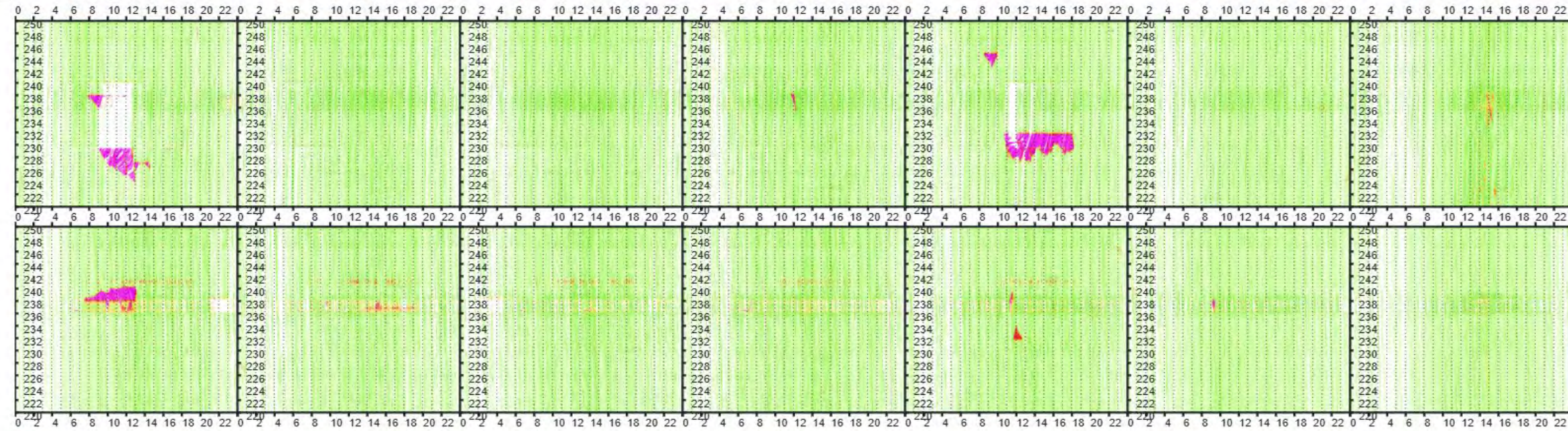
Fri 05 / 02

Sat 05 / 03

Sun 05 / 04

N

S



Mon 05 / 05

Tue 05 / 06

Wed 05 / 07

Thu 05 / 08

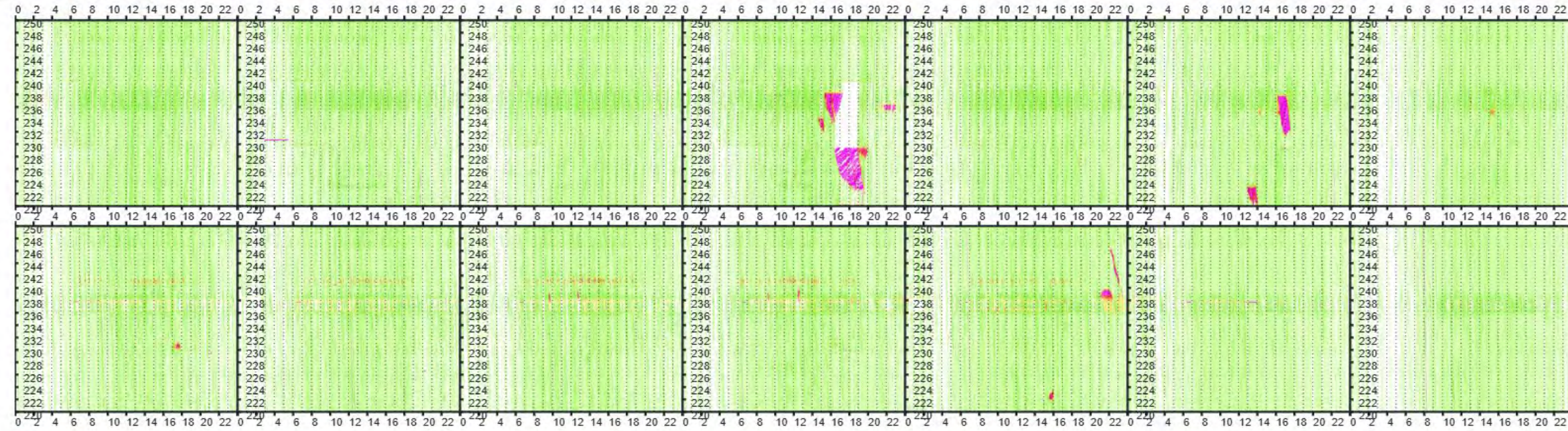
Fri 05 / 09

Sat 05 / 10

Sun 05 / 11

N

S







Mon 05 / 12

Tue 05 / 13

Wed 05 / 14

Thu 05 / 15

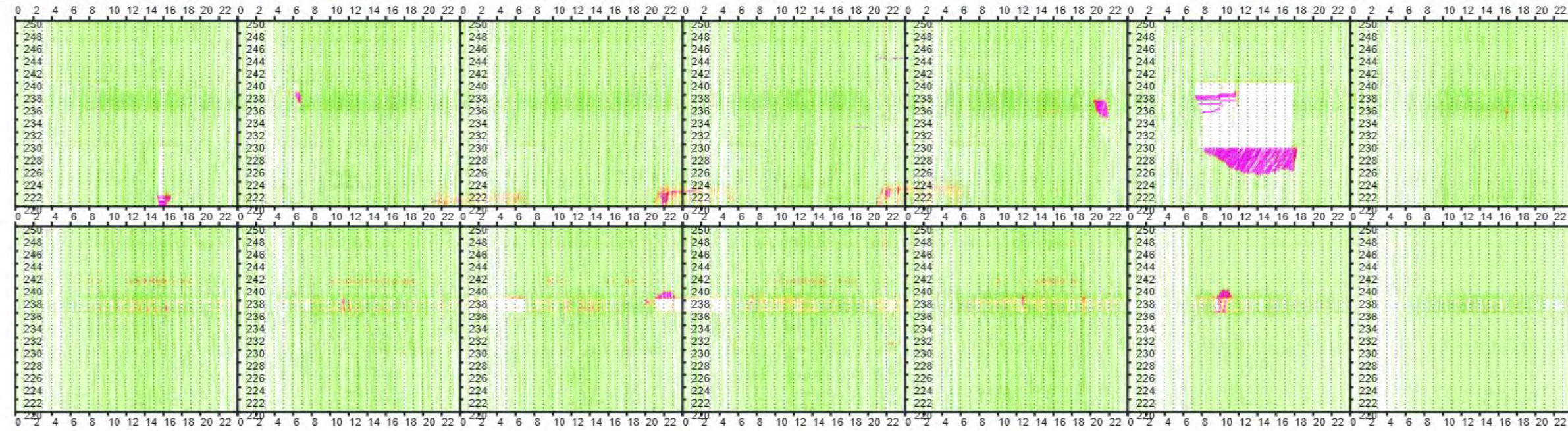
Fri 05 / 16

Sat 05 / 17

Sun 05 / 18

N

S



Mon 05 / 19

Tue 05 / 20

Wed 05 / 21

Thu 05 / 22

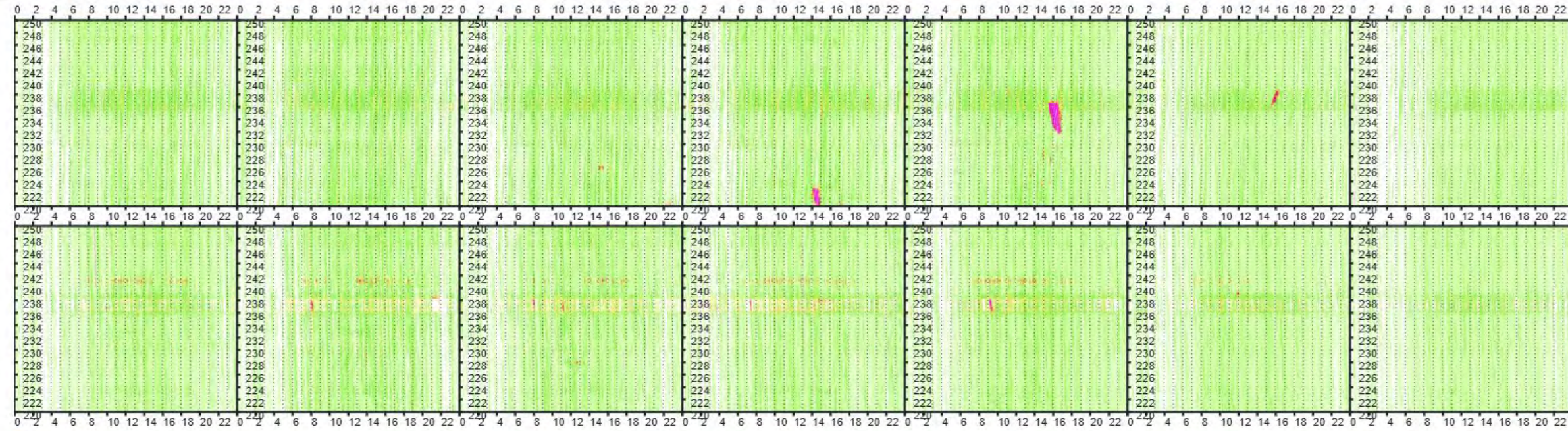
Fri 05 / 23

Sat 05 / 24

Sun 05 / 25

N

S







Mon 05 / 26

Tue 05 / 27

Wed 05 / 28

Thu 05 / 29

Fri 05 / 30

Sat 05 / 31

Sun 06 / 01

N

S



Mon 06 / 02

Tue 06 / 03

Wed 06 / 04

Thu 06 / 05

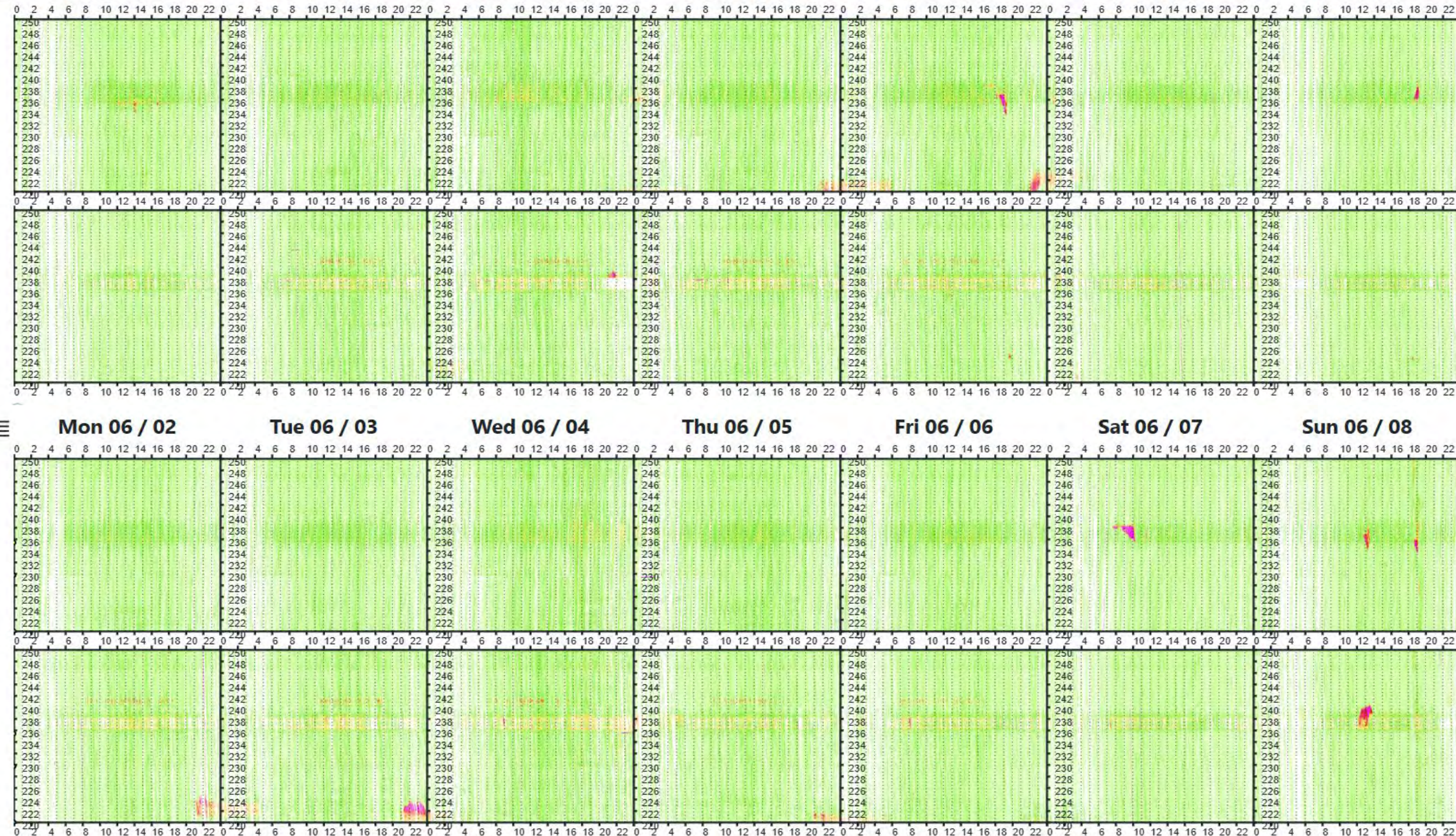
Fri 06 / 06

Sat 06 / 07

Sun 06 / 08

N

S







Mon 06 / 09

Tue 06 / 10

Wed 06 / 11

Thu 06 / 12

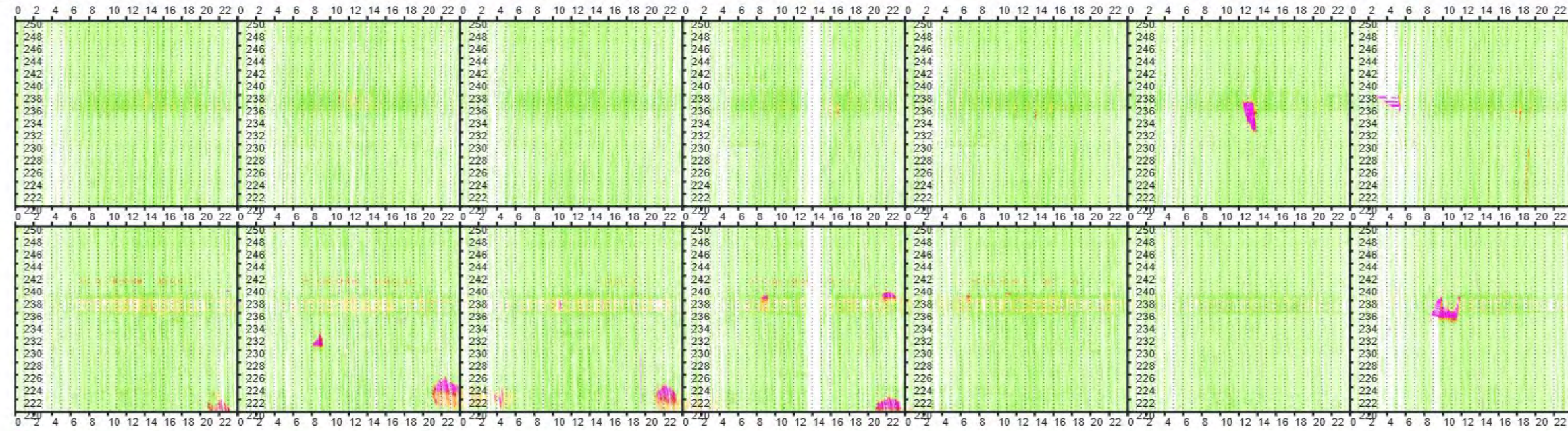
Fri 06 / 13

Sat 06 / 14

Sun 06 / 15

N

S



Mon 06 / 16

Tue 06 / 17

Wed 06 / 18

Thu 06 / 19

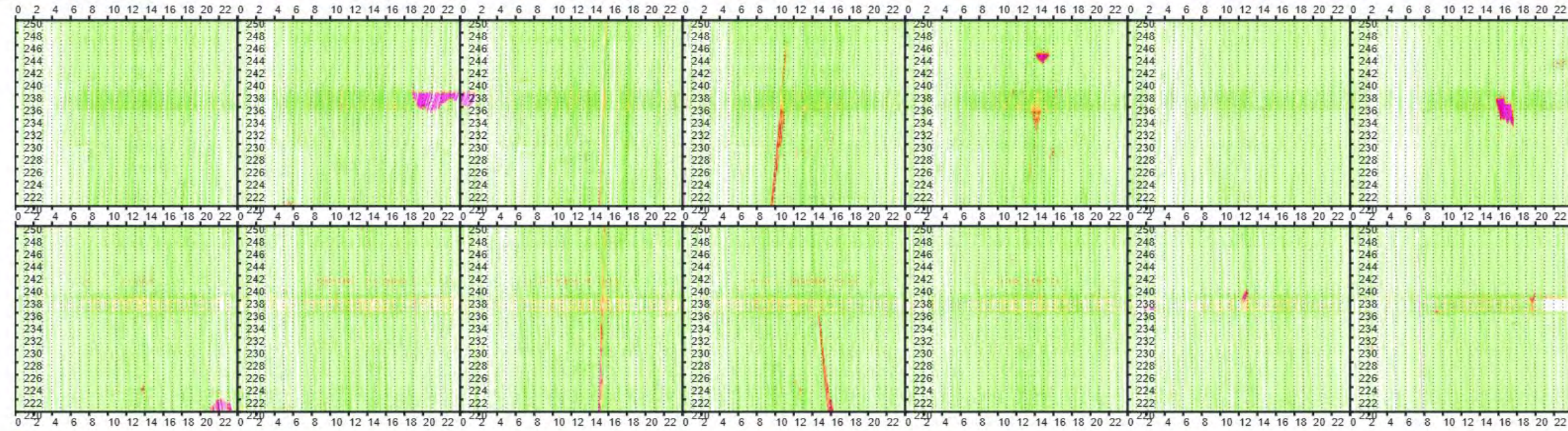
Fri 06 / 20

Sat 06 / 21

Sun 06 / 22

N

S







Mon 06 / 23

Tue 06 / 24

Wed 06 / 25

Thu 06 / 26

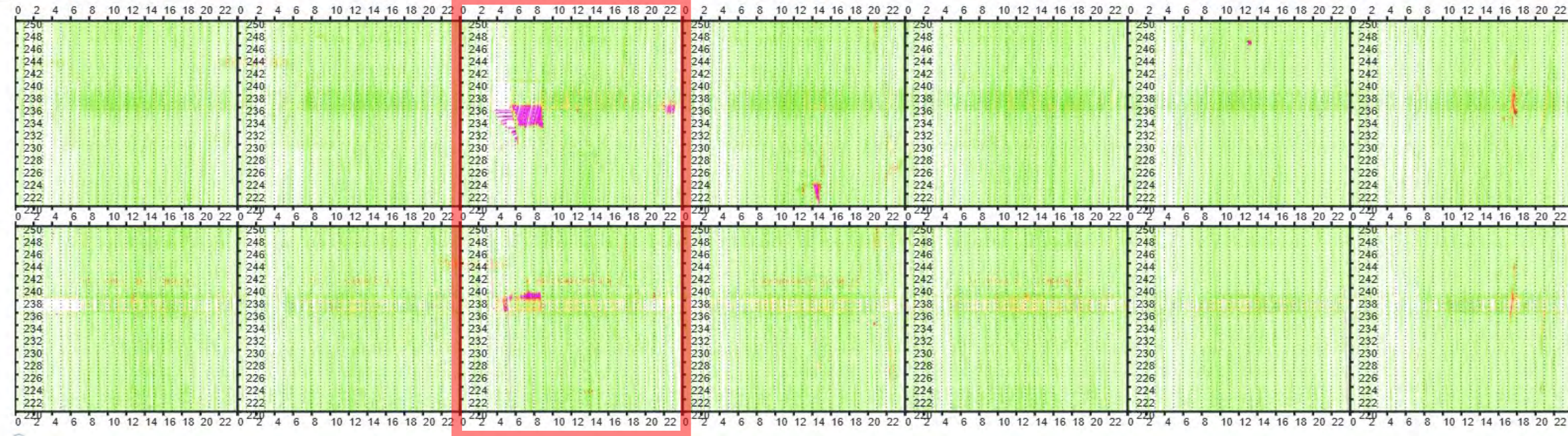
Fri 06 / 27

Sat 06 / 28

Sun 06 / 29

N

S



Mon 06 / 30

Tue 07 / 01

Wed 07 / 02

Thu 07 / 03

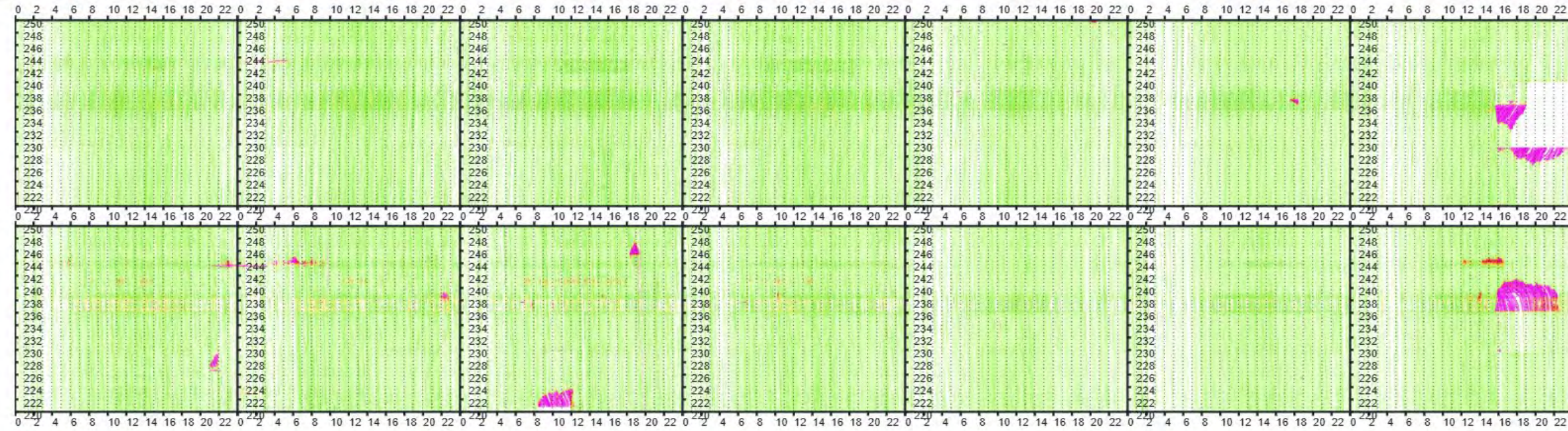
Fri 07 / 04

Sat 07 / 05

Sun 07 / 06

N

S

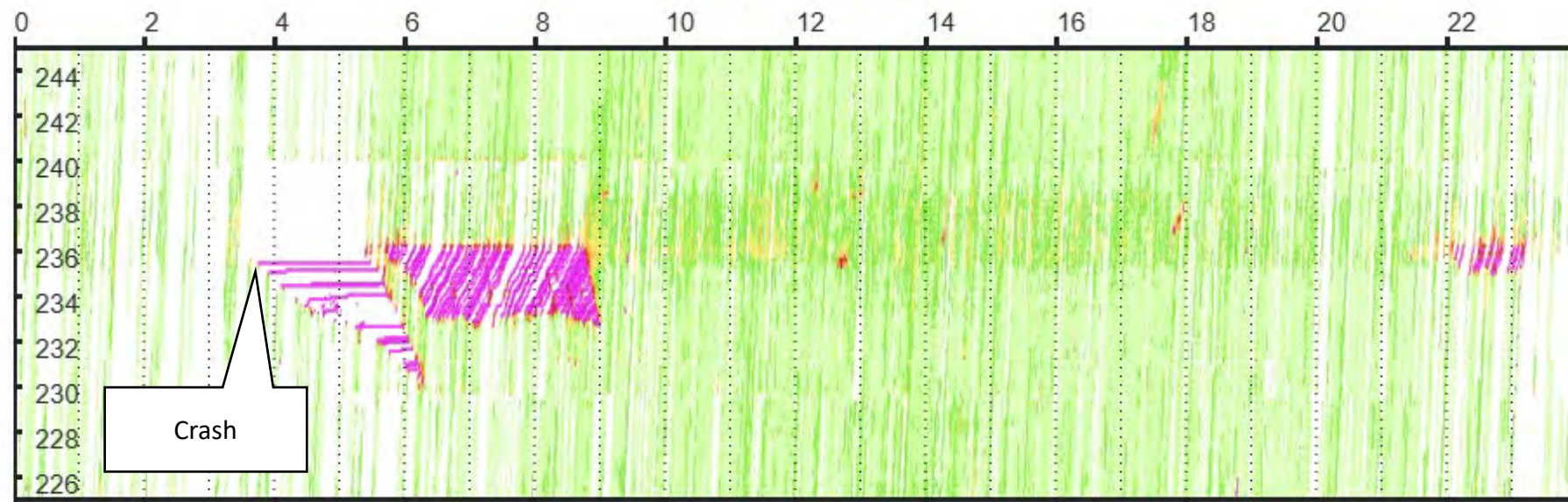




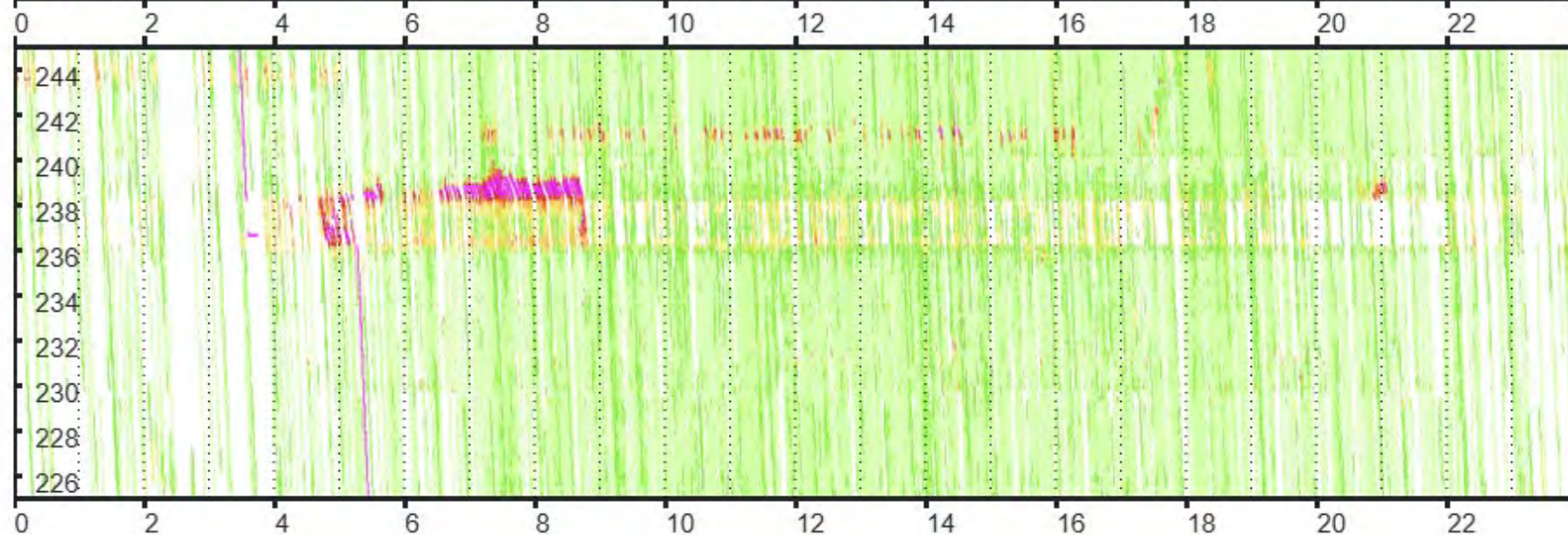


Wed 06 / 25

N



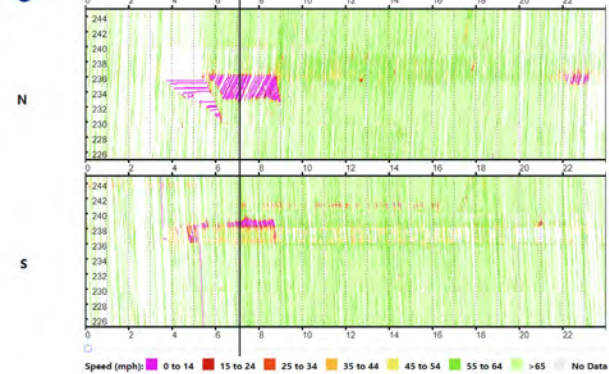
S



Speed (mph): 0 to 14 15 to 24 25 to 34 35 to 44 45 to 54 55 to 64 > 65 No Data



## I-65/235.4 217TH AVE

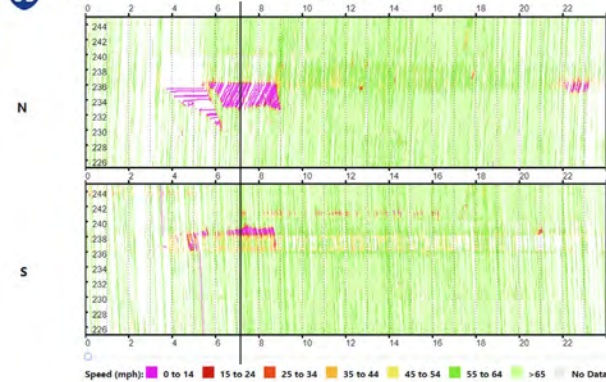


2025-06-25 06:04:24

N

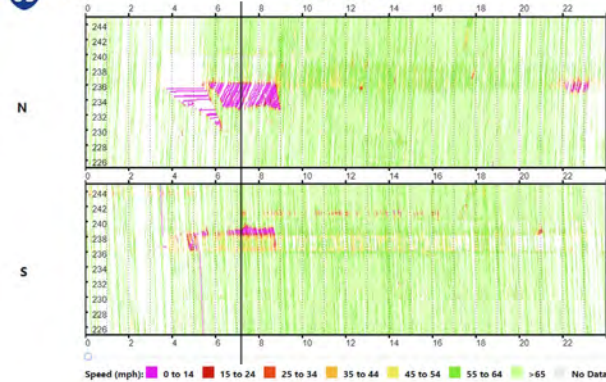


## I-65/235.4 217TH AVE





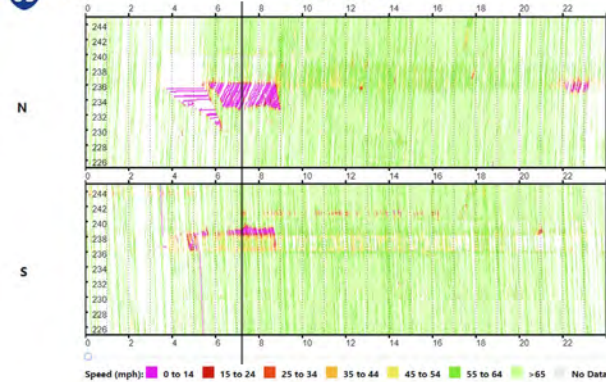
## I-65/235.4 217TH AVE



Arrow board  
truck brought in

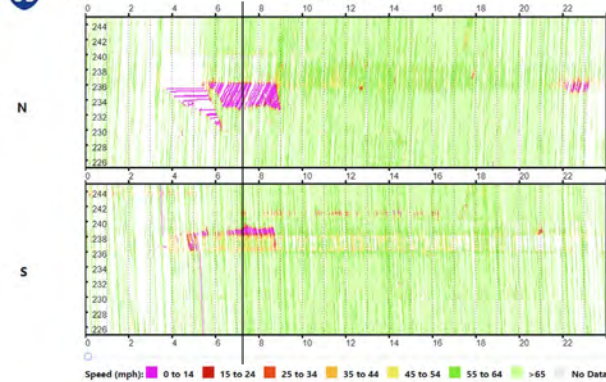


## I-65/235.4 217TH AVE



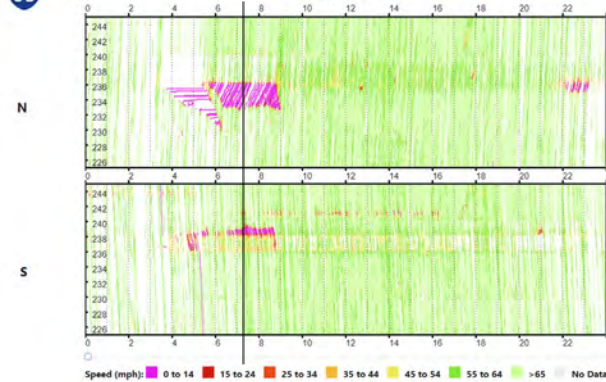


## I-65/235.4 217TH AVE





## I-65/235.4 217TH AVE





65

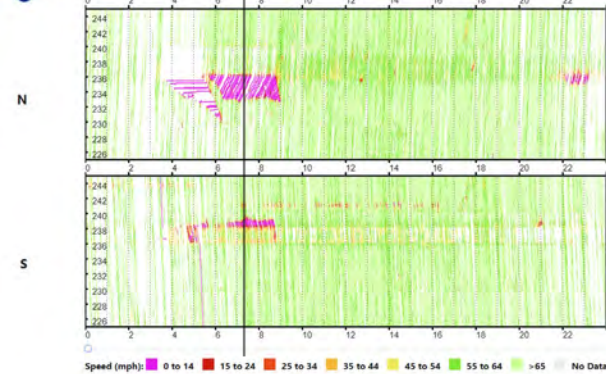
Wed 06 / 25

I-65/235.4 217TH AVE



N

S

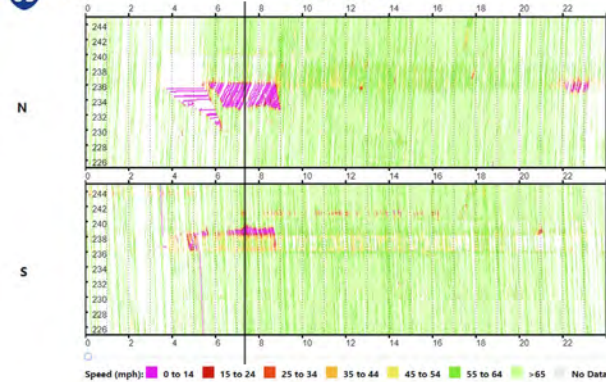


2025-06-25 06:16:24

N



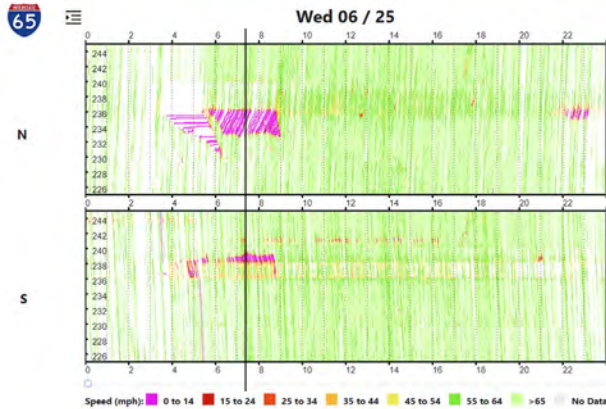
## I-65/235.4 217TH AVE



2025-06-25 06:18:23

N





# I-65/235.4 217TH AVE

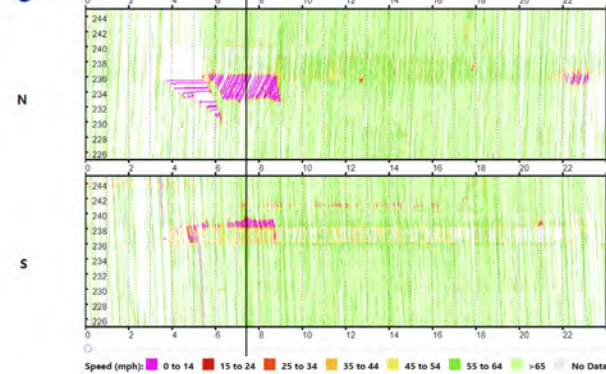


2025-06-25 06:20:24

N



## I-65/235.4 217TH AVE

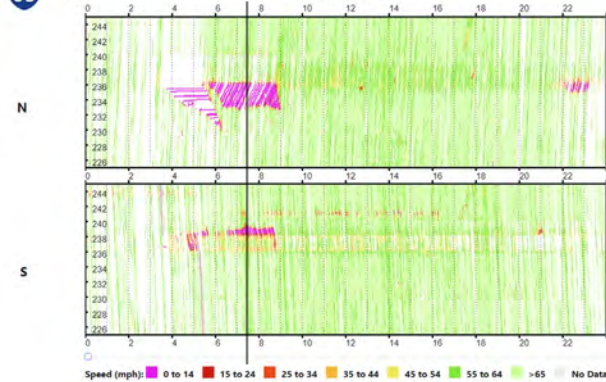


2025-06-25 06:22:23

N



# I-65/235.4 217TH AVE

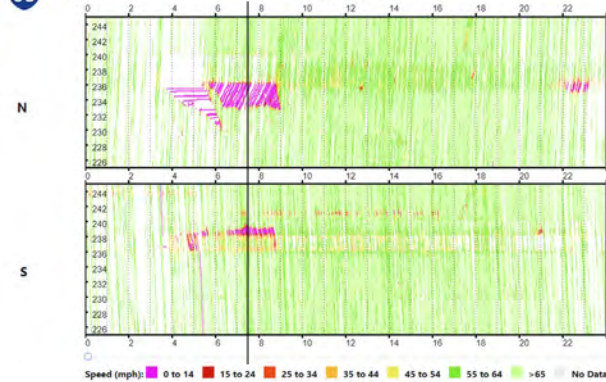


2025-06-25 06:24:24

N

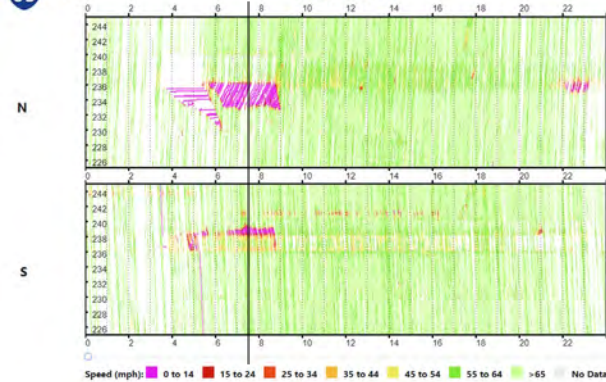


## I-65/235.4 217TH AVE





## I-65/235.4 217TH AVE

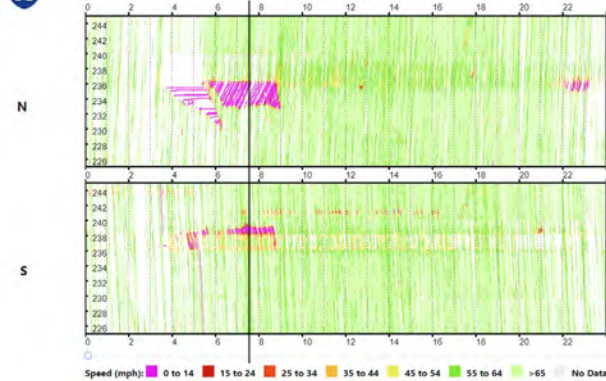


2025-06-25 06:28:24

N

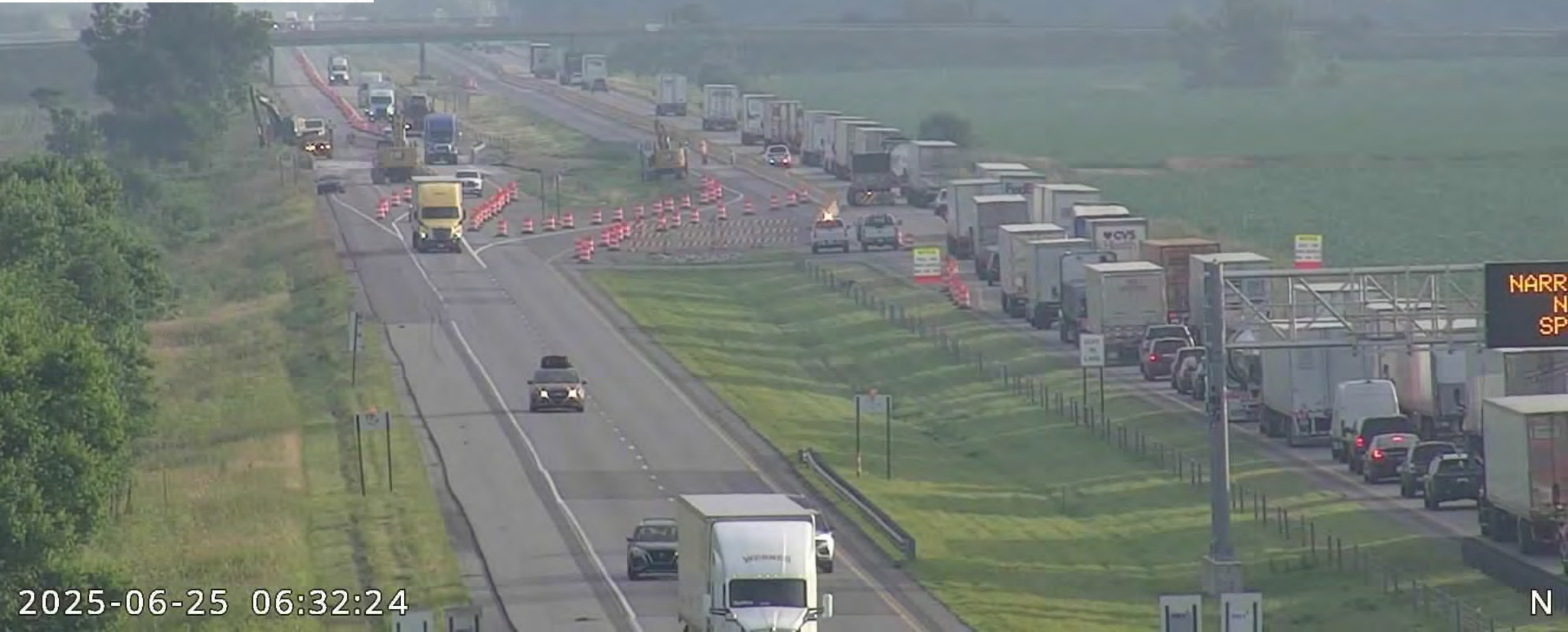
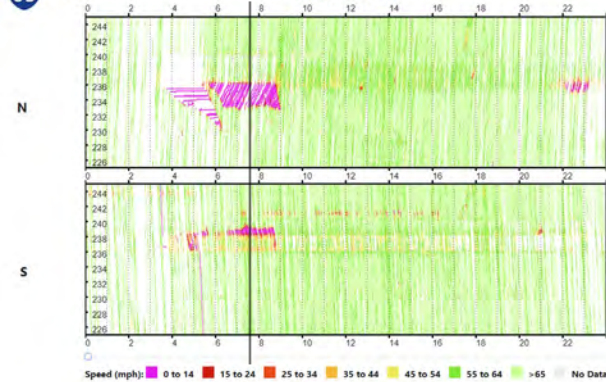


## I-65/235.4 217TH AVE



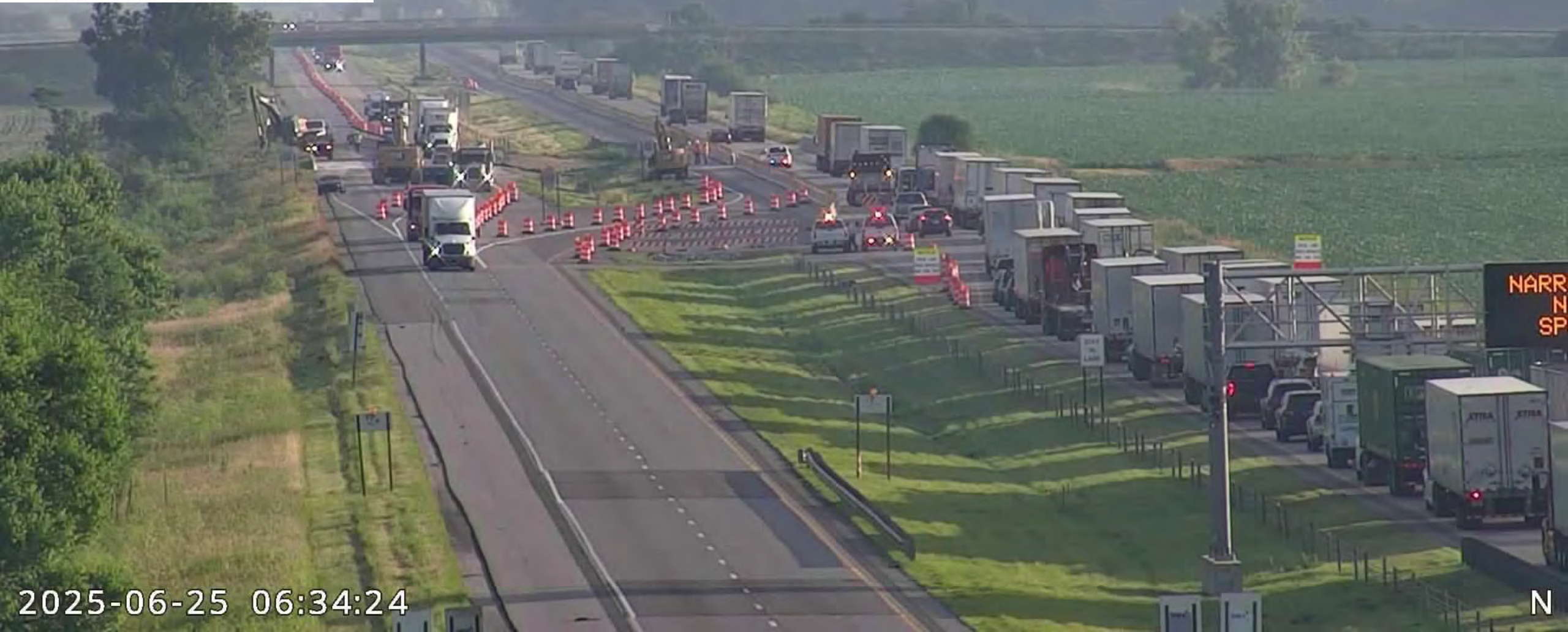
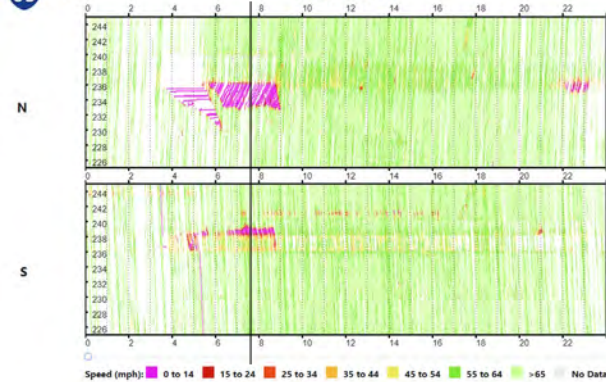


## I-65/235.4 217TH AVE



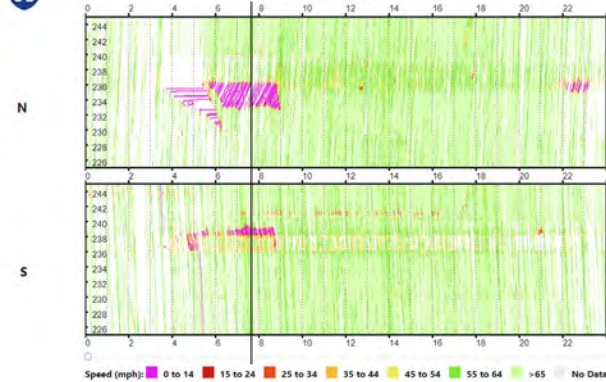


## I-65/235.4 217TH AVE





## I-65/235.4 217TH AVE

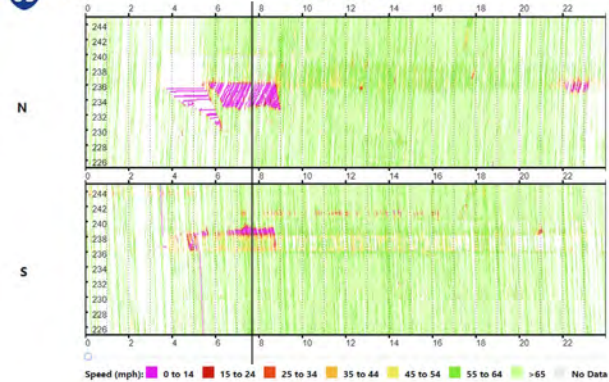




65

Wed 06 / 25

## I-65/235.4 217TH AVE

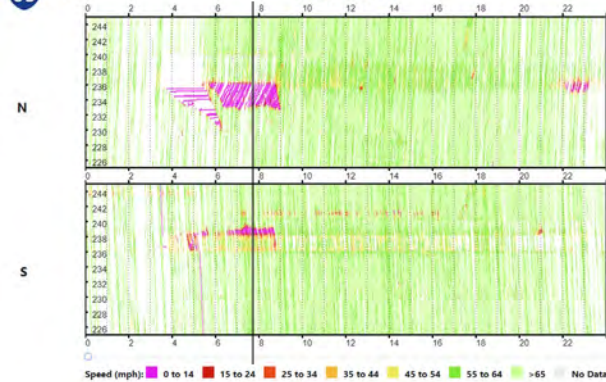


2025-06-25 06:38:24

N

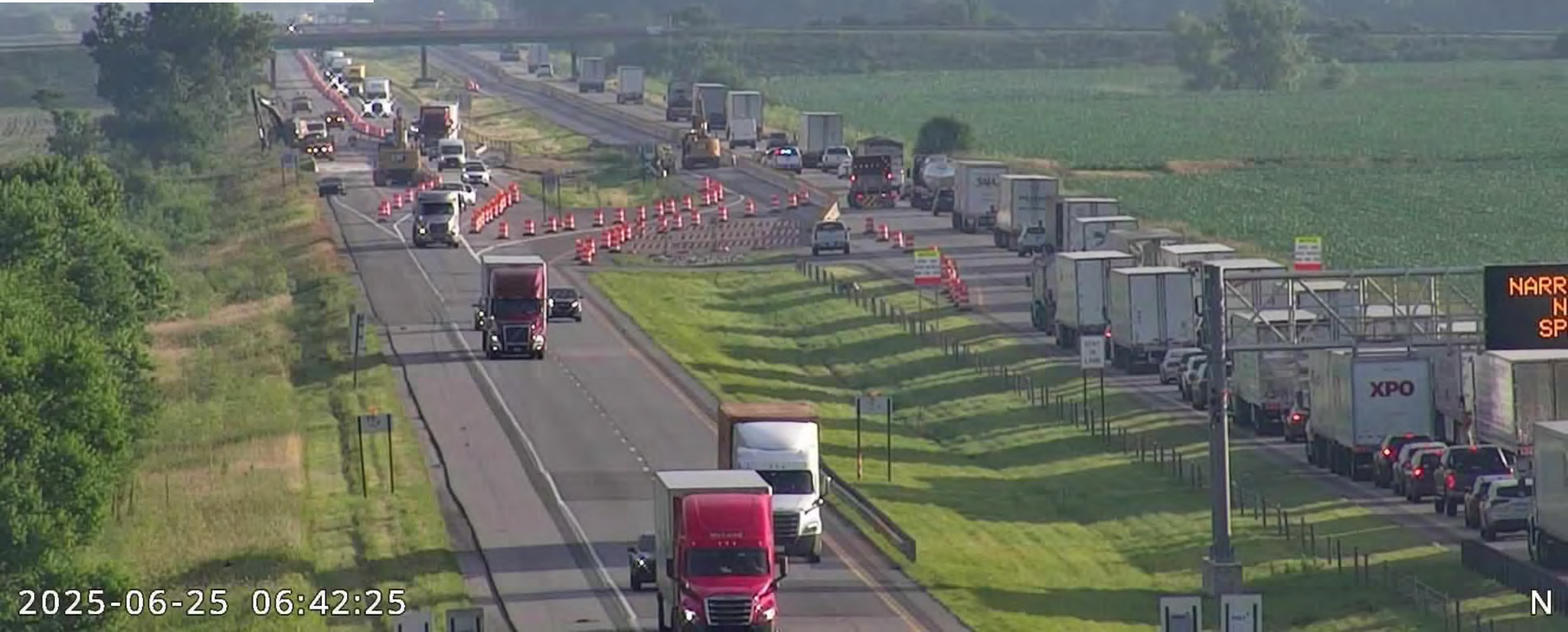
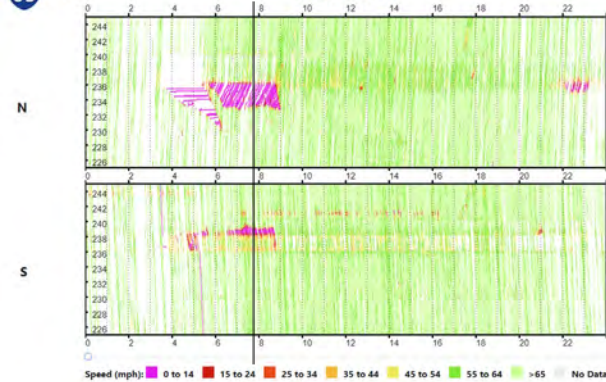


## I-65/235.4 217TH AVE



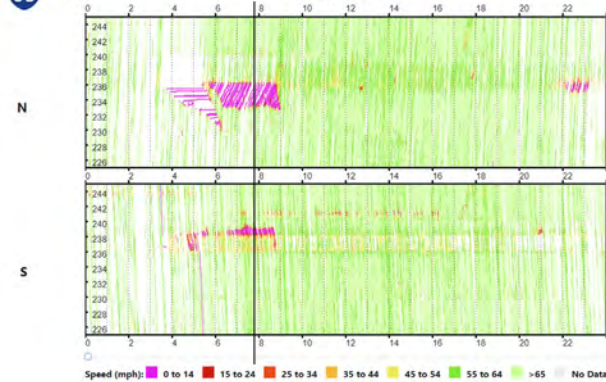


## I-65/235.4 217TH AVE



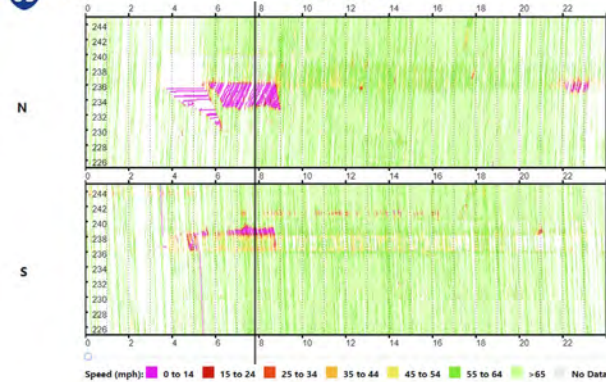


## I-65/235.4 217TH AVE



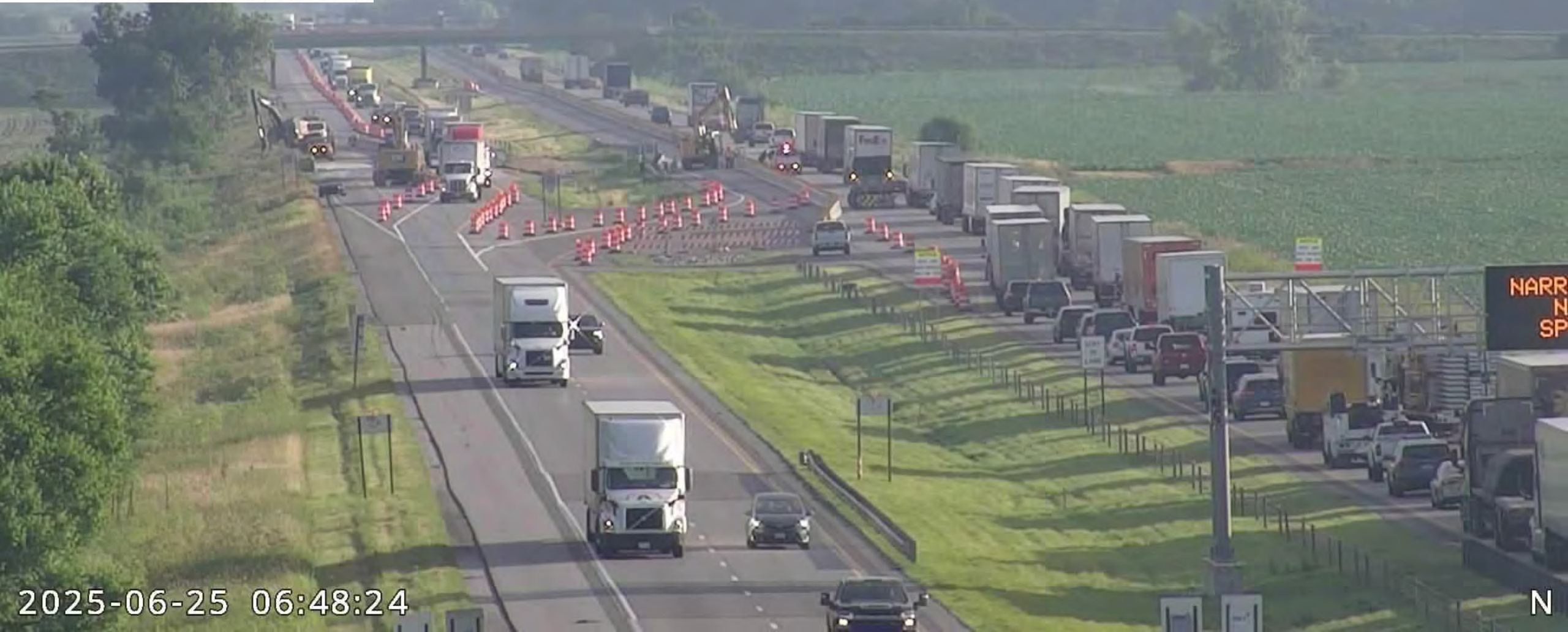
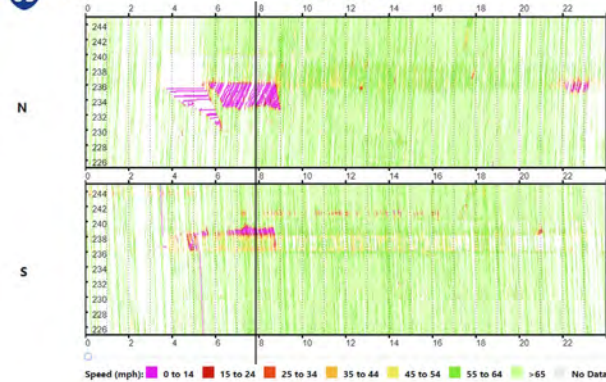


## I-65/235.4 217TH AVE



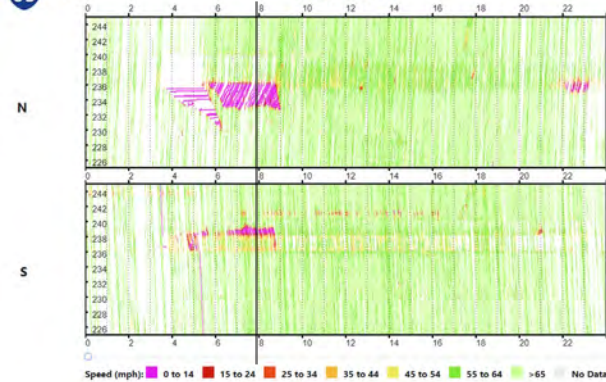


## I-65/235.4 217TH AVE



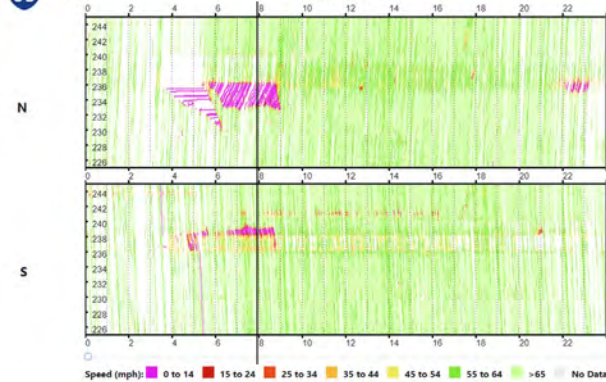


## I-65/235.4 217TH AVE



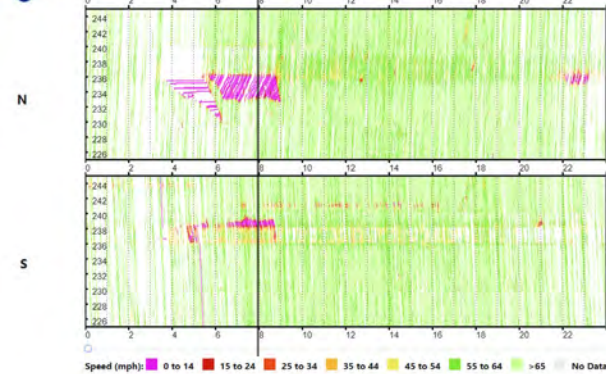


## I-65/235.4 217TH AVE



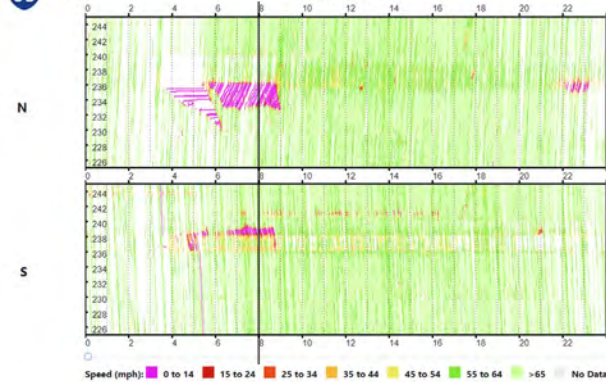


## I-65/235.4 217TH AVE





## I-65/235.4 217TH AVE

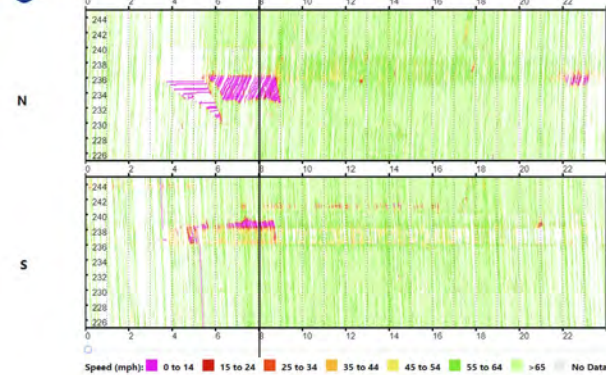


2025-06-25 06:56:25

N

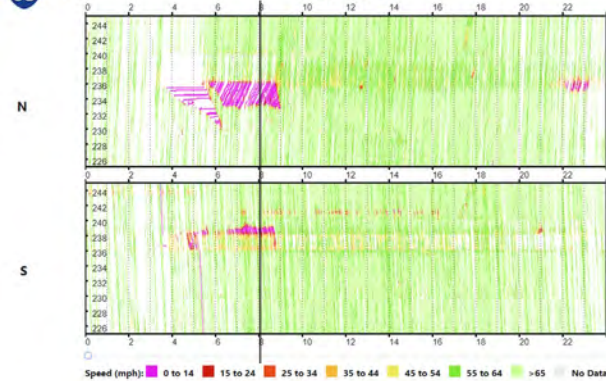


## I-65/235.4 217TH AVE

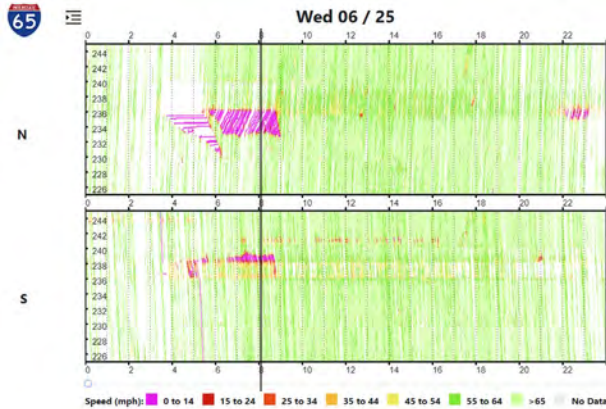




## I-65/235.4 217TH AVE





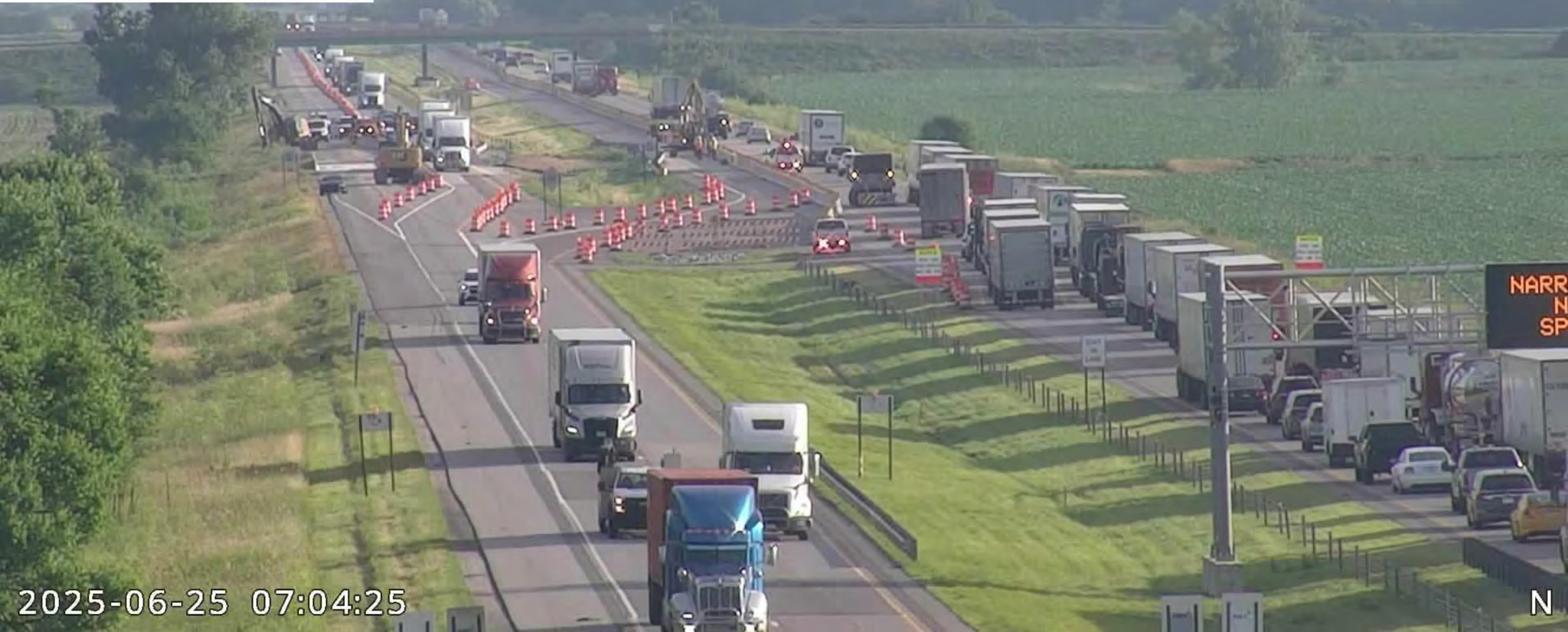
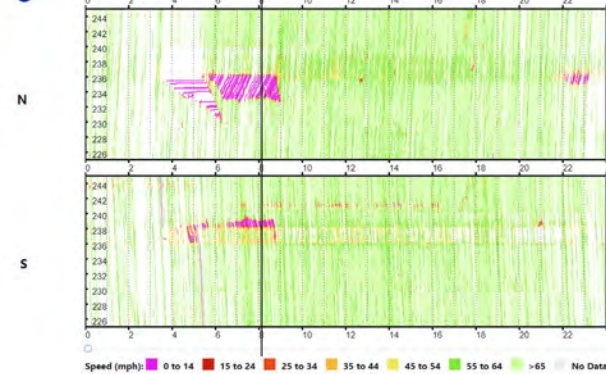


# I-65/235.4 217TH AVE



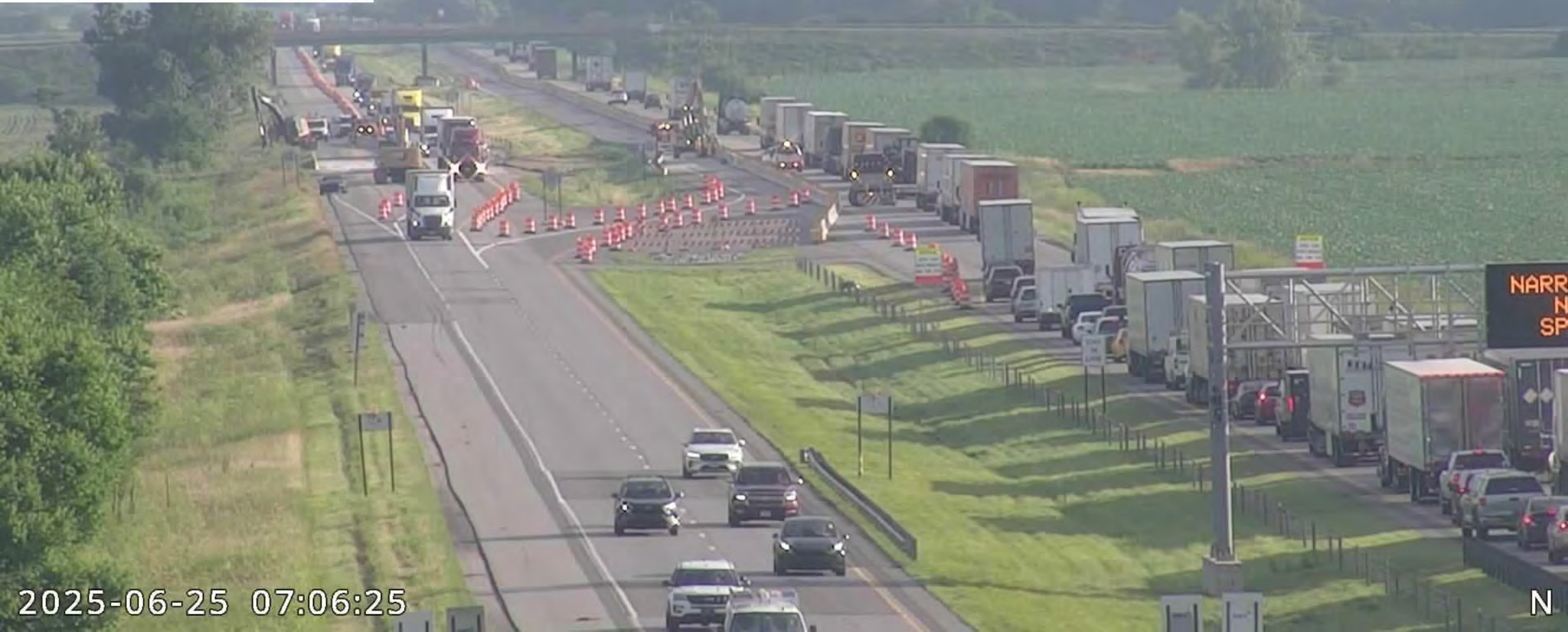
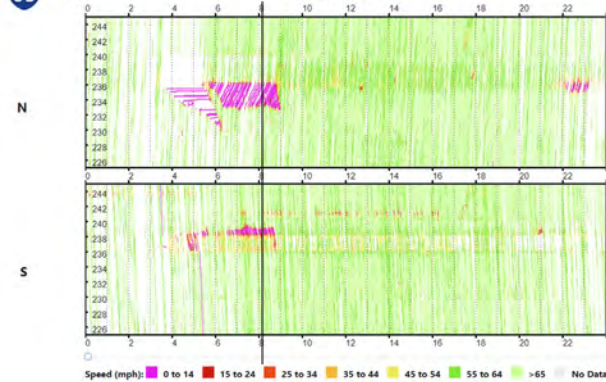


## I-65/235.4 217TH AVE



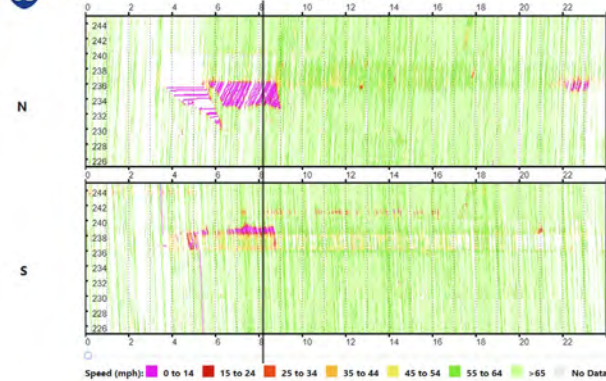


## I-65/235.4 217TH AVE



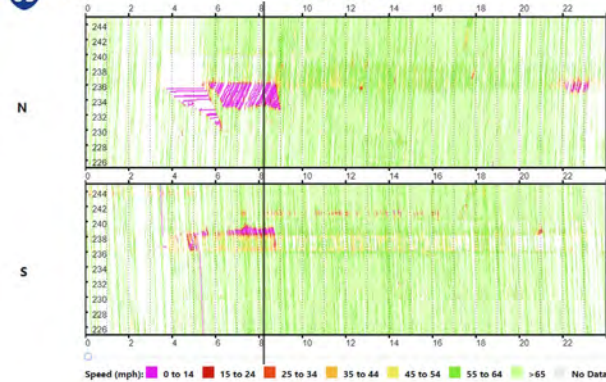


## I-65/235.4 217TH AVE



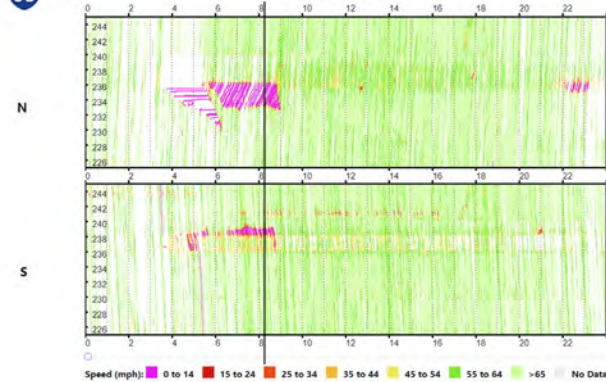


## I-65/235.4 217TH AVE





## I-65/235.4 217TH AVE



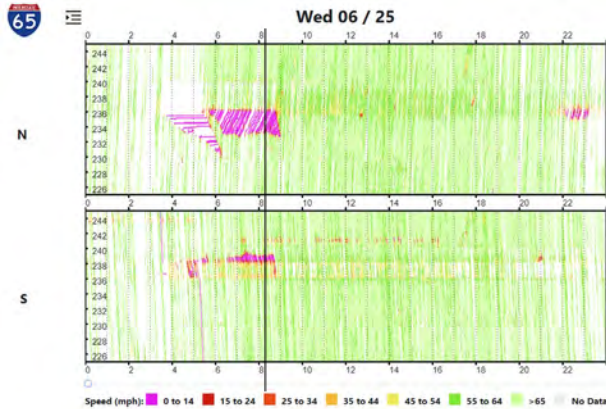


65

Wed 06 / 25

N

S



# I-65/235.4 217TH AVE

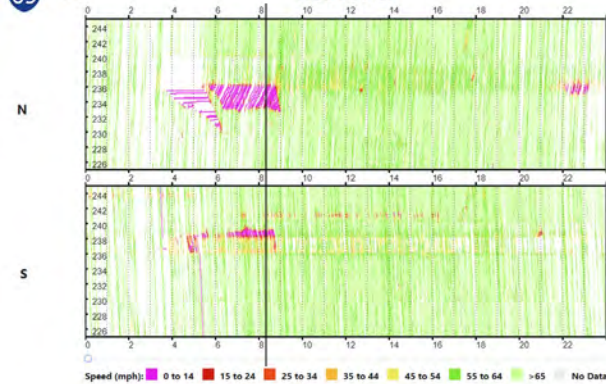


2025-06-25 07:14:25

N



## I-65/235.4 217TH AVE

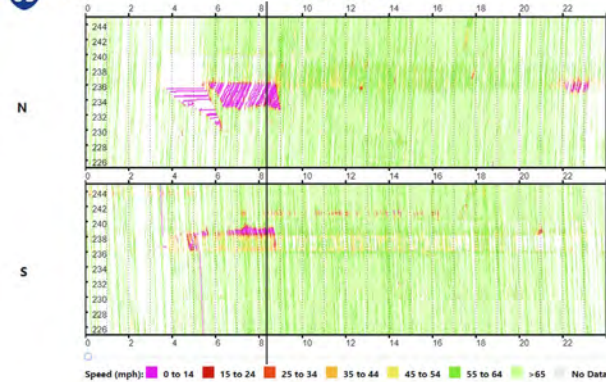


2025-06-25 07:16:27

N

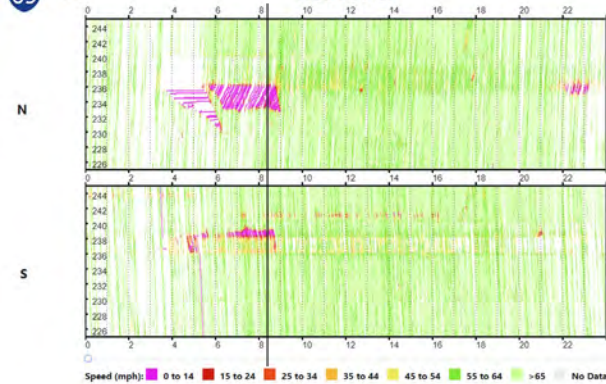


## I-65/235.4 217TH AVE





## I-65/235.4 217TH AVE

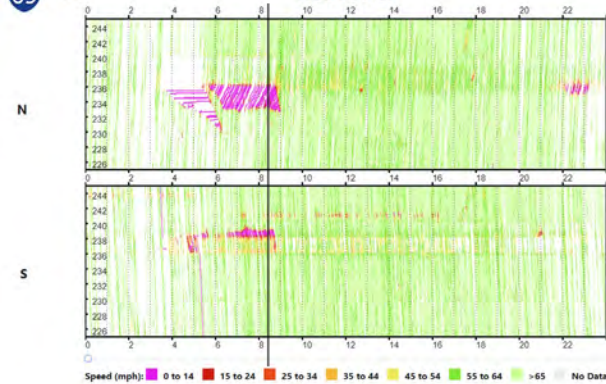


2025-06-25 07:20:25

N

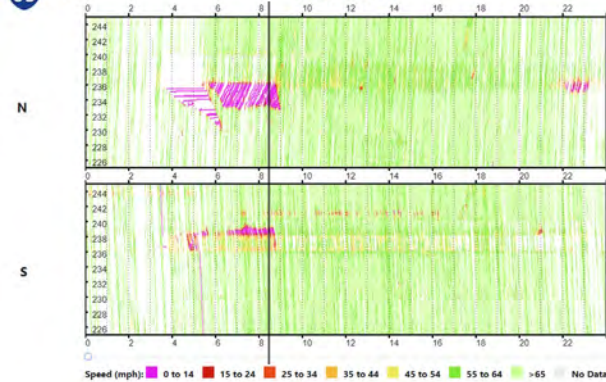


## I-65/235.4 217TH AVE





## I-65/235.4 217TH AVE

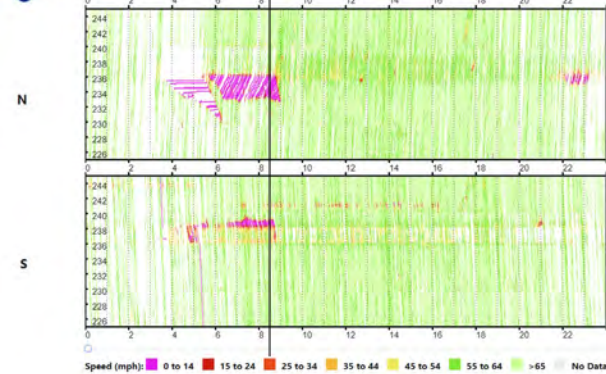


2025-06-25 07:24:26

N



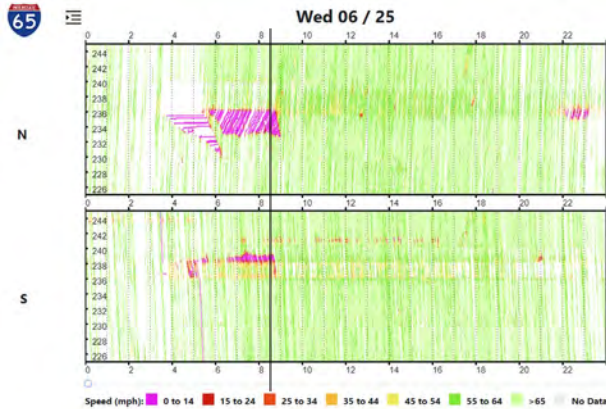
## I-65/235.4 217TH AVE



2025-06-25 07:26:25

N





# I-65/235.4 217TH AVE

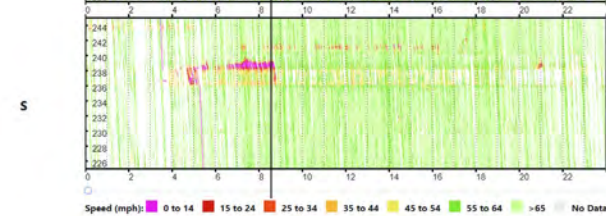


2025-06-25 07:28:26

N



## I-65/235.4 217TH AVE

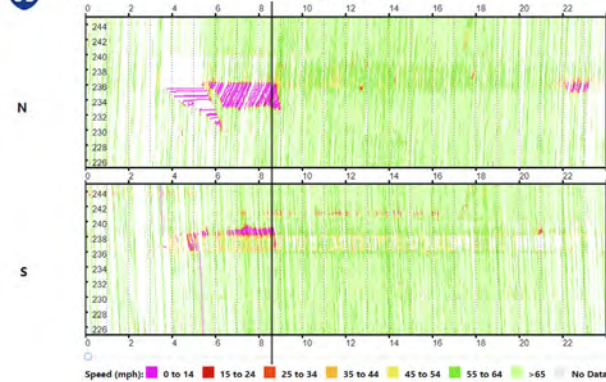


2025-06-25 07:30:26

N



## I-65/235.4 217TH AVE

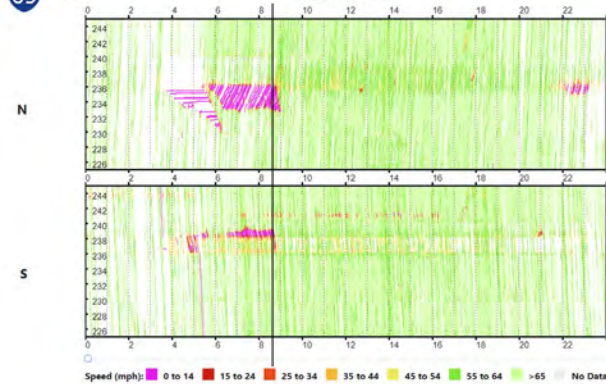


2025-06-25 07:32:25

N

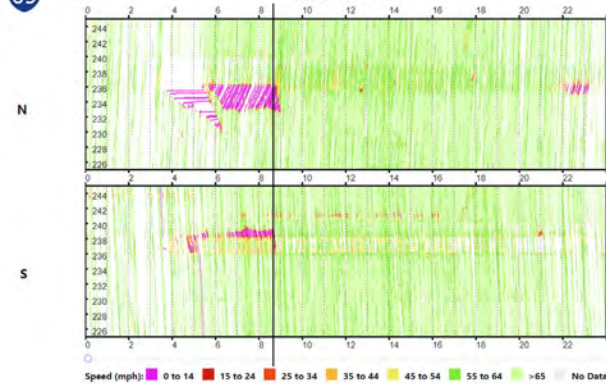


## I-65/235.4 217TH AVE





## I-65/235.4 217TH AVE

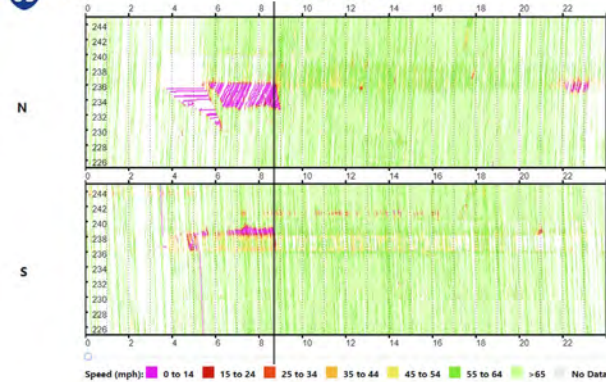


2025-06-25 07:36:25

N



## I-65/235.4 217TH AVE



2025-06-25 07:38:25

N



MM 236 July 2025





May 6<sup>th</sup>, 2025





May 6<sup>th</sup>, 2025

Tire tracks





May 6<sup>th</sup>, 2025

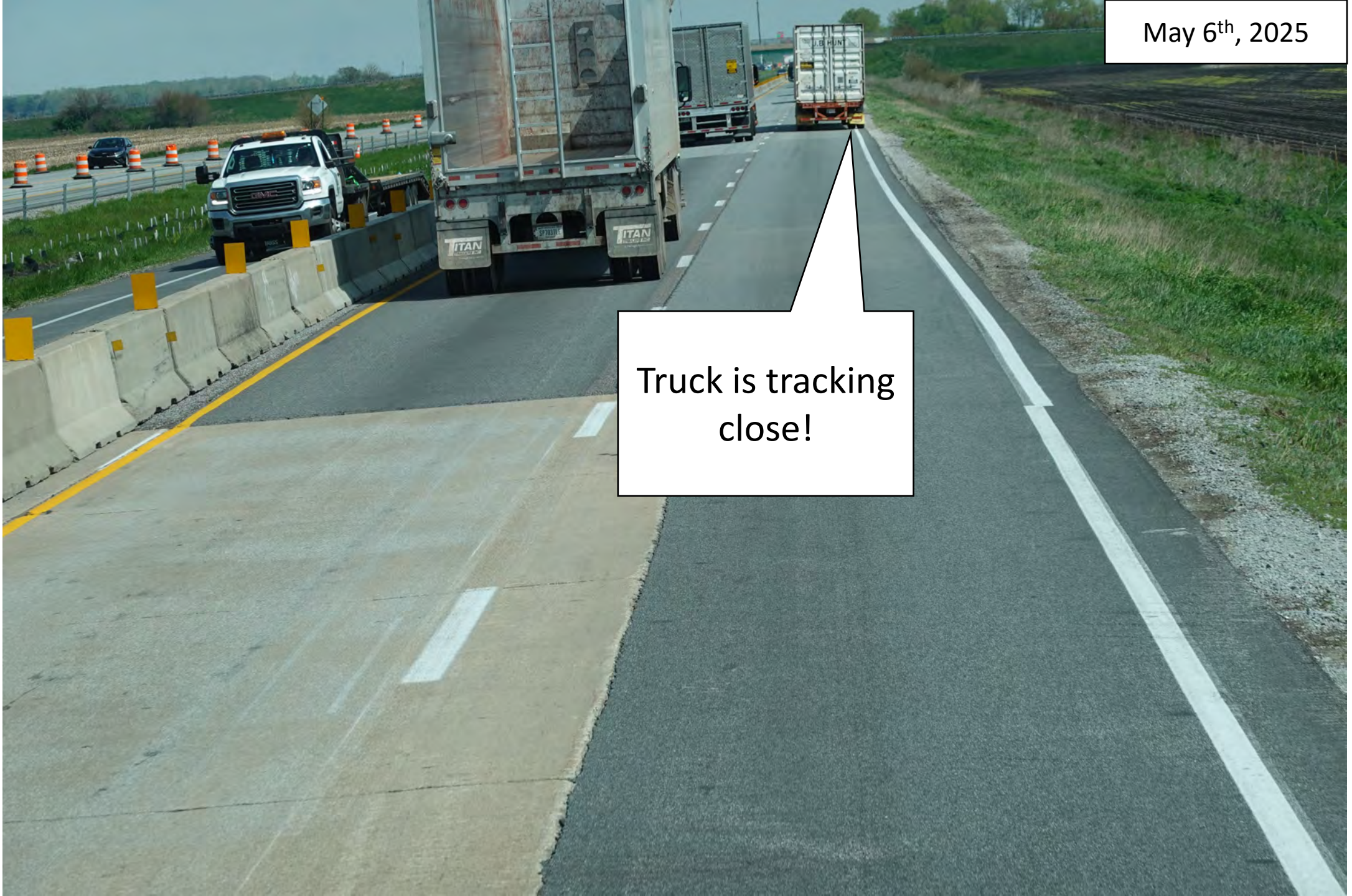
Damage from  
previous  
incident





May 6<sup>th</sup>, 2025

Truck is tracking  
close!



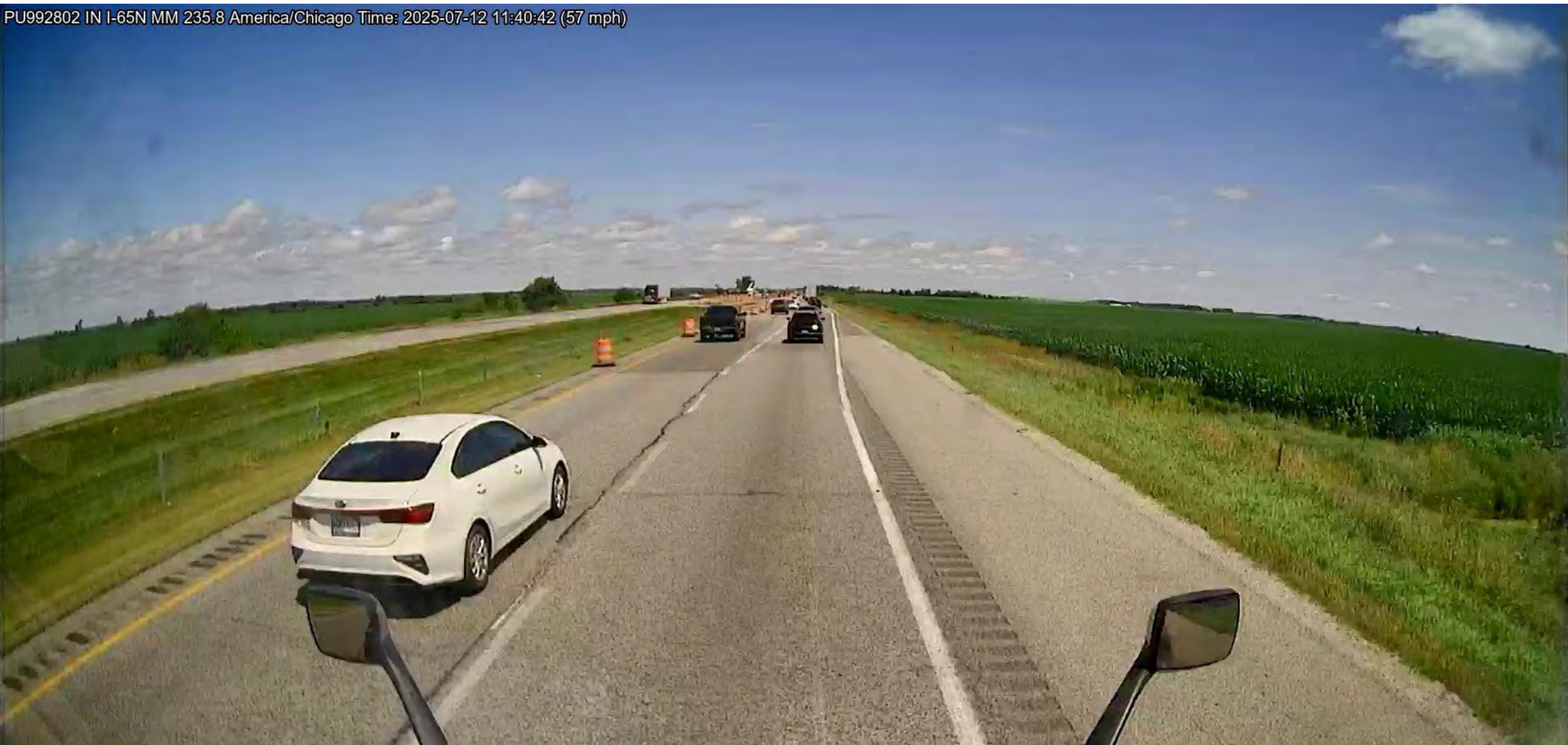


PU992802 IN I-65N MM 235.8 America/Chicago Time: 2025-07-12 11:40:41 (57 mph)





PU992802 IN I-65N MM 235.8 America/Chicago Time: 2025-07-12 11:40:42 (57 mph)





PU992802 IN I-65N MM 235.8 America/Chicago Time: 2025-07-12 11:40:43 (57 mph)





PU992802 IN I-65N MM 235.8 America/Chicago Time: 2025-07-12 11:40:44 (57 mph)





PU992802 IN I-65N MM 235.9 America/Chicago Time: 2025-07-12 11:40:45 (57 mph)





PU992802 IN I-65N MM 235.9 America/Chicago Time: 2025-07-12 11:40:46 (57 mph)





PU992802 IN I-65N MM 235.9 America/Chicago Time: 2025-07-12 11:40:47 (56 mph)





PU992802 IN I-65N MM 235.9 America/Chicago Time: 2025-07-12 11:40:48 (55 mph)





PU992802 IN I-65N MM 235.9 America/Chicago Time: 2025-07-12 11:40:49 (53 mph)





PU992802 IN I-65N MM 235.9 America/Chicago Time: 2025-07-12 11:40:50 (53 mph)





PU992802 IN I-65N MM 235.9 America/Chicago Time: 2025-07-12 11:40:51 (53 mph)





PU992802 IN I-65N MM 236.0 America/Chicago Time: 2025-07-12 11:40:52 (53 mph)



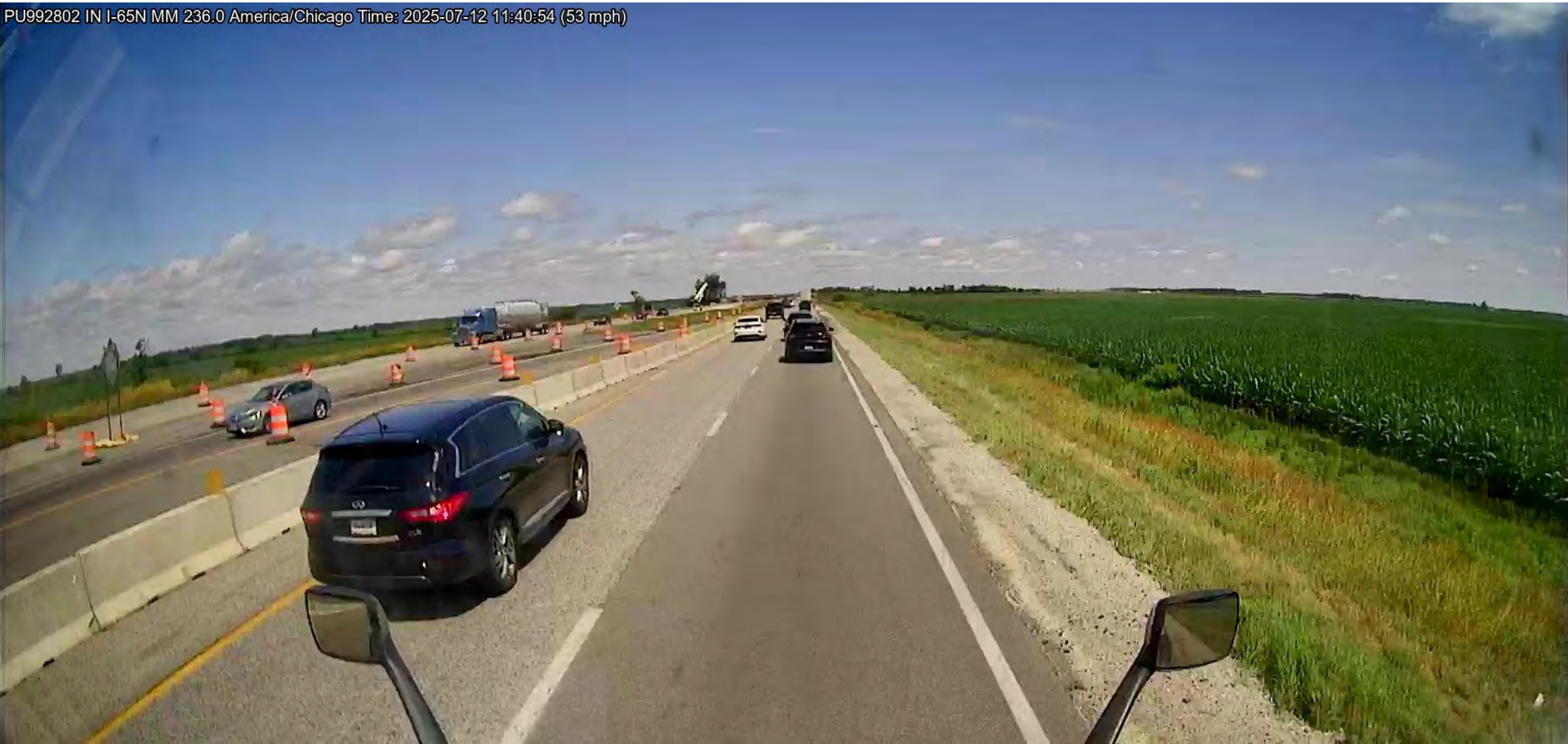


PU992802 IN I-65N MM 236.0 America/Chicago Time: 2025-07-12 11:40:53 (53 mph)





PU992802 IN I-65N MM 236.0 America/Chicago Time: 2025-07-12 11:40:54 (53 mph)





PU992802 IN I-65N MM 236.0 America/Chicago Time: 2025-07-12 11:40:55 (53 mph)





PU992802 IN I-65N MM 236.0 America/Chicago Time: 2025-07-12 11:40:56 (52 mph)





PU992802 IN I-65N MM 236.0 America/Chicago Time: 2025-07-12 11:40:57 (52 mph)





PU992802 IN I-65N MM 236.0 America/Chicago Time: 2025-07-12 11:40:58 (52 mph)





PU992802 IN I-65N MM 236.1 America/Chicago Time: 2025-07-12 11:40:59 (52 mph)





PU992802 IN I-65N MM 236.1 America/Chicago Time: 2025-07-12 11:41:00 (52 mph)





PU992802 IN I-65N MM 236.1 America/Chicago Time: 2025-07-12 11:41:01 (53 mph)





PU992802 IN I-65N MM 236.2 America/Chicago Time: 2025-07-12 11:41:08 (54 mph)





PU992802 IN I-65N MM 236.2 America/Chicago Time: 2025-07-12 11:41:09 (54 mph)





PU992802 IN I-65N MM 236.2 America/Chicago Time: 2025-07-12 11:41:10 (55 mph)





PU992802 IN I-65N MM 236.2 America/Chicago Time: 2025-07-12 11:41:11 (55 mph)





PU992802 IN I-65N MM 236.3 America/Chicago Time: 2025-07-12 11:41:12 (55 mph)





PU992802 IN I-65N MM 236.3 America/Chicago Time: 2025-07-12 11:41:13 (56 mph)





PU992802 IN I-65N MM 236.3 America/Chicago Time: 2025-07-12 11:41:14 (56 mph)





PU992802 IN I-65N MM 236.3 America/Chicago Time: 2025-07-12 11:41:15 (57 mph)



Tire Tracks



PU992802 IN I-65N MM 236.3 America/Chicago Time: 2025-07-12 11:41:16 (57 mph)





PU992802 IN I-65N MM 236.3 America/Chicago Time: 2025-07-12 11:41:17 (57 mph)



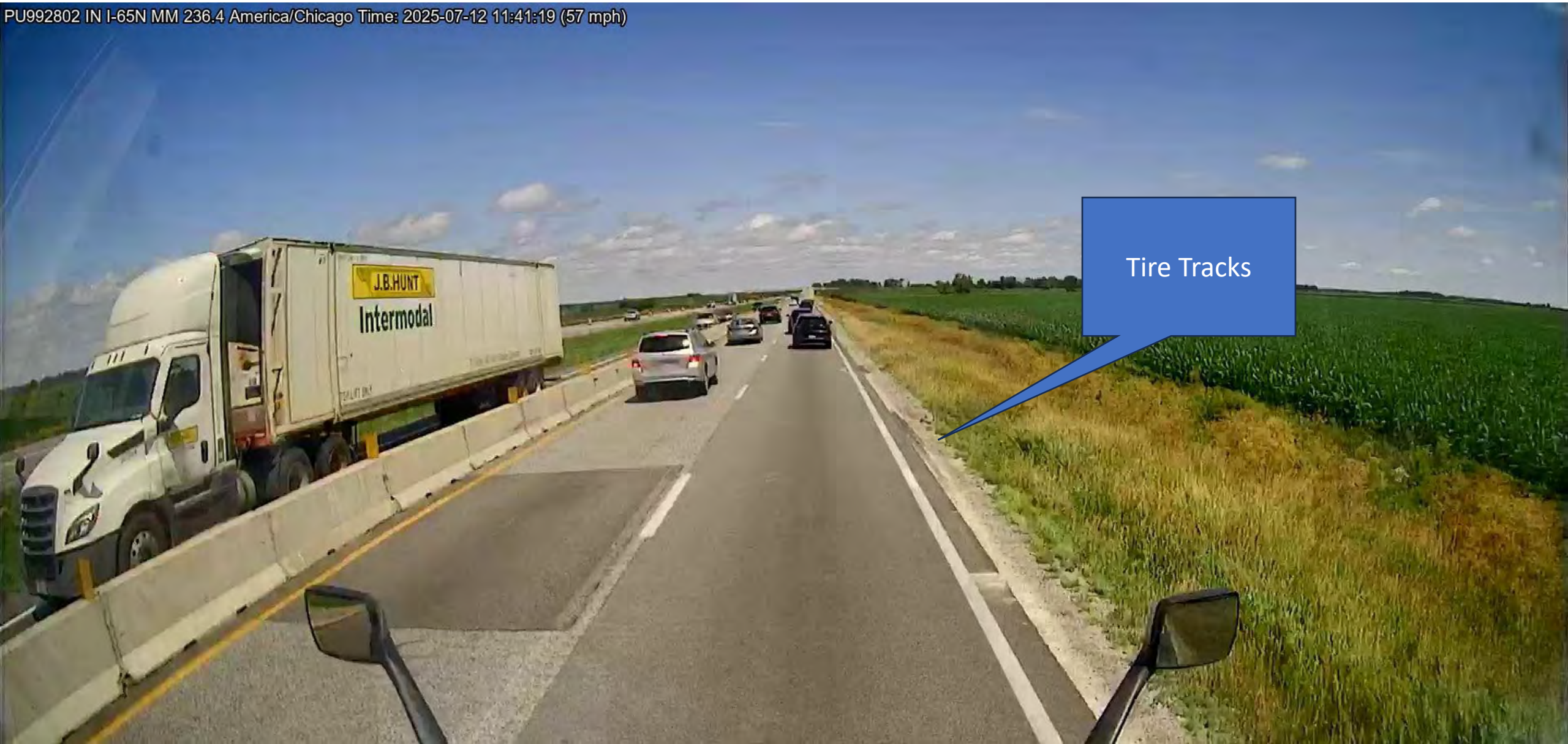


PU992802 IN I-65N MM 236.3 America/Chicago Time: 2025-07-12 11:41:18 (57 mph)





PU992802 IN I-65N MM 236.4 America/Chicago Time: 2025-07-12 11:41:19 (57 mph)



Tire Tracks



PU992802 IN I-65N MM 236.4 America/Chicago Time: 2025-07-12 11:41:20 (56 mph)





PU992802 IN I-65N MM 236.4 America/Chicago Time: 2025-07-12 11:41:21 (56 mph)





PU992802 IN I-65N MM 236.4 America/Chicago Time: 2025-07-12 11:41:22 (55 mph)





PU992802 IN I-65N MM 236.4 America/Chicago Time: 2025-07-12 11:41:23 (55 mph)





PU992802 IN I-65N MM 236.4 America/Chicago Time: 2025-07-12 11:41:24 (55 mph)





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PU992802 IN I-65N MM 236.5 America/Chicago Time: 2025-07-12 11:41:26 (53 mph)





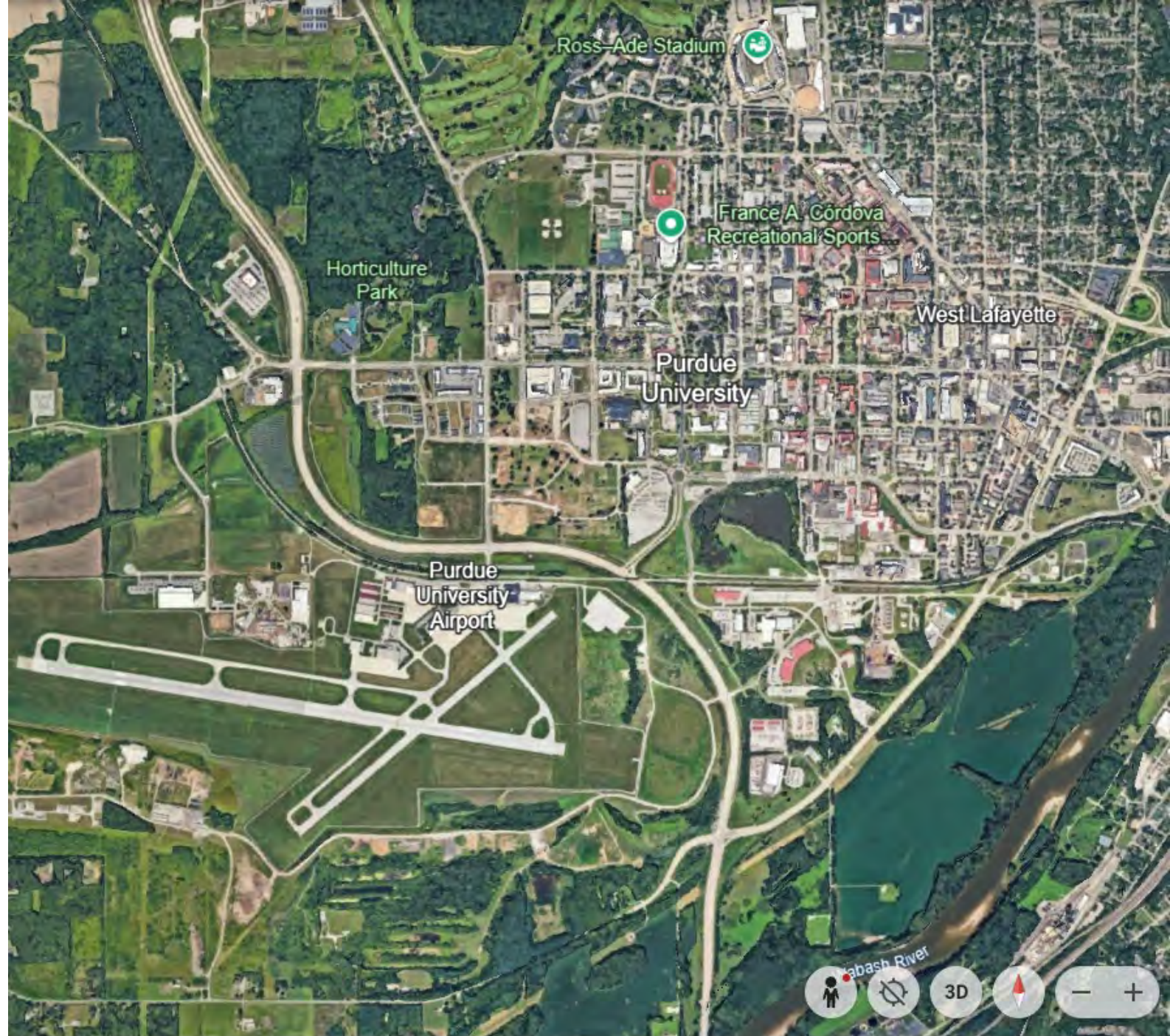
# What is an After Action Case Study?

- Traffic Heatmap
- Selected ITS Camera Images
- Dash Cams

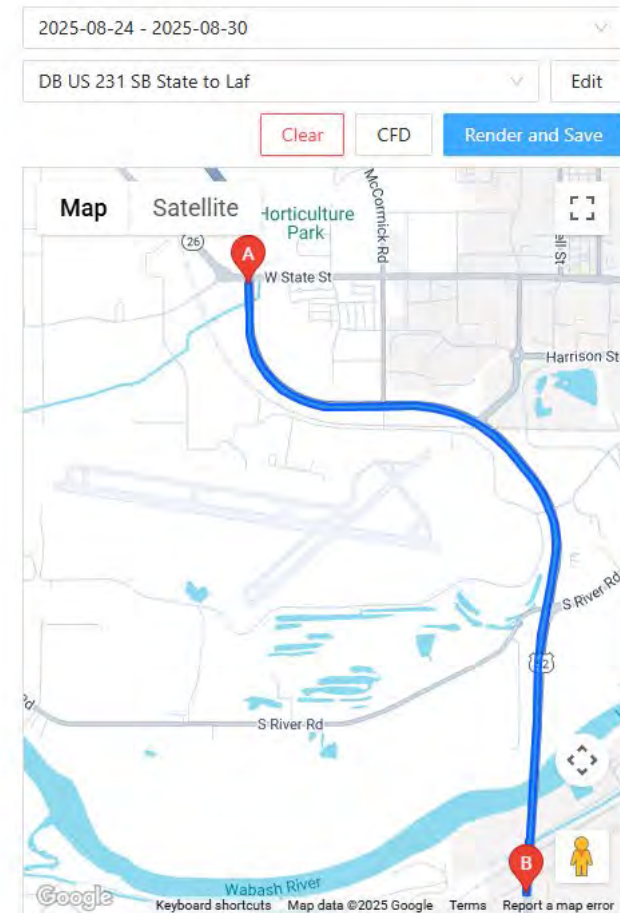
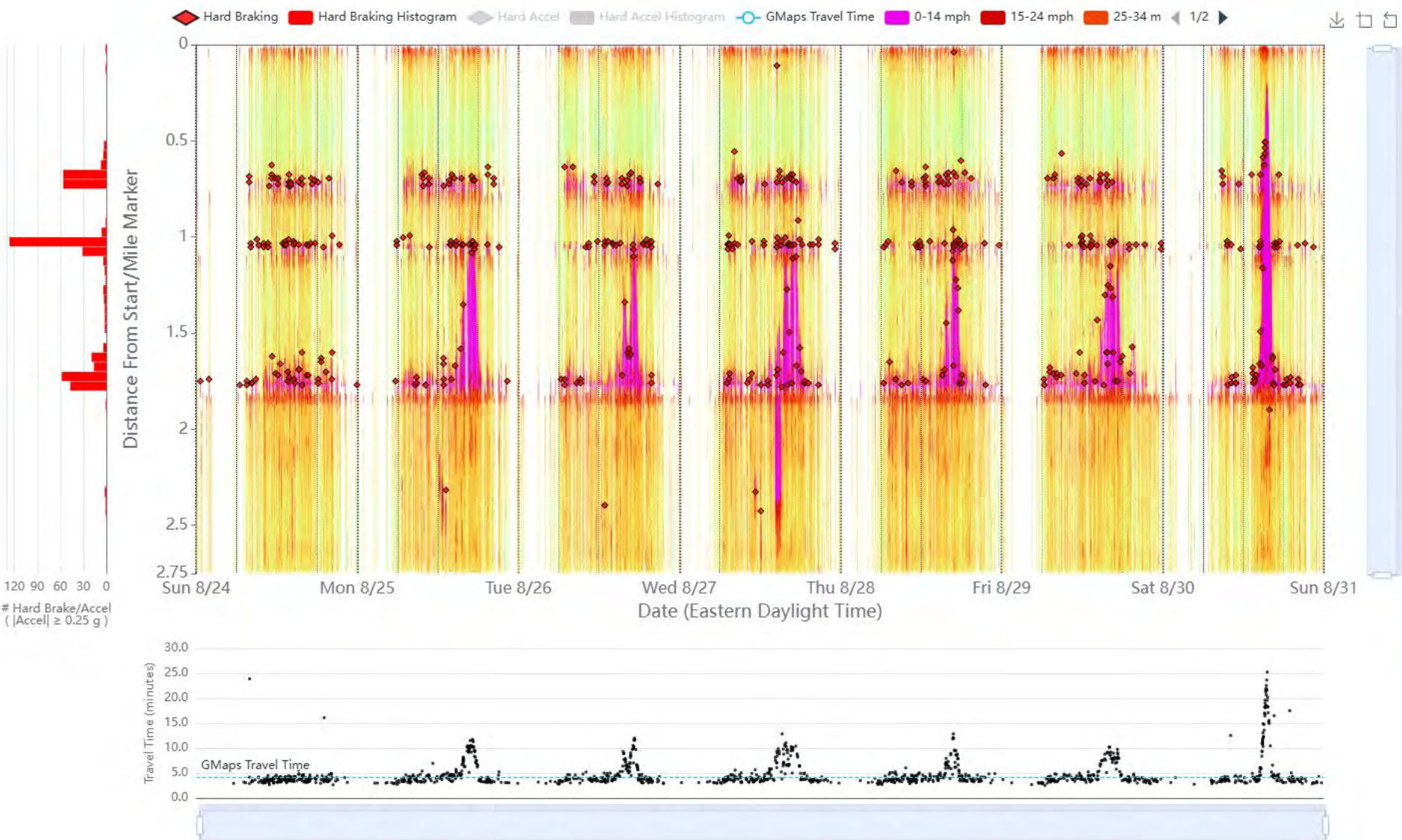


# And a bonus slide

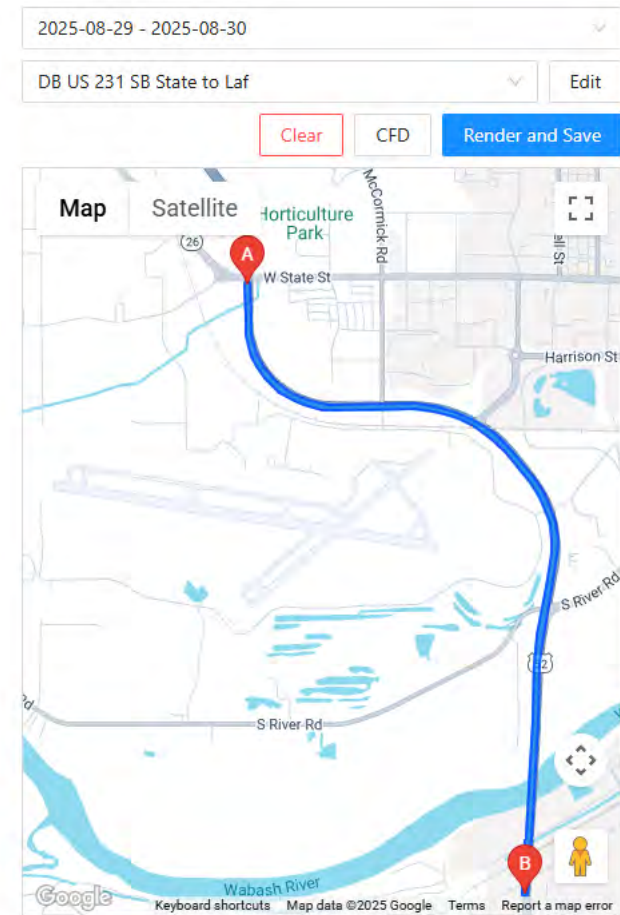
Ball State vs Purdue					
FBS I					
FBS I · Sat, Aug 30					
Final					
	0	-	31		
Ball State Cardinals				Purdue Boilermakers	
(0 - 1)				(1 - 0)	
Team	1	2	3	4	T
Ball State Cardinals	0	0	0	0	0
Purdue Boilermakers	14	7	7	3	31













# What have we/are we learning?

1. Hard Braking is powerful tool for monitoring crash risk.
2. Opportunities to mitigate back of queue crashes with queue trucks and in vehicle alerts.
3. Close proximity to unpaved shoulders should be avoided.
4. Hour of day is strong indication of queuing.
5. Connected Vehicle Data combined with past projects is particularly valuable for forecasting queues.
6. In-Vehicle Alerting is an important supplement to traditional construction signs and message boards.
7. Motorists follow Google/Apple/Waze more than our signs. We need to partner with them



# And a demo





## 1 Advisory

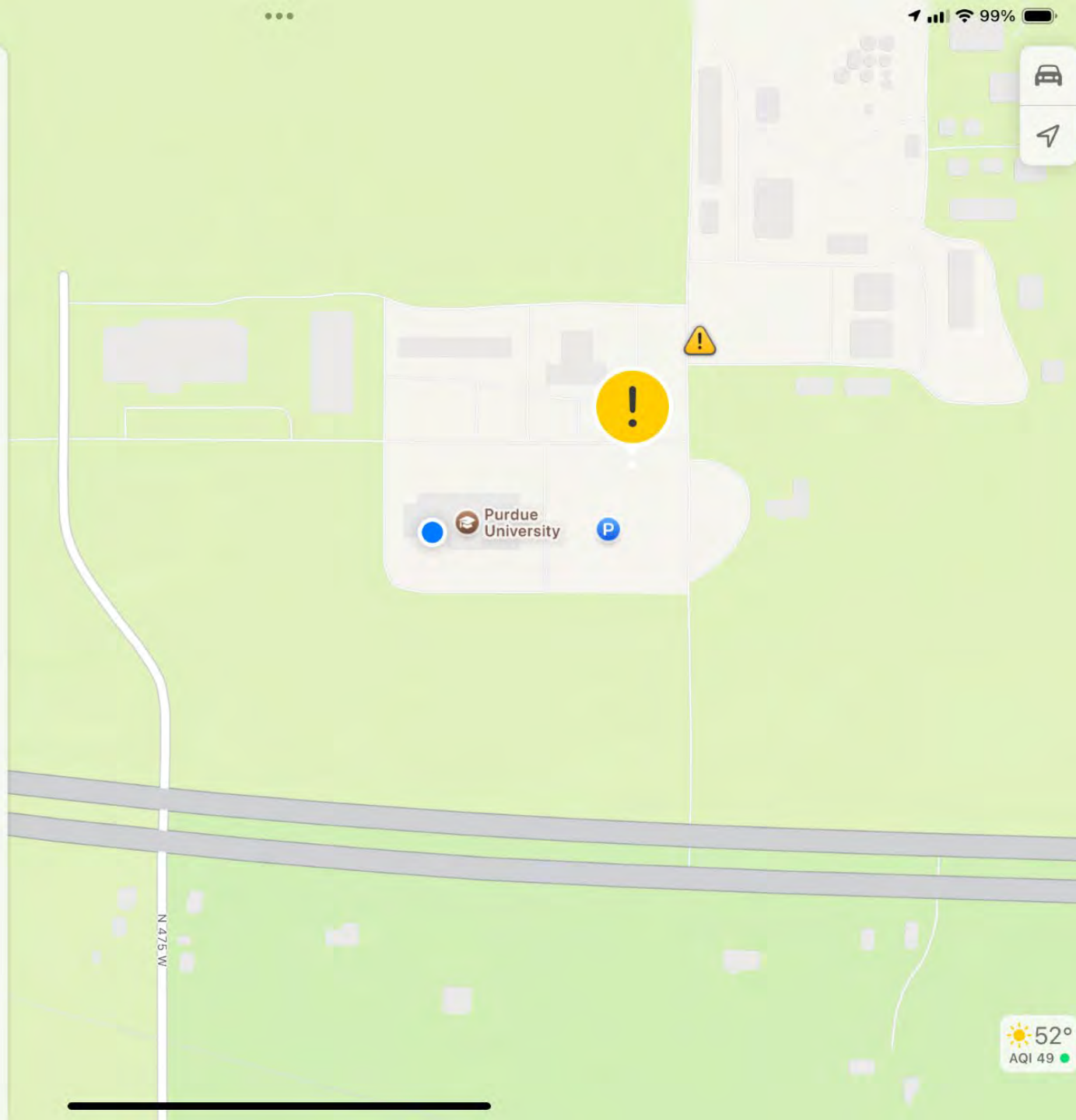


### Hazard

Last updated: today at 7:50 AM

Cleared

Still Here







bleweed Ln

N 475 W



Purdue University Agronomy Center  
for Research and Education



Where to?



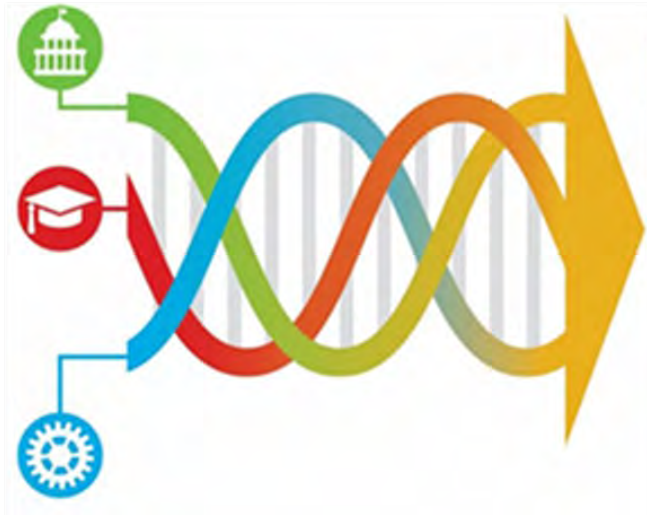


# Work Zone Monitoring: Hard Braking and Implementation

Government

Academia

Industry



## IMPACT

*Darcy Bullock*

*Purdue University*

[darcy@purdue.edu](mailto:darcy@purdue.edu)



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# PURDUE FOOTBALL



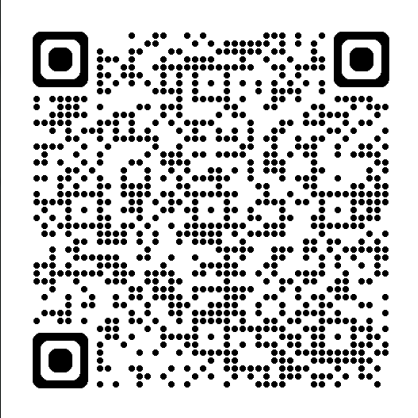
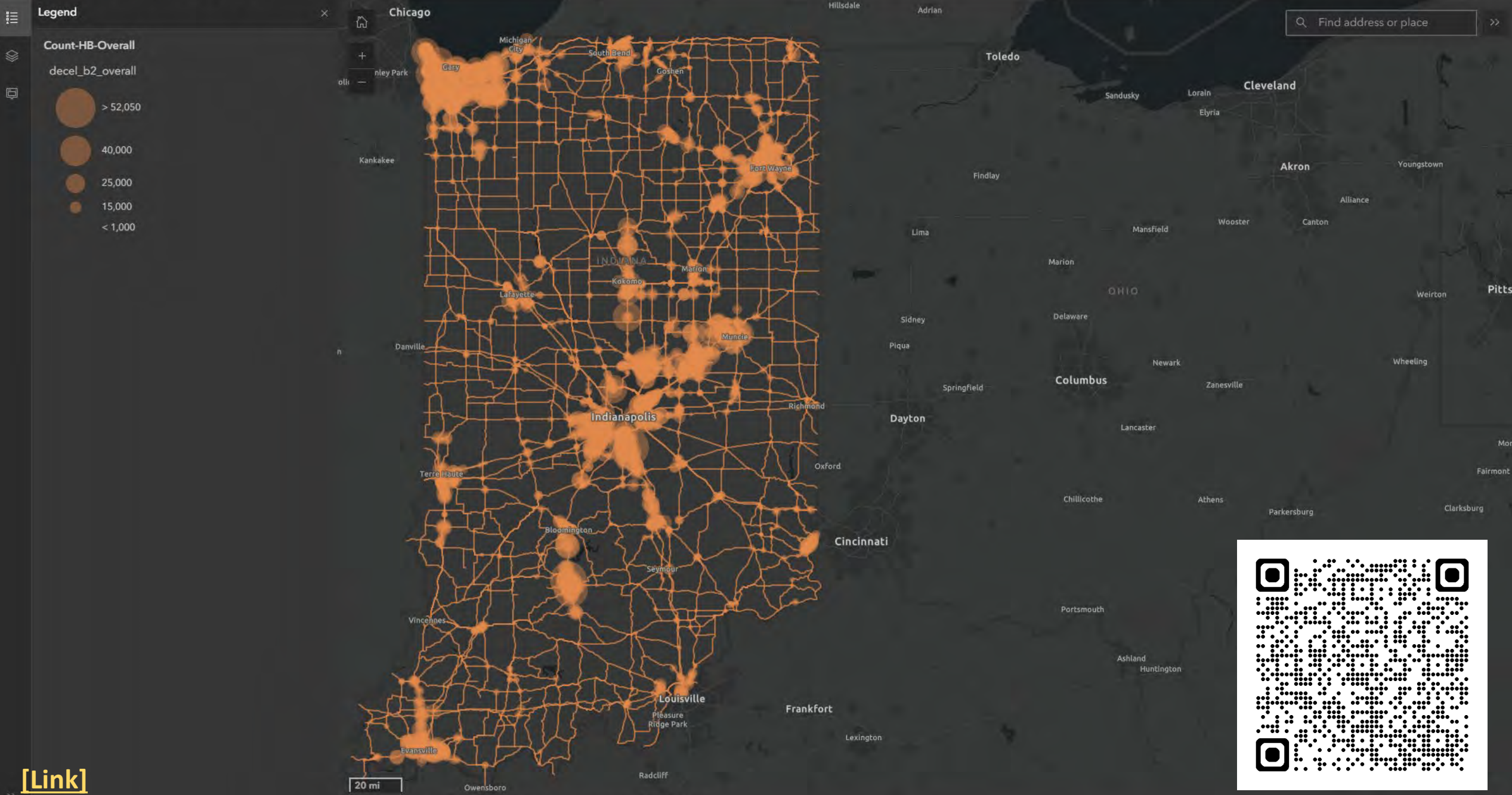






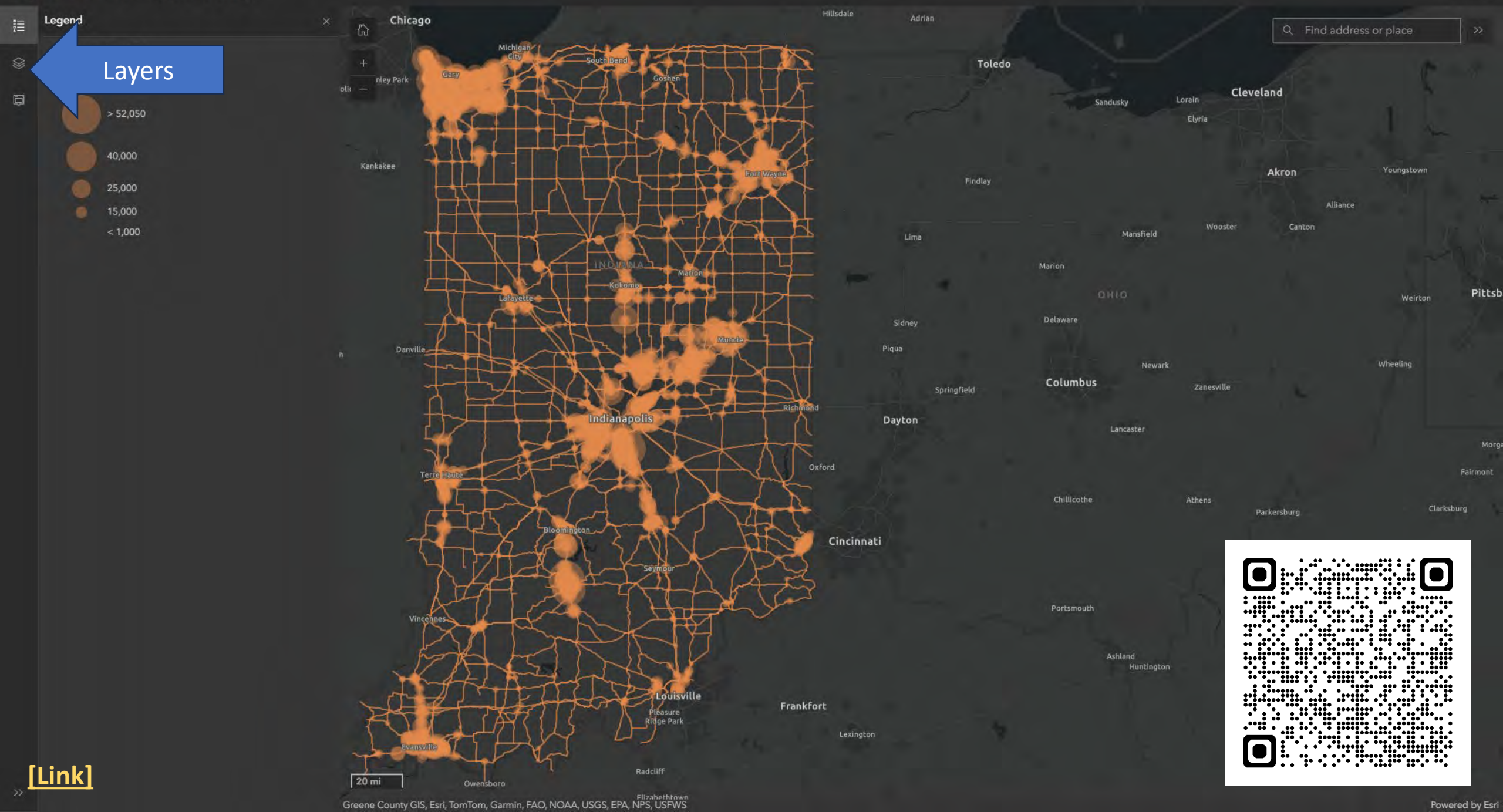
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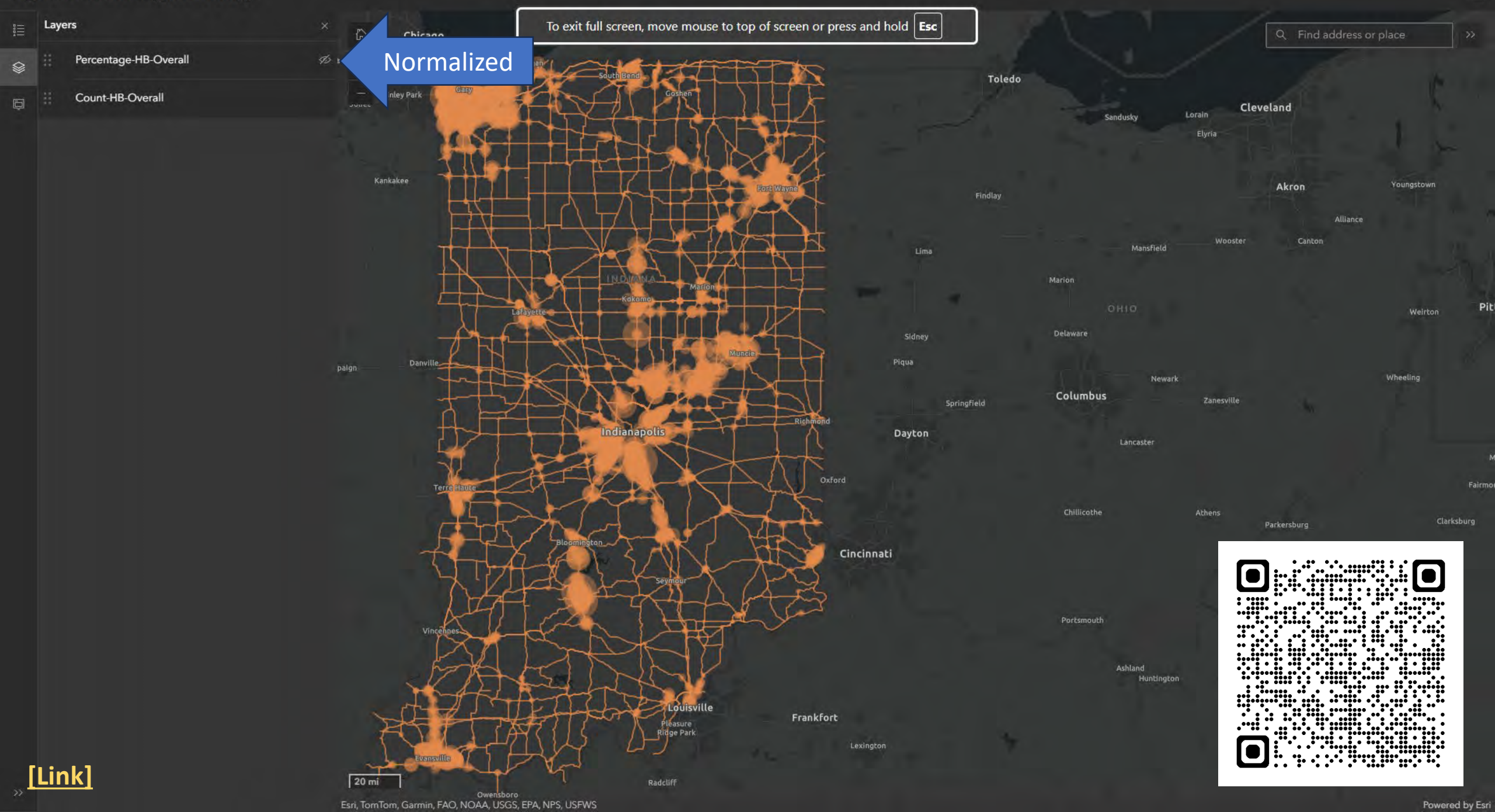
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<div> <div>This space is rapidly evolving</div> </div>	Commercial OEM Floating Car Data	Commercial Enhanced OEM data	Emerging OEM Data	Commercial Dashcams	Commercial Dashboards	Consulting Services
Freeways PM	X				X	X
Work zones PM	X				X	Emerging
Signals PM	X				X	X
Incident Diversion	X					
Mobility impact of weather	X					
Surrogates for Crash/Safety Data Hard Braking/ABS	X				X	X
Pavement Condition		X				
Asset Inventory (Signs, Marking)			X	X		Emerging
Work zone activity				X		Emerging