NATIONAL ACADEMIES Sciences Engineering Medicine

TRB TRANSPORTATION RESEARCH BOARD

TRB Webinar: Wrong-Way Driving Solutions Handbook

March 27th, 2024

12:00 – 1:30 PM

PDH Certification Information

1.5 Professional Development Hours (PDH) – see follow-up email

You must attend the entire webinar.

Questions? Contact Andie Pitchford at TRBwebinar@nas.edu

The Transportation Research Board has met the standards and requirements of the Registered Continuing Education Program. Credit earned on completion of this program will be reported to RCEP at RCEP.net. A certificate of completion will be issued to each participant. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the RCEP.

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Purpose Statement

This webinar will provide an overview of NCHRP Research Report 1050: Wrong-Way Driving Solutions Handbook that provides the latest solutions to wrong-way driving incidents and crashes on roadways. Presenters will share experiences, challenges, and successful strategies employed by the Iowa Department of Transportation (DOT). Presenters will also discuss how to secure funding, collect incident data, conduct a statewide network screening, and implement effective, low-cost countermeasures at ramp terminals and unsignalized intersections on divided highways.

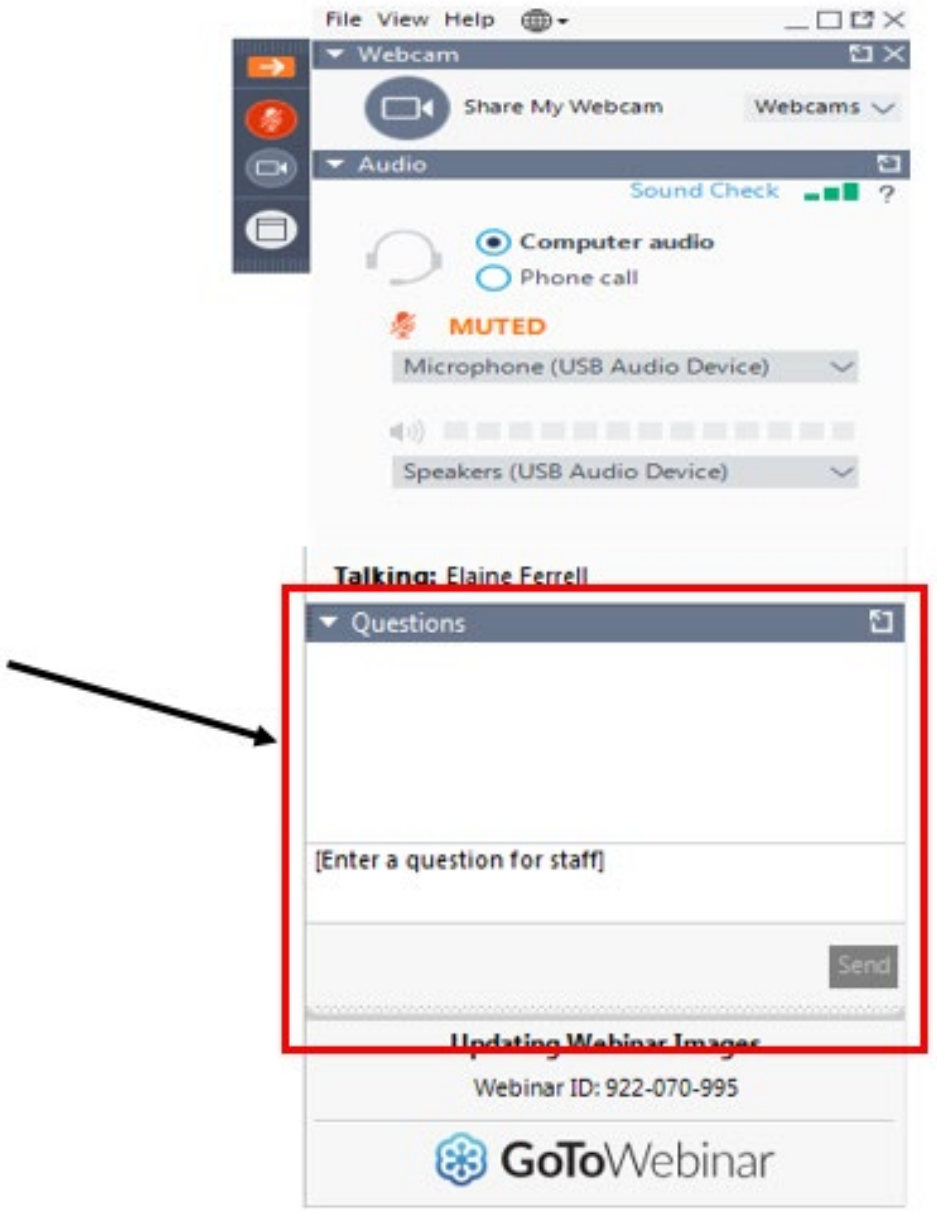
Learning Objectives

At the end of this webinar, you will be able to:

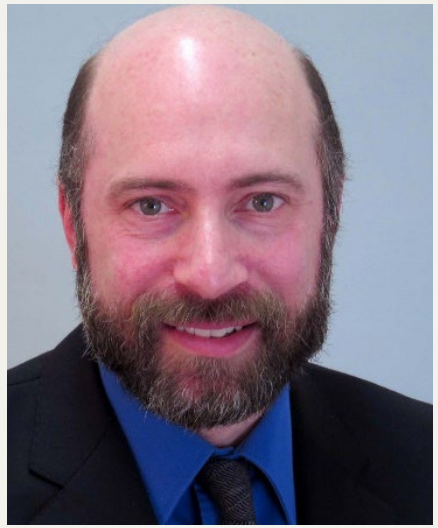
- Apply low-cost countermeasures, advanced technologies, geometric design elements, education, and enforcement strategies to reduce wrong-way driving incidents and crashes
- Apply insights from the Wrong-Way Driving Solutions Handbook to conduct a comprehensive statewide study of wrong-way driving incidents and crashes
- Gain valuable perspectives on experiences, challenges, and lessons learned from Iowa DOT's successful initiatives

Questions and Answers

- Please type your questions into your webinar control panel
- We will read your questions out loud, and answer as many as time allows



Today's presenters



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NCHRP Research Report 1050
Wrong-Way Driving Solutions Handbook

H. Hugo Zhou, Ph.D., P.E.
Elton Z. and Lois G. Huff Professor
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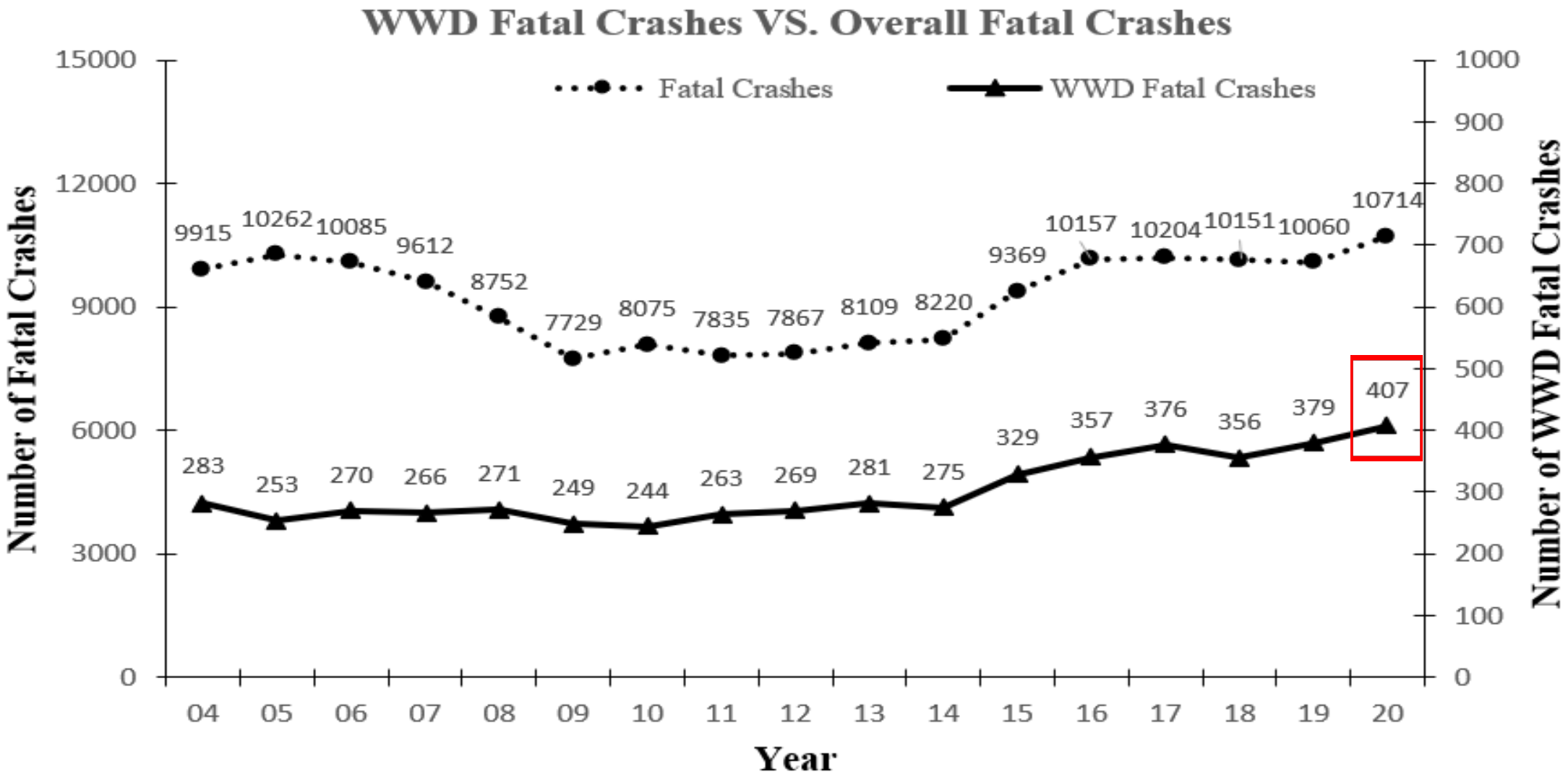
Department of Civil and Environmental Engineering
Auburn University

National Trend of WWD Fatal Crashes

FARS DATA 2004-2020



Background

6. Recommendations

As a result of this special investigation, the National Transportation Safety Board makes the following safety recommendations:

To the Federal Highway Administration:

Work with the National Highway Traffic Safety Administration to (1) identify efforts to reduce the involvement of older drivers in wrong-way collisions and (2) publish the findings in a report that includes consideration of Strategic Highway Safety Plan countermeasures that have been effective. (H-12-38)

Develop an assessment tool that the states can use to select appropriate countermeasures for problematic controlled-access highway locations that is based on a review of (1) state research concerning wrong-way driving and (2) countermeasures found to be effective by the states in reducing the instances of wrong-way driving. (H-12-39)

Develop and distribute to the states a manual they can use as a resource document when implementing strategies and countermeasures to reduce the instances of drivers traveling the wrong way on divided highways. At a minimum, such a manual should provide solutions that would (1) prevent drivers from entering an access ramp that would allow them to travel in the wrong direction on a divided highway, (2) alert drivers to their error should they enter a ramp while traveling in the wrong direction, (3) allow drivers to correct for traveling in the wrong direction while on an access ramp, and (4) alert drivers to their error if they are traveling the wrong way on a divided highway. (H-12-40)

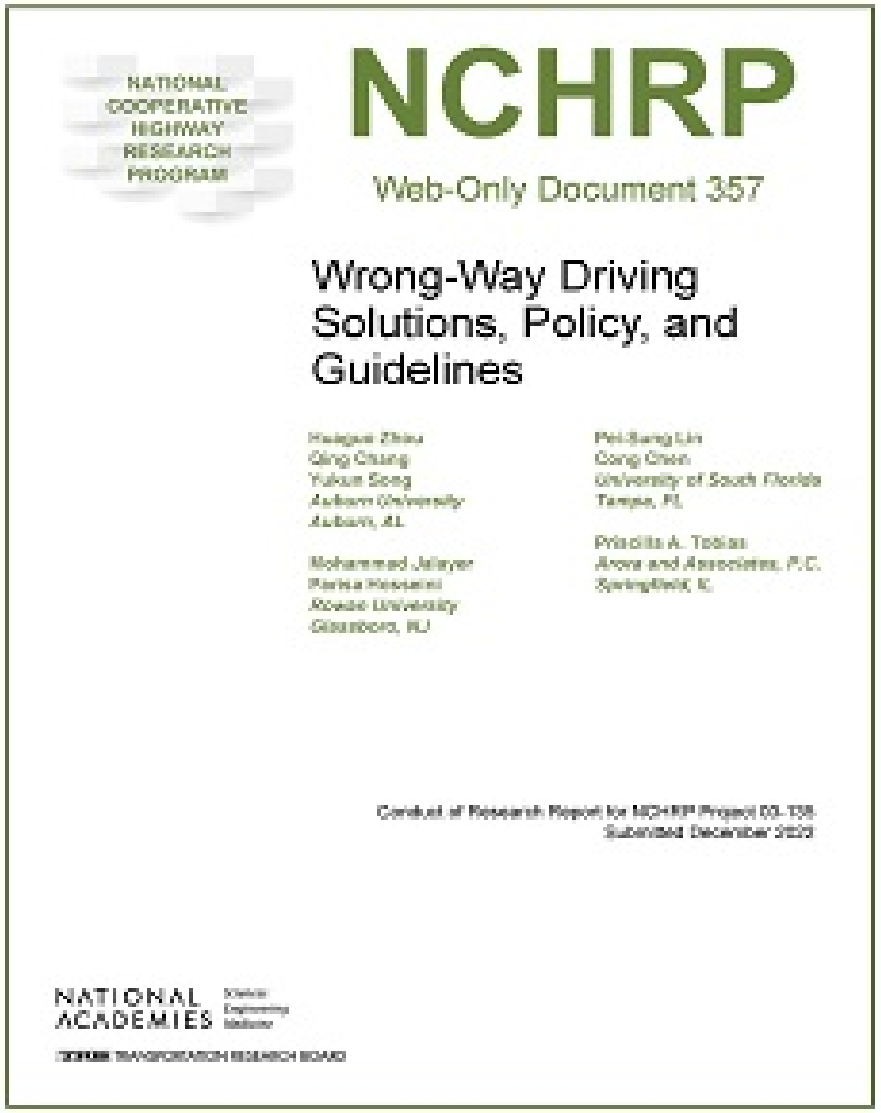
NCHRP 03-135 Project Objectives

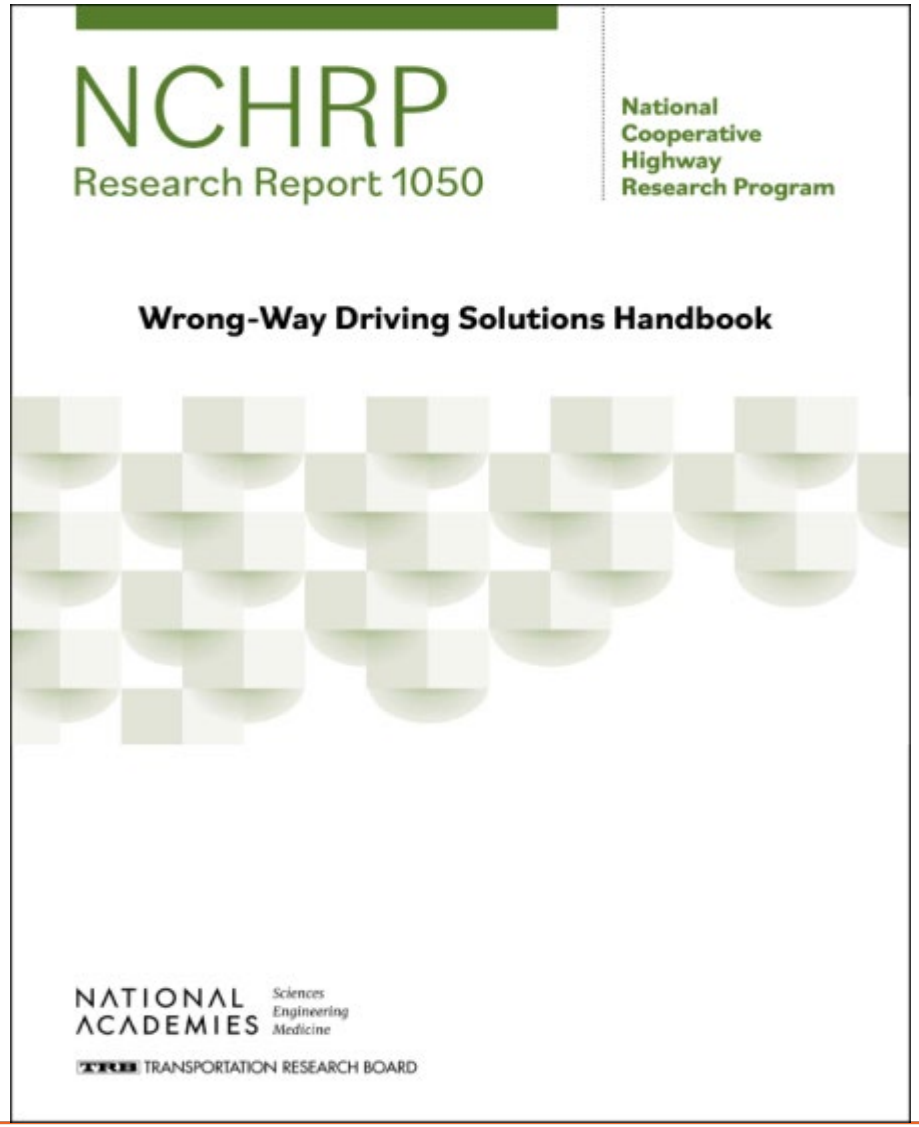
To develop a handbook that guides uniformly implementing safety countermeasures to significantly reduce the number of WWD incidents and crashes on divided highways

The project period (July 2019- December 2022)

- **Phase 1** identified current practices; determined the handbook contents; collected incident and crash data for evaluating countermeasures
- **Phase 2** organized a workshop to gather feedback on the draft handbook on August 4-5, 2022

NCHRP Reports 357 and 1050





Ranking of Topics for the Handbook

Subject	Rank	Related Chapter
Guidelines for low-cost countermeasures	1	Chapter 3
Network screening tools to identify high-risk ramp terminals for WWD	2	Chapter 2
Guidelines for advanced ITS countermeasures	3	Chapter 4
Guidelines for geometric design elements and access control techniques	4	Chapter 5
Guidelines for mitigating WWD on multi-lane divided highways	5	Chapter 3
Methods to quantify the safety effectiveness of countermeasures	6	Chapter 6
Comprehensive field investigation checklist	7	Appendix A
Strategies for enforcement and education program	8	Chapter 7
Relationship between WWD incidents and crashes	9	Chapter 6
National WWD crash history	10	Chapter 1

Key References

Iowa DOT Traffic and safety

ADOT Traffic Engineering Guidelines and Processes

Caltrans CAMUTCD

Caltrans Highway Design Manual

FHWA MUTCD

AASHTO Greenbook

MDOT Geometric Design Guidelines

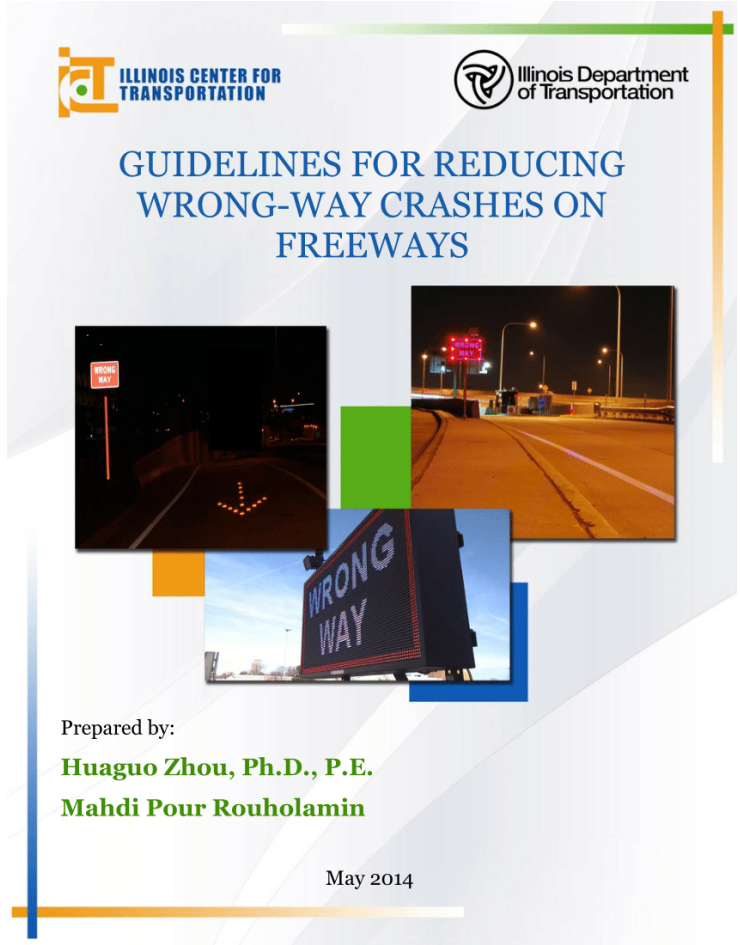
FDOT Design Manual, Section 230.4

TXDOT Texas MUTCD

WSDOT Design Mannual

NCDOT Wrong Way Driving Toolbox

ODOT Ohio MUTCD



IDOT Guidelines for Reducing Wrong-Way Crashes on Freeways

Handbook Content: Chapters 1 and 2

CHAPTER 1: INTRODUCTION

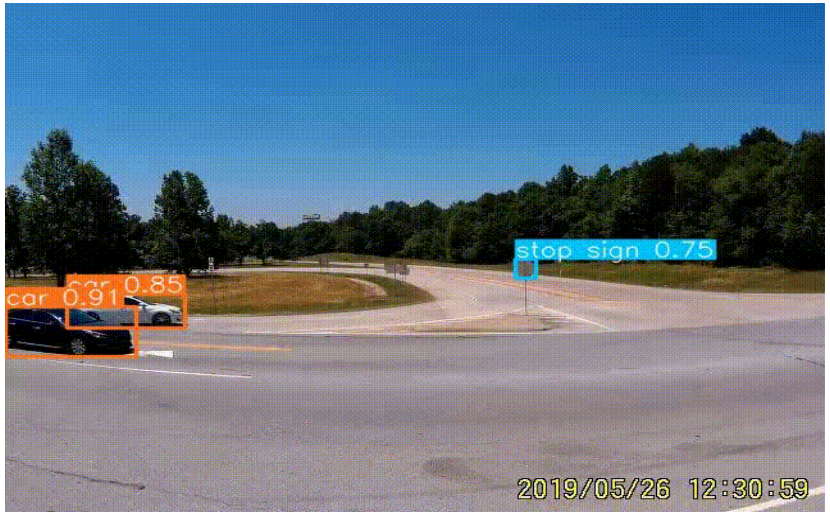
CHAPTER 2: DATA ANALYSIS AND NETWORK SCREENING METHODS

SECTION 2.1 DISCUSSION

SECTION 2.2 STATE-LEVEL NETWORK SCREENING METHODS

SECTION 2.3 SEGMENT-LEVEL NETWORK SCREENING METHODS

SECTION 2.4 SITE-SPECIFIC NETWORK SCREENING METHODS



Handbook Content: Chapter 3

CHAPTER 3: SIGNS, PAVEMENT MARKING, AND SIGNALS

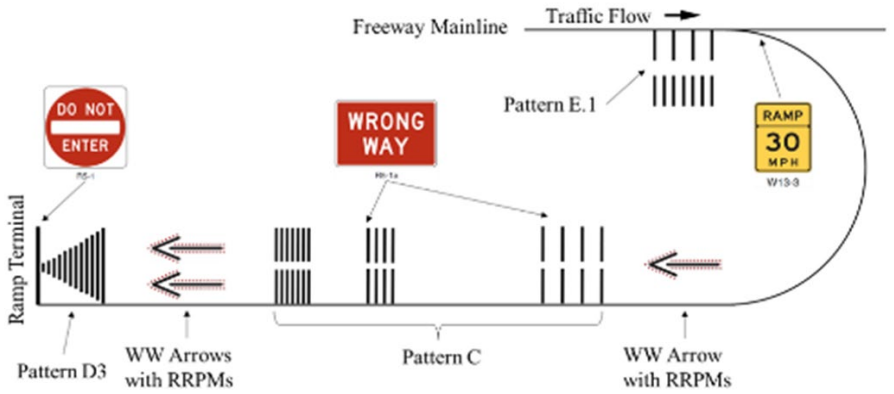
SECTION 3.1 SIGNS

SECTION 3.2 PAVEMENT MARKINGS

SECTION 3.3 TRAFFIC SIGNALS

SECTION 3.4 SIGNING AND PAVEMENT MARKINGS AT OFF-RAMP TERMINALS FOR DIFFERENT INTERCHANGE TYPES

SECTION 3.5 SIGNAGE AND PAVEMENT MARKINGS ON MULTILANE DIVIDED HIGHWAYS



Handbook Content: Chapter 4

CHAPTER 4: ADVANCED TECHNOLOGIES

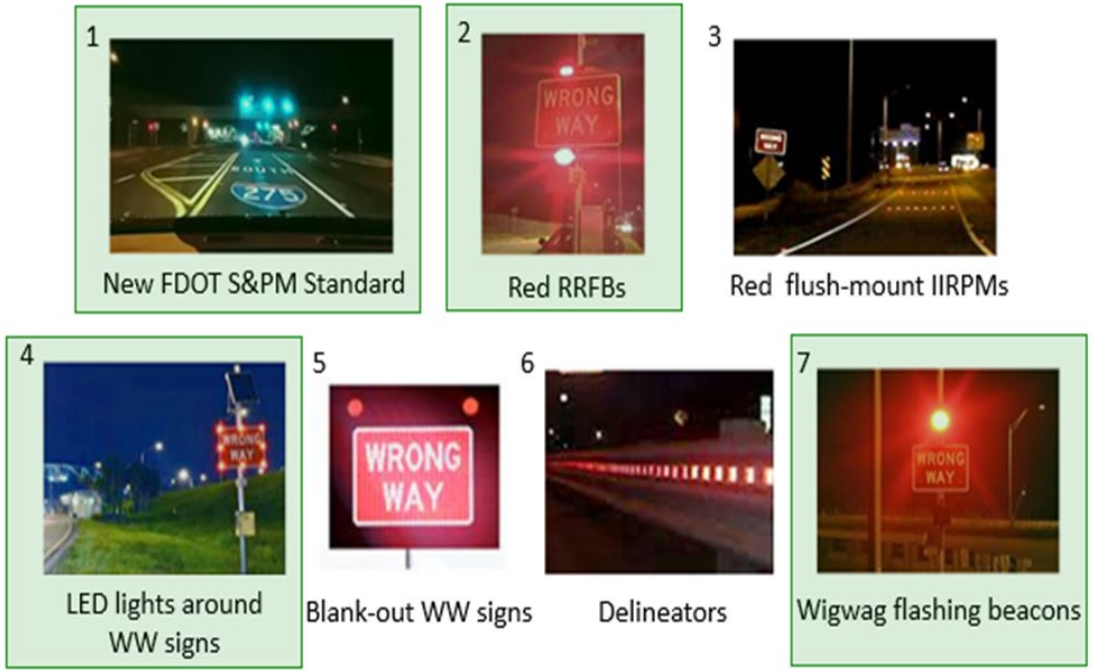
SECTION 4.1 ADVANCED TECHNOLOGIES

- DETECTION
- IN-ROADWAY SENSOR TECHNOLOGIES

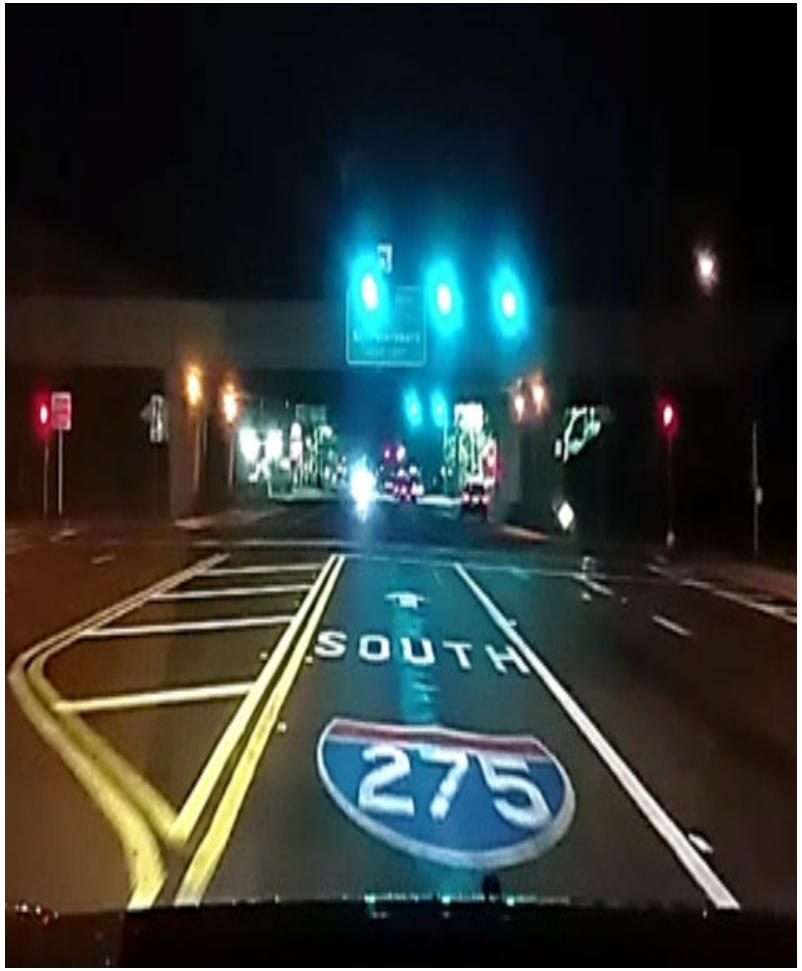
SECTION 4.2 EXAMPLES OF APPLICATION OF ITS TECHNOLOGIES

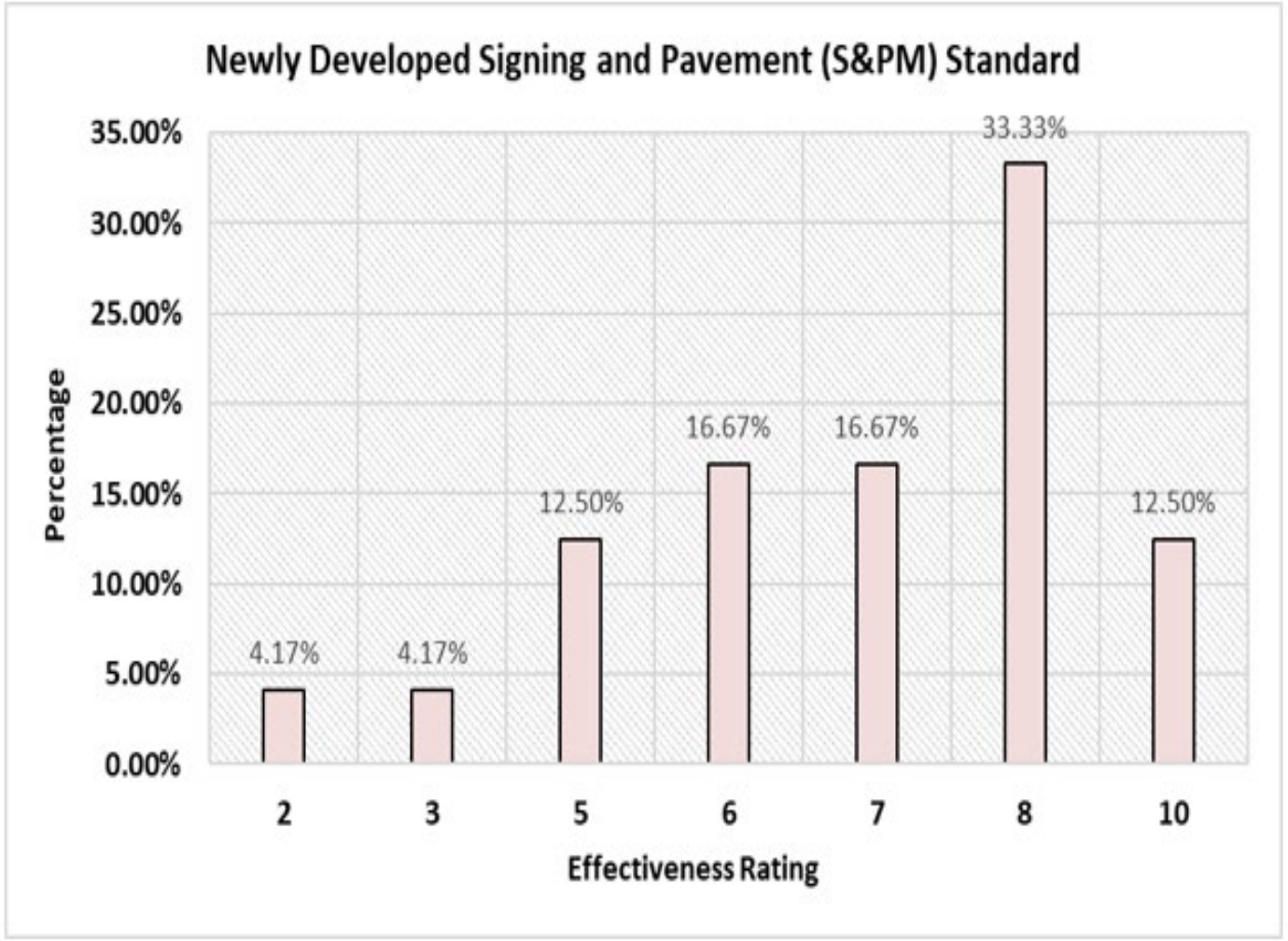
- ADOT GUIDELINE ON WWD ITS SYSTEM
- FDOT DISTRICT 5 DESIGN GUIDANCE ON WWD DETECTION SYSTEM
- HARRIS COUNTY TOLL ROAD AUTHORITY IMPLEMENTATION OF RADAR DETECTION SYSTEM

SECTION 4.3 GUIDELINE FOR WWD DETECTION IN CONNECTED VEHICLE ENVIRONMENT



Evaluation of Advanced TCDs through Nationwide Follow-up Surveys





Handbook Content: Chapter 5

CHAPTER 5: GEOMETRIC DESIGN ELEMENTS

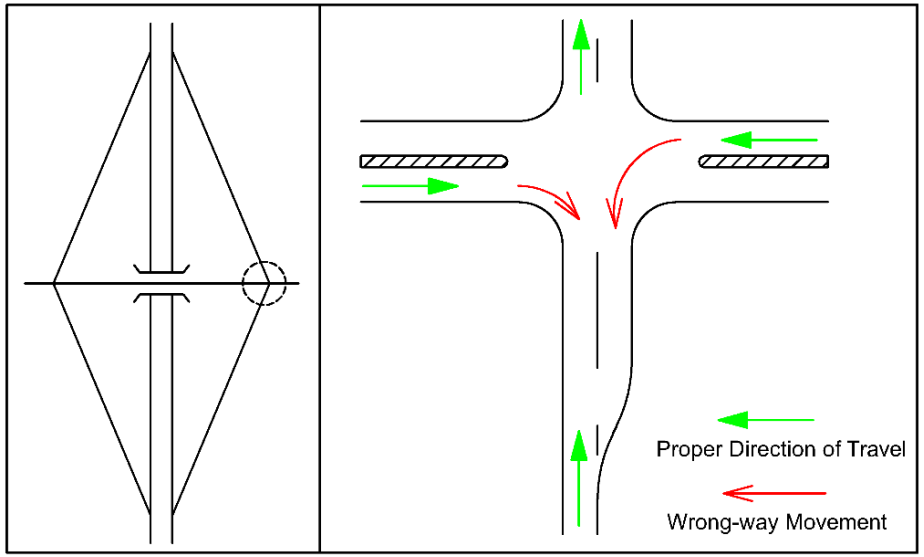
SECTION 5.1 GEOMETRIC DESIGN ELEMENTS

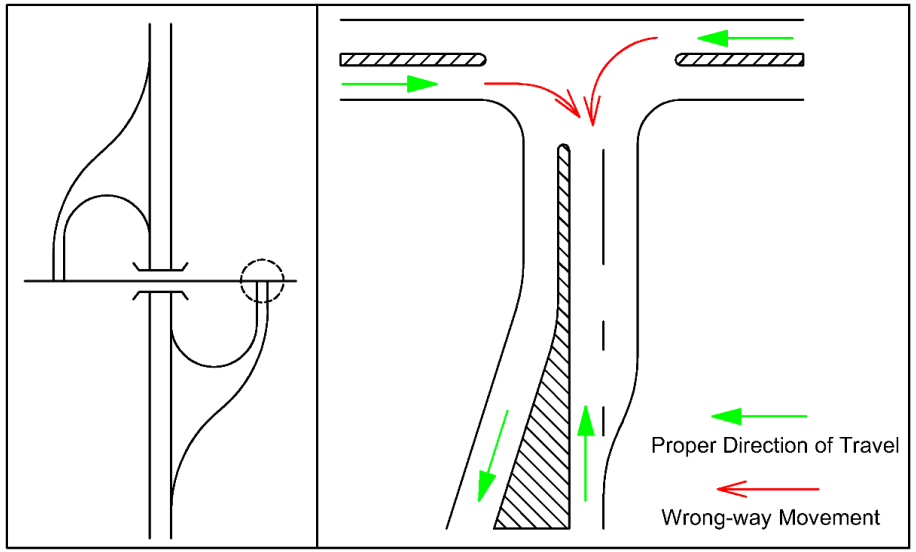
SECTION 5.2 GEOMETRIC DESIGN ELEMENTS AT OFF-RAMP

PARTIAL CLOVERLEAF INTERCHANGE

DIAMOND INTERCHANGE WITH CONTINUOUS FRONTAGE ROAD

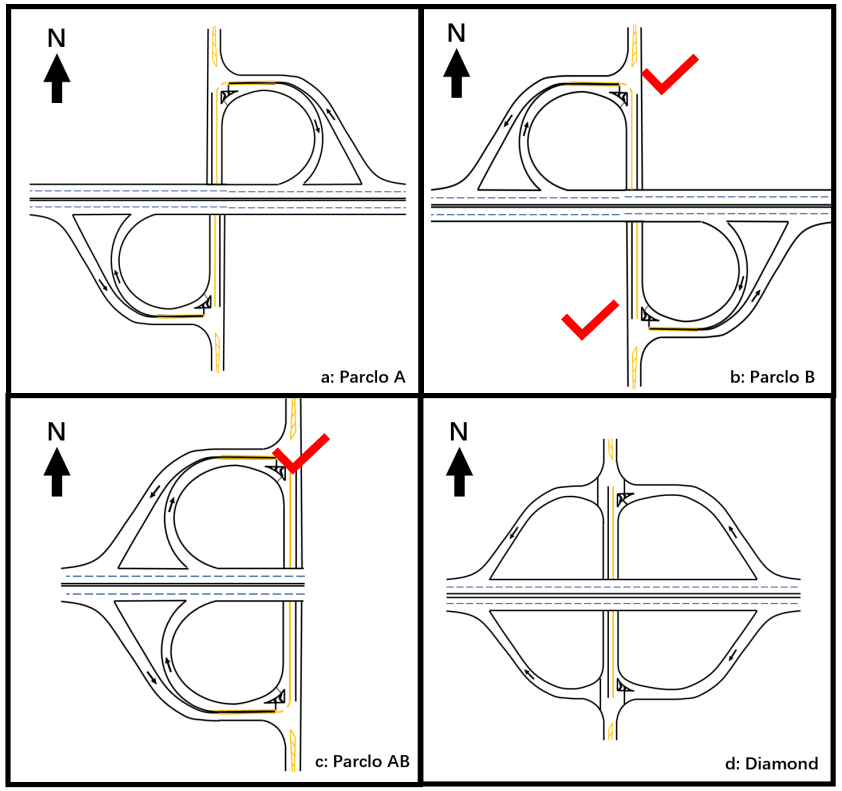
CONVENTIONAL DIAMOND INTERCHANGE





Parclo A vs. Parclo B

88% of High-risk Locations are Parclo B



	12 Low-frequency locations		16 High-frequency locations	
Number of WWD incidents	Mean	(Min, Max)	Mean	(Min, Max)
	1	(1, 1)	11.5	(3, 28)
Corner Radius	Mean	Std.	Mean	Std.
	50.55	15.29	48.56	17.96
Median on the crossroad				
	Count	Percentage	Count	Percentage
Non-traversable	3	25%	1	6%
Traversable	9	75%	15	94%
Median on the crossroad covering the ramp				
Covered (0)	5	42%	5	31%
Not covered (2)	7	58%	11	69%
Number of lanes on the off-ramp				
1 (1)	11	92%	12	75%
2 or more (2)	1	8%	4	25%
Interchange design type				
Parclo A	6	50%	2	13%
Parclo B	6	50%	14	88%
Channelized Island on the off-ramp				
Exist	6	50%	11	69%
Not exist	6	50%	5	31%
Control Type				
Controlled	3	25%	5	31%
Uncontrolled	9	75%	11	69%
Sign Enhancement				
Minimum requirements	6	50%	8	50%
Enhanced	6	50%	8	50%

Handbook Content: Chapter 6

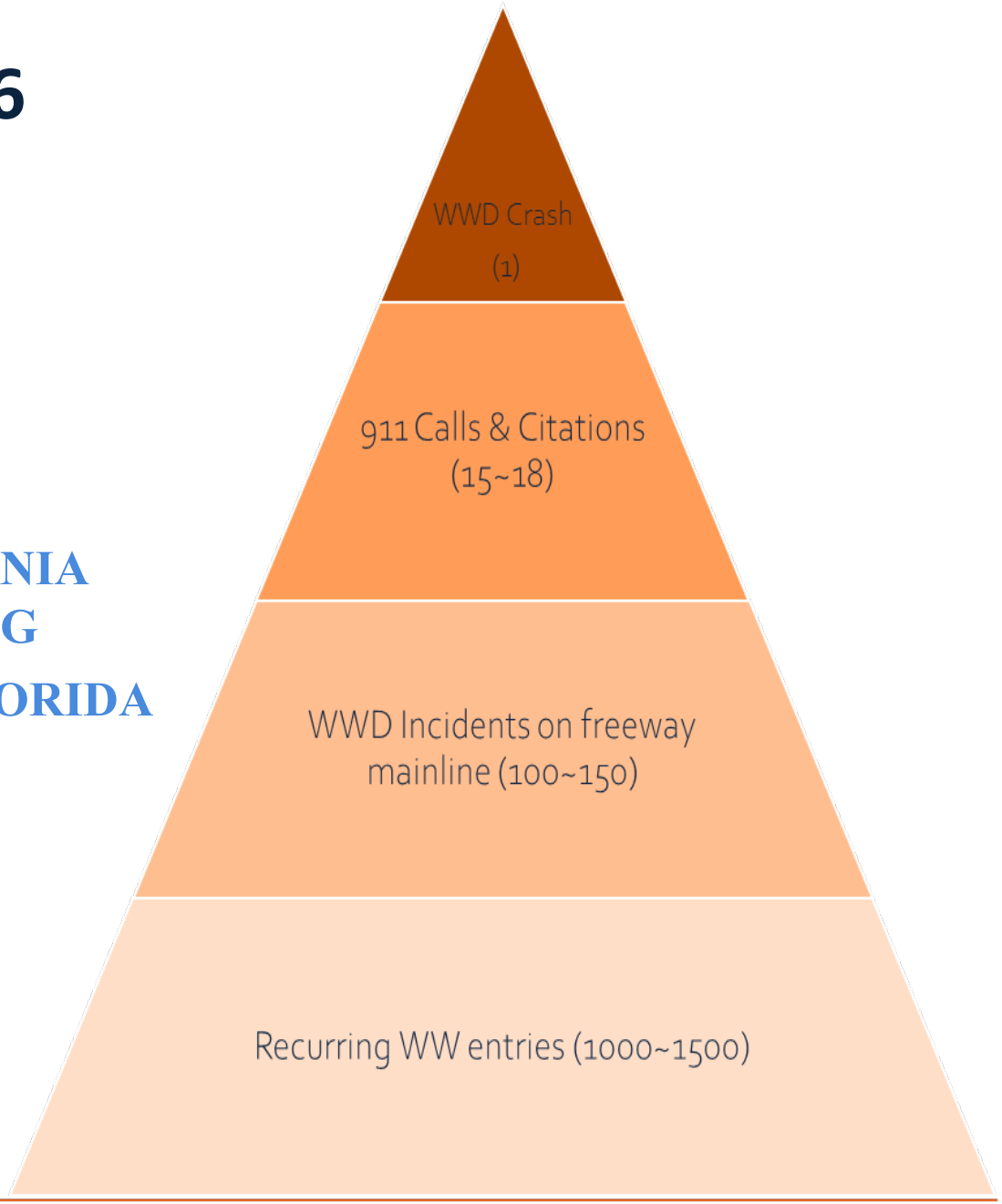
CHAPTER 6: COUNTERMEASURE EFFECTIVENESS EVALUATION

SECTION 6.1 PROPOSED METHOD

SECTION 6.2 CASE STUDY 1: RRPM IN CALIFORNIA

SECTION 6.3 CASE STUDY 2: WIGWAG FLASHING BEACONS AND MEDIAN EXTENSION IN FLORIDA

SECTION 6.4 CASE STUDY 3: RRFB IN FLORIDA



Handbook Content: Chapter 7

CHAPTER 7: ENFORCEMENT AND EDUCATION

SECTION 7.1 ENFORCEMENT

DATA-DRIVEN ENFORCEMENT

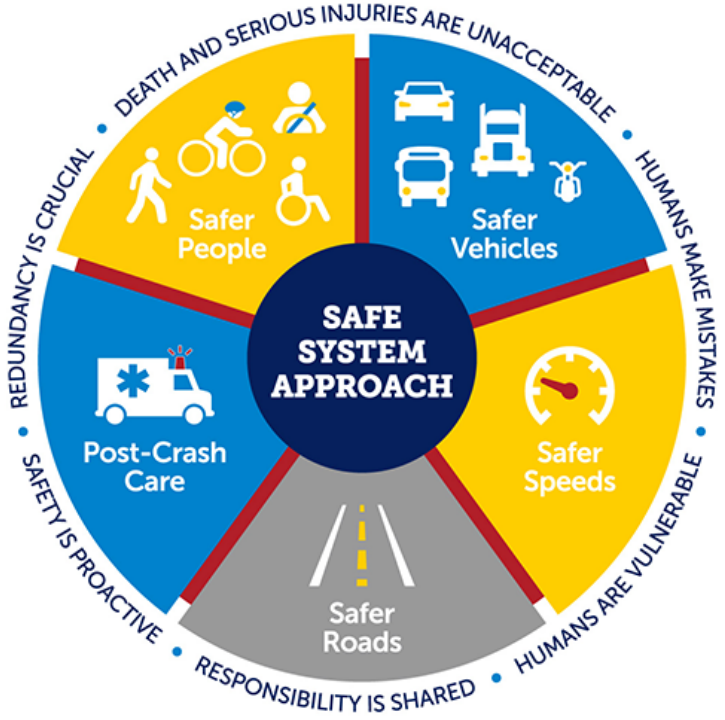
METHODS TO STOP WW VEHICLES

WWD CRASH REPORTING

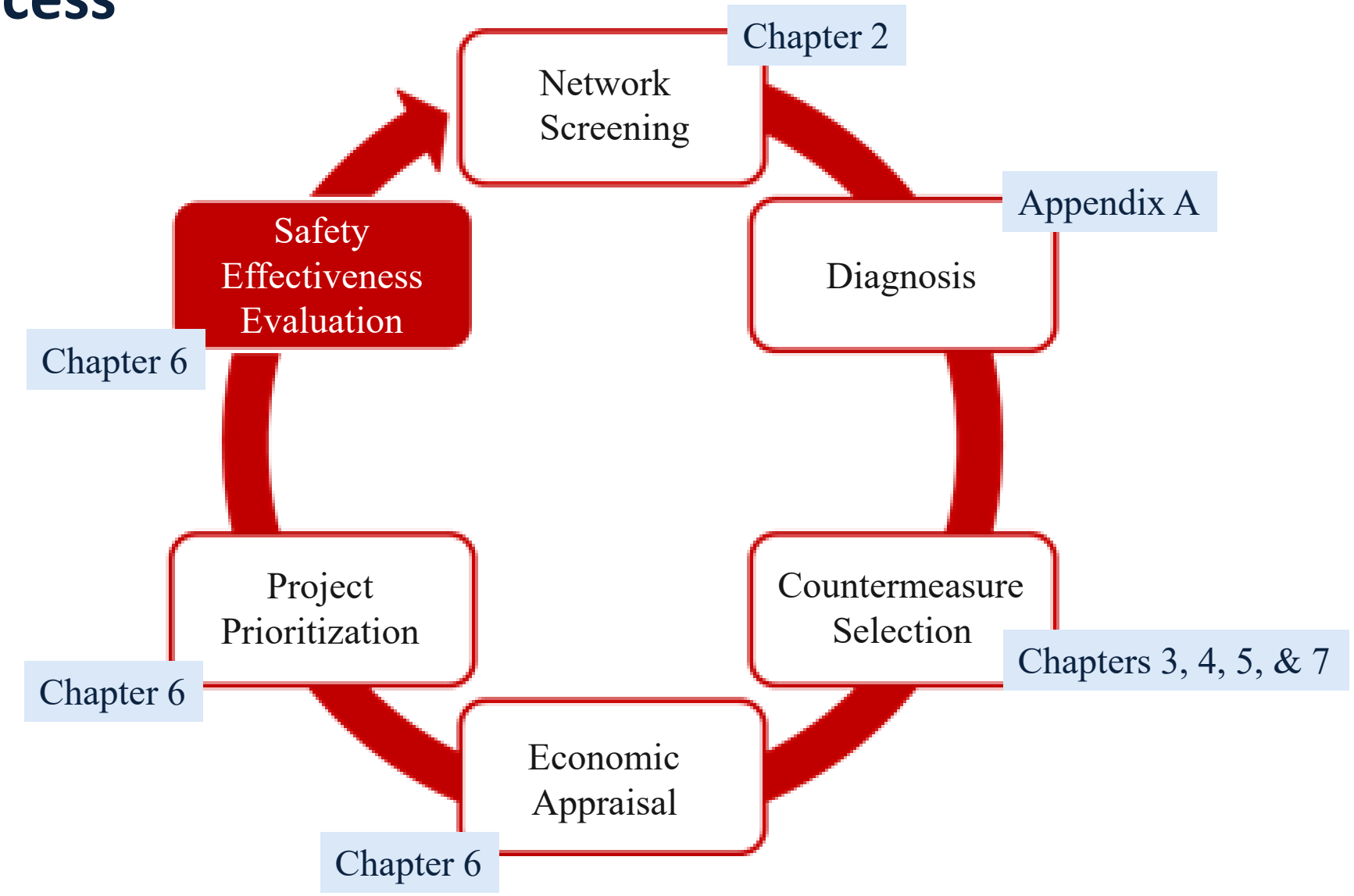
TECHNIQUES FOR USE WITH DUI OFFENDERS

SECTION 7.2 EDUCATION

SECTION 7.3 COMMUNICATIONS WITH MEDIA ON WWD CRASHES



Handbook in the Six Steps of Road Safety Management Process



Panel Members

- Eric Hemphill, North Texas Tollway Authority, Chair
- Richard Retting, TRB, TRB Staff Representative
- William Rogers, TRB, TRB Staff Representative
- Jeffrey Shaw, Federal Highway Administration, FHWA Liaison
- Joseph Horton, California Department of Transportation
- F. Bryan Homayouni, Central Florida Expressway Authority
- Tymli Frierson, Arkansas Department of Transportation
- Michael McNeill, Ohio Department of Transportation
- Scott Neidert, Delaware Department of Transportation
- Heidi Spangler, Michigan Department of Transportation
- Paul Steinman, HNTB Corporation
- Brian Ness, Idaho Department of Transportation, AASHTO Monitor

AUBURN

THANK YOU!

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Implementation of Wrong Way Driving Countermeasures

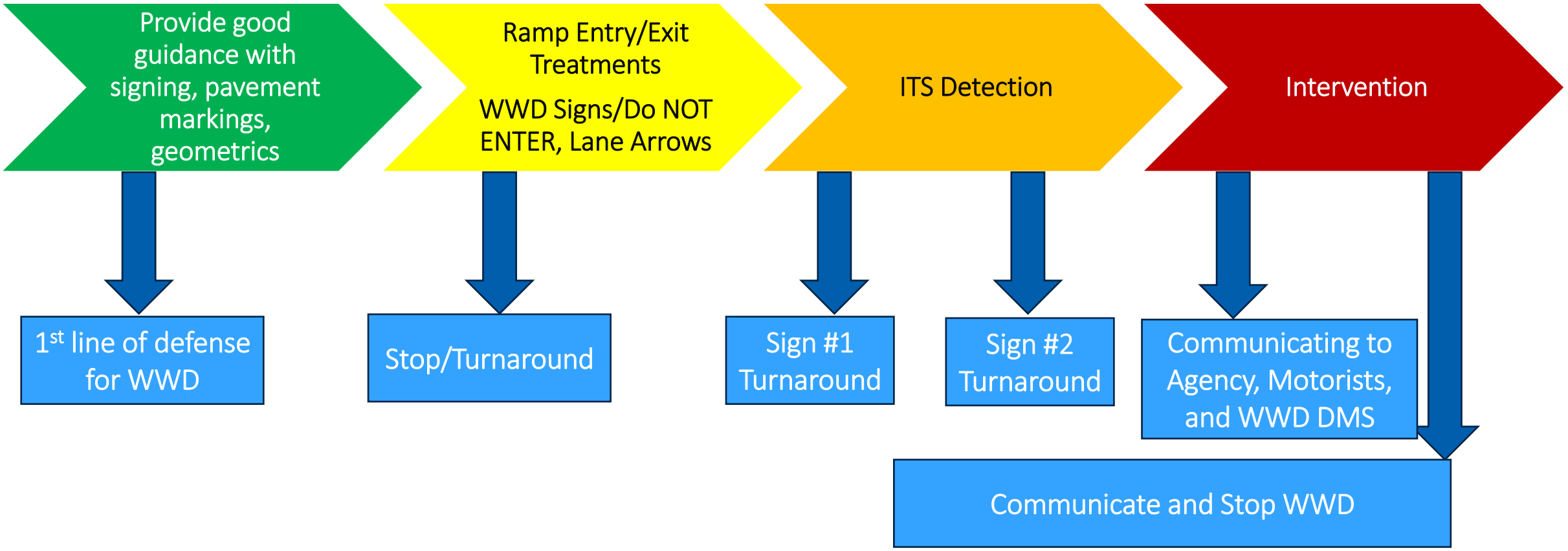
Priscilla A. Tobias, Pe, RSP2IB
Vice President, Midwest Operations
Arora and Associates, P.C.

ARORA and ASSOCIATES, P.C.
Consulting Engineers

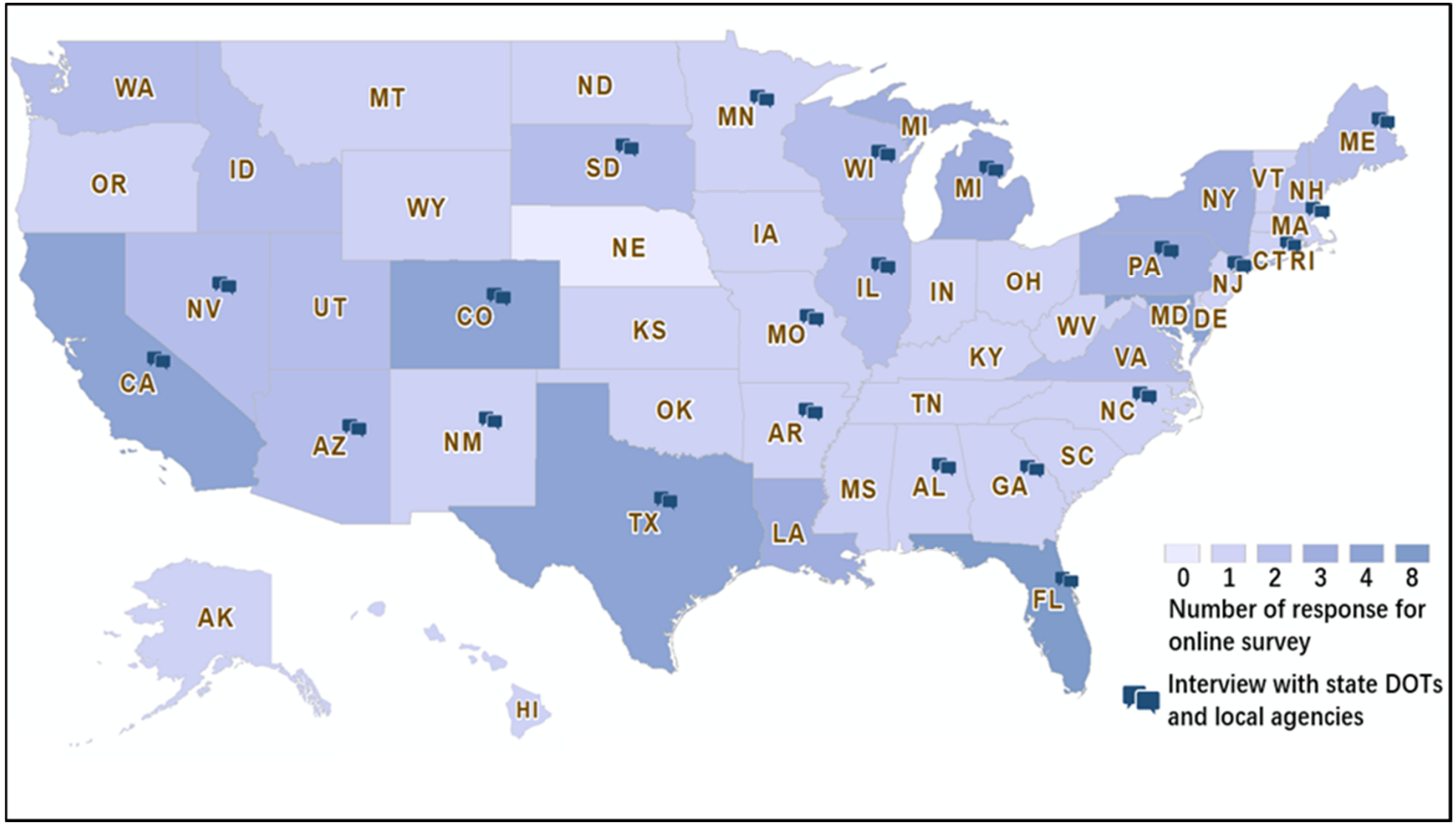
Wrong Way Driving and the Safe System Approach Principles

- Responsibility is shared
- Death and injury are unacceptable
- Humans are vulnerable—kinetic energy
- Humans make mistakes
- Safety is proactive
- Redundancy is crucial

Redundancy


Provide good guidance with signing, pavement markings, geometrics
Ramp Entry/Exit Treatments
WWD Signs/Do NOT ENTER, Lane Arrows
ITS Detection
Intervention
1st line of defense for WWD
Stop/Turnaround
Sign #1 Turnaround
Sign #2 Turnaround
Communicating to Agency, Motorists, and WWD DMS
Communicate and Stop WWD

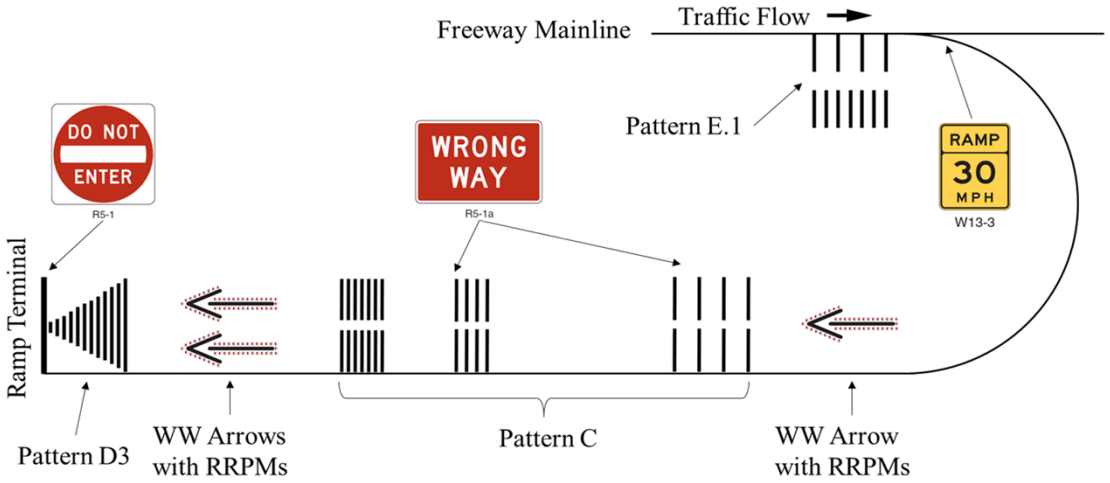
Number of responses to the Online Survey and geographic distribution of interview respondents



WWD Mitigation Needs

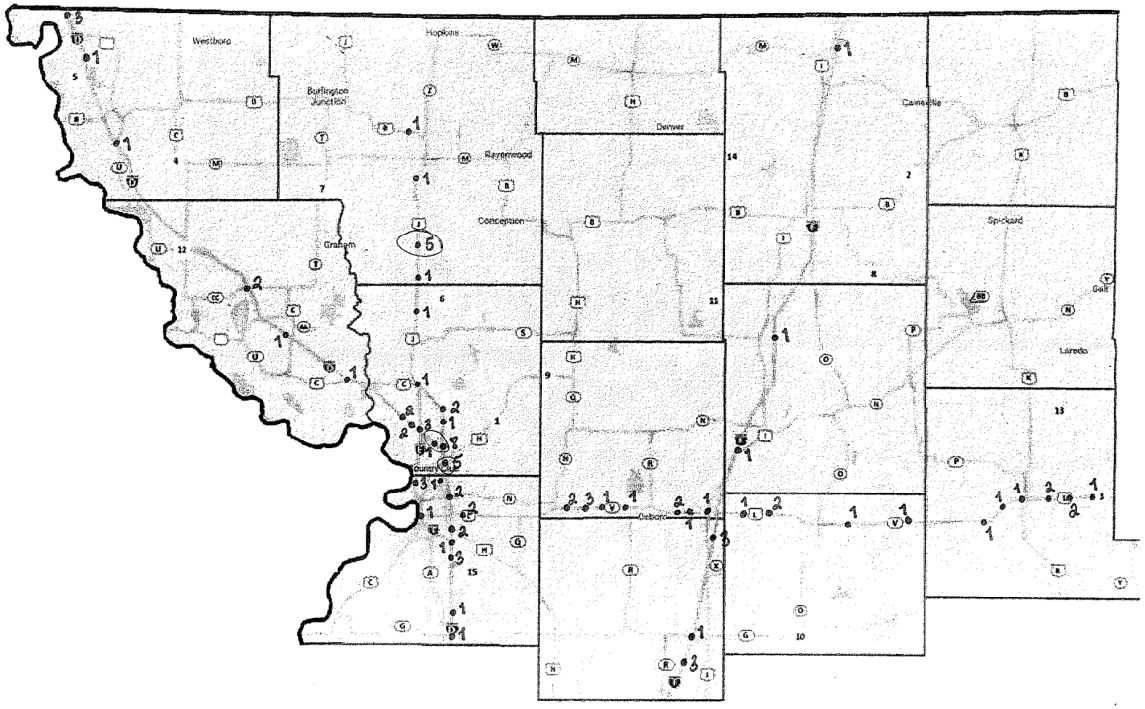
State DOTs	Specific Needs/Concerns
CA	Further research on **impaired drivers** and their perception of different wrong way driver countermeasures Provide a history of how the WW problem has evolved and how DOTs have been addressing WW
MA/KS/IL	**Ranking tool** to identify the effectiveness of WWD countermeasures WWD mitigation techniques including the location to implement countermeasures
GA	Separate guideline based on **roadway type or interchange design**
VA	Further research on **DDI interchange** and guidelines
OR	Criteria to identify **risk factors**, suggested countermeasures to address those risk factors (hotspot and systemic approaches) and methods to **prioritize locations**
TX	**PSA and educational goals** to inform the public of recommended countermeasures when they encounter WWDs
NV	**Testing procedures** for advanced ITS countermeasures and protocols

Best Practices, Existing Policy, and Guidance



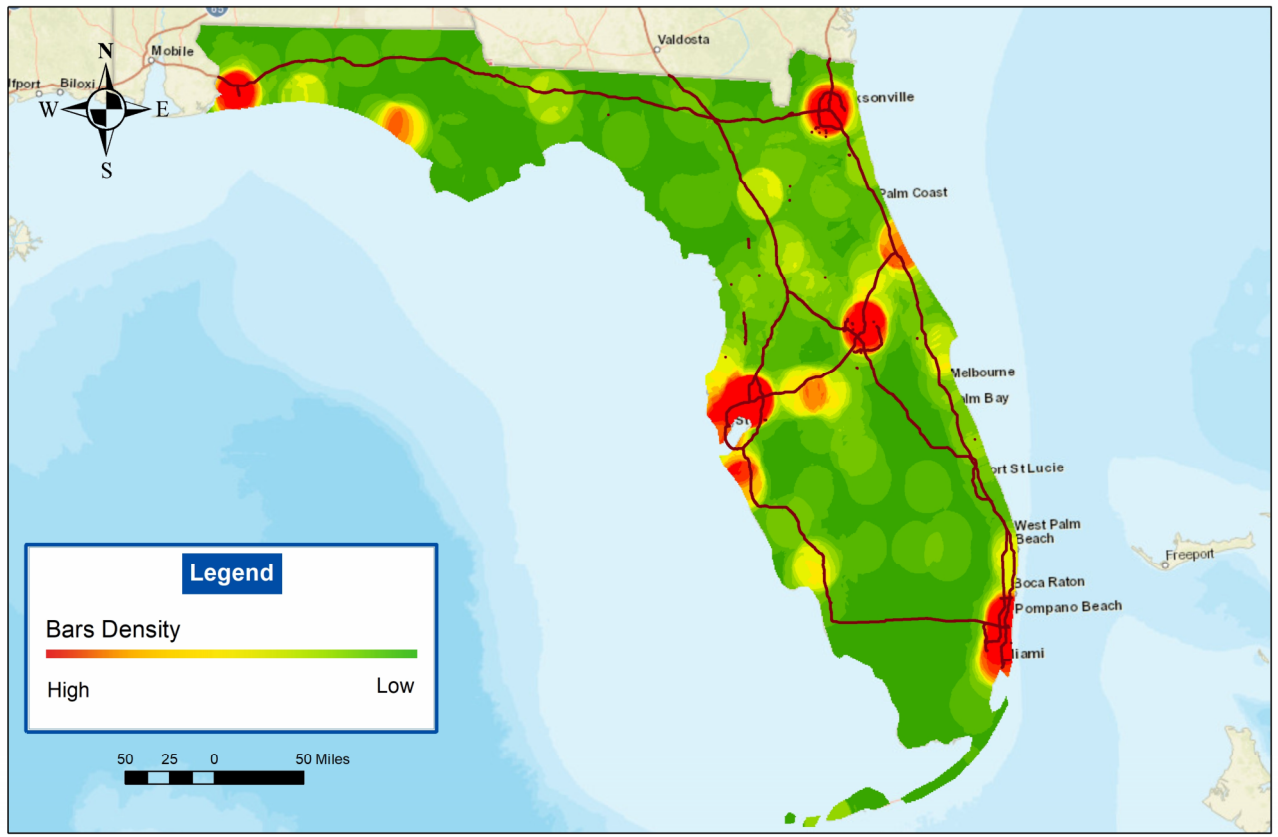
- Partnerships with enforcement to understand where/if there was a WWD issue and responding to it.
- Incident data can help an agency better understand the WWD issue and identify locations with a higher potential of WWD.
- Heat maps based on WWD crashes and incidents help identify locations and patterns.
- WWD Checklist to evaluate multiple factors.
- Additional geometrics combined with signing and pavement markings installations that direct motorists to a WW entry point.
- Tiered systemic approach to WWD mitigation
- ITS systems are being used more frequently at targeted locations to mitigate WWD, especially in urban areas.

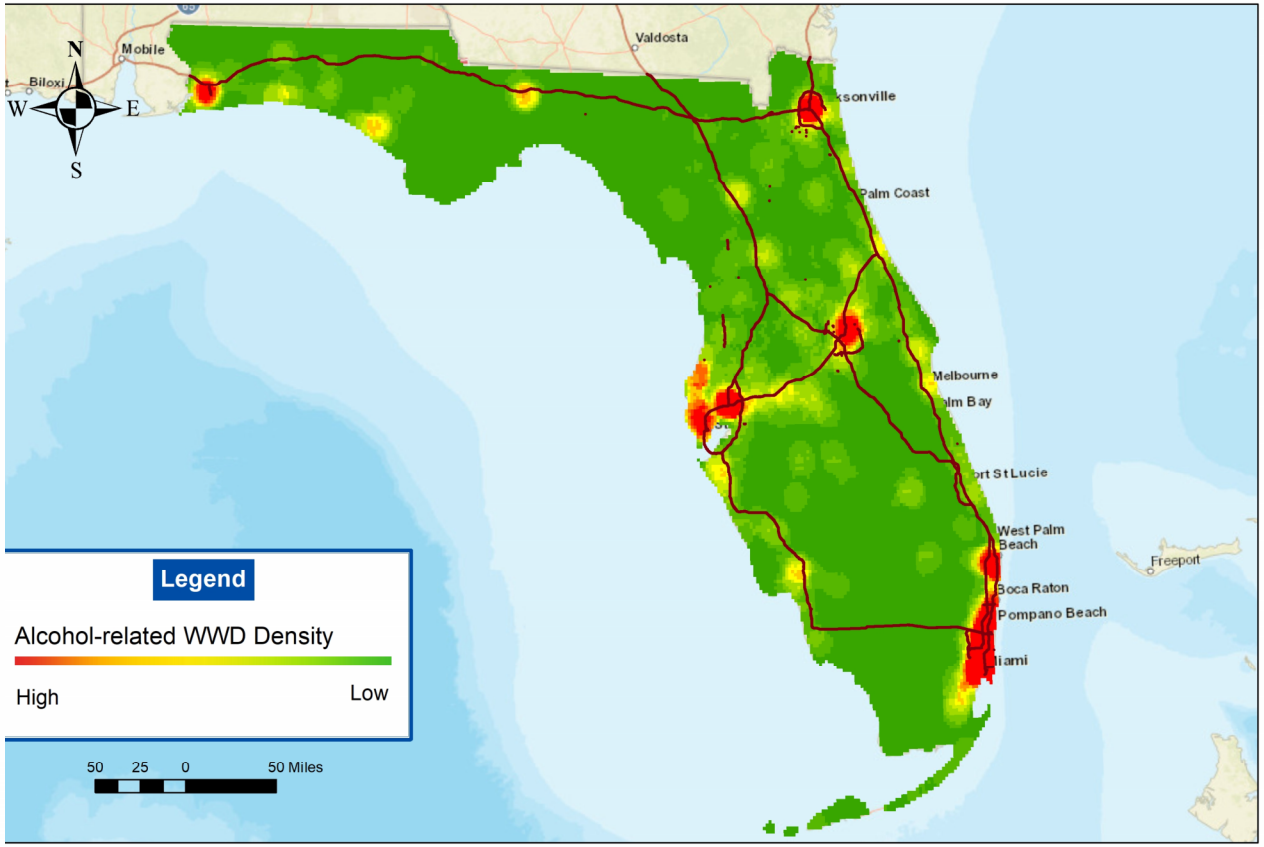
Best Practices, Existing Policy, and Guidance



- Network Screening--GIS maps
  - Data since year 2000.
  - Incident
  - Using “close call” data
  - Customer concern calls
  - Crashes

Network Screening-Heat Maps





Source: Florida DOT

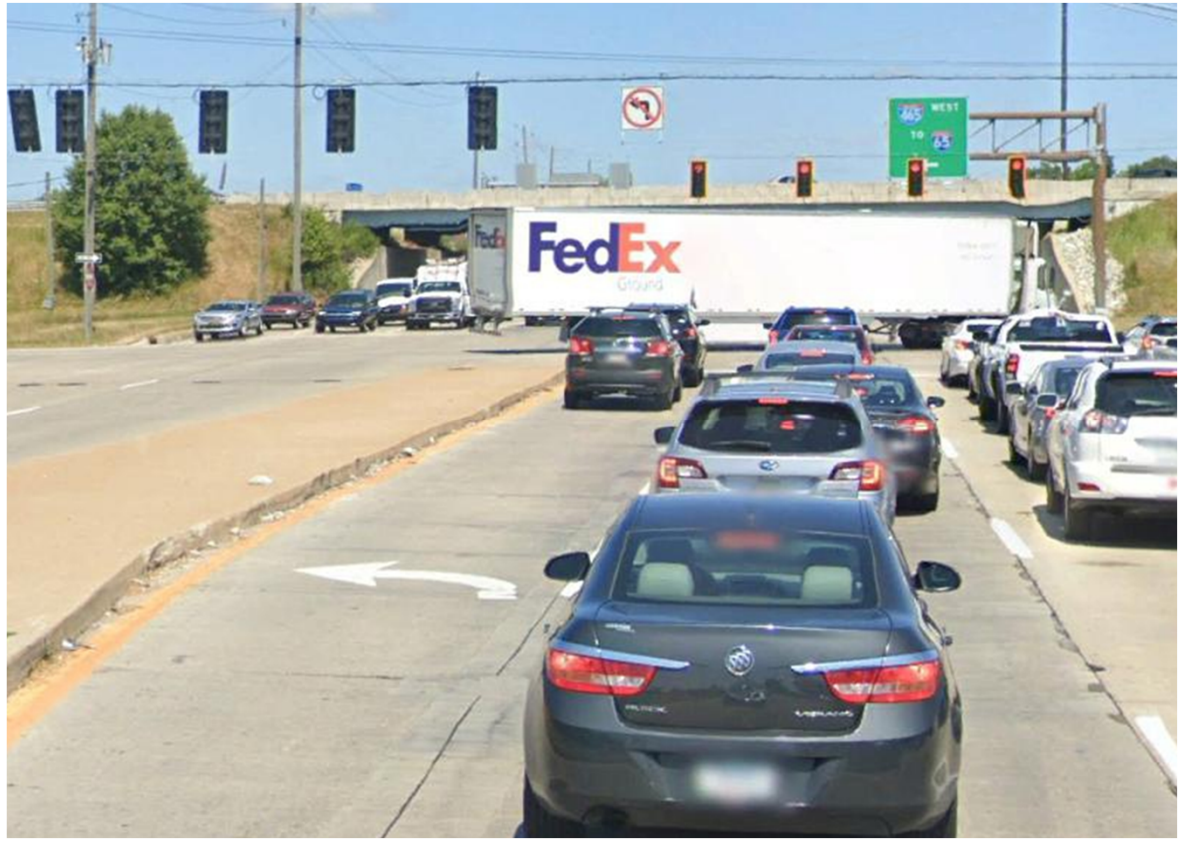
- State Level
- Drinking Establishment vs Impaired Driving WWD incidents and crashes
- Older population vs. WWD

Monitor and Video Analytics (Pre-Permanent ITS Solution)

- ITS systems are being used more frequently at targeted locations to mitigate WWD, especially in urban areas.
- Temporary monitoring — Basic, temporary video camera with a trailer
- Near miss/conflict video

Source: Maine DOT

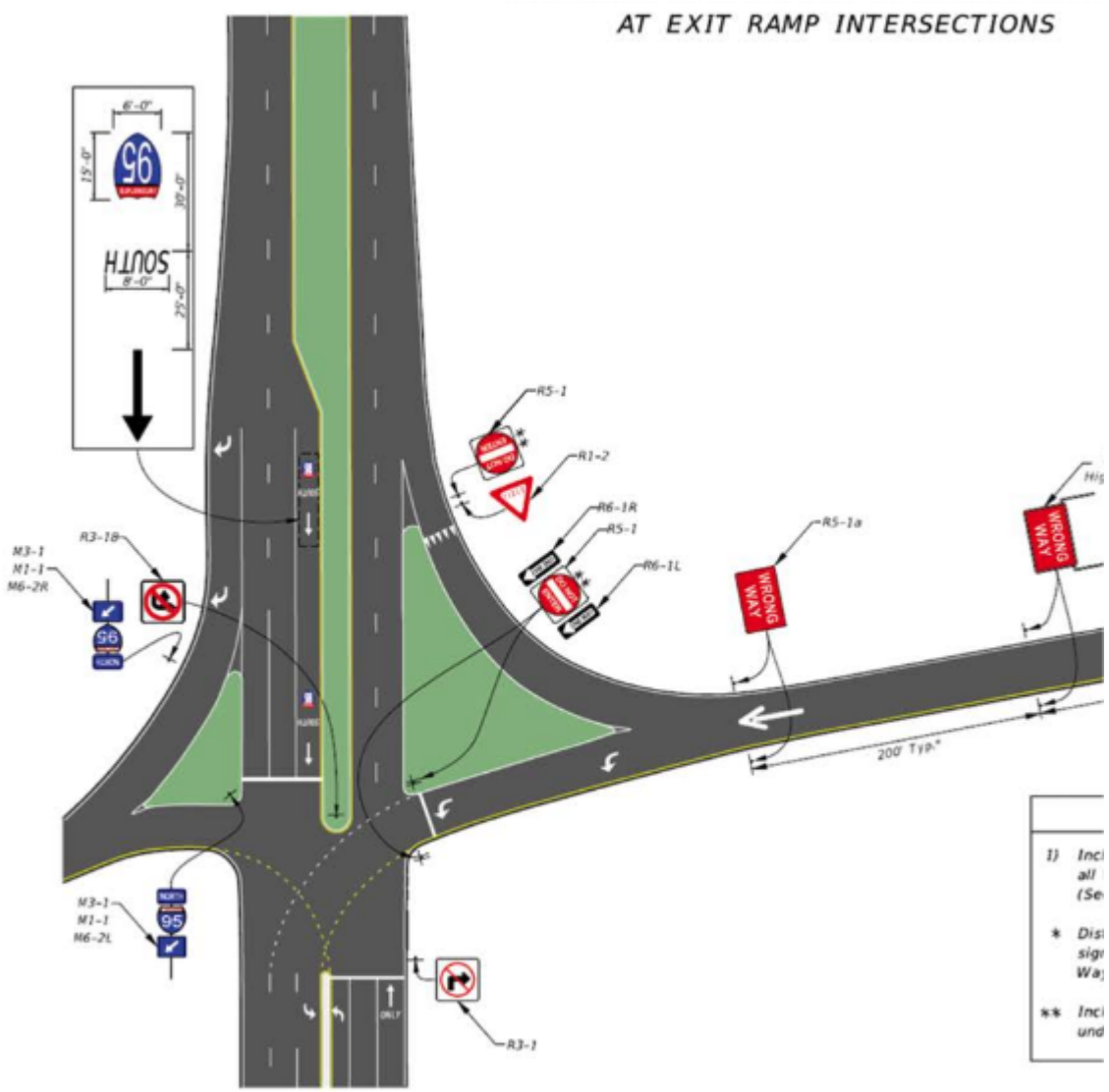
Conflicting Guidance and Human Error



Signs and Pavement Markings

Signs and Pavement Markings

Positive Guidance to Mitigate Human Error

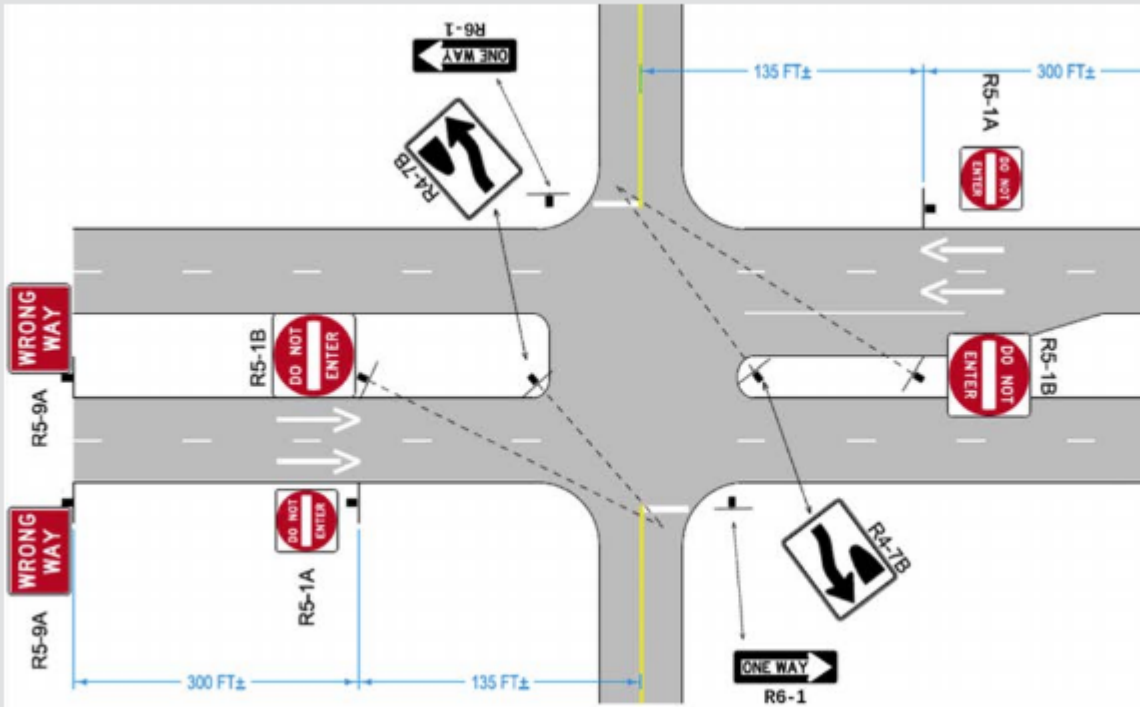


Source: Florida DOT (2022a).

Signing and Pavement Markings

Resources

Box 3-8. Design Guidelines for Limited Sight Distance *(Continued)*



Source: W. Sorenson.

Figure 3-48. Signage and pavement markings at at-grade intersections on divided highwa

Wrong-Way Entry Checklist Field Inspection Sheet

WRONG-WAY DRIVING FIELD INSPECTION SHEET					
Inspector					
Route information		Date			
Ramp Description		Time			
Sign			**Pavement Markings**		
DO NOT ENTER (R5-1)	Minimum quantity present?		Wrong-Way Arrows	Present?	
	Good visibility at night?			In good condition?	
	Faced to the intended motorists?			First set within 100 ft?	
	Standard mounting height?			RPM around the edge of the arrow?	
	Retroreflective tape on the sign post?		Skip Stripping for Turning Guidance	Present?	
	LED border present?			In good condition?	
	Enlarged size?		Double Yellow Line on the Crossroad	Present?	
	Present on both side of exit ramp?			In good condition?	
WRONG-WAY (R5-1a)	Minimum quantity present?			Extended to intersection functional area?	
	Good visibility at night?		STOP bar on the exit ramp throat	Present?	
	Combined with DO NOT ENTER sign?			In good condition?	
	Faced to the intended motorists?			RPM with STOP bar?	
	Standard mounting height?		Lane use arrow for exit ramp lanes	Present?	
	Retroreflective tape on the sign post?			In good condition?	
	First set within 100 feet?		Any Enhancement? (Wider, directional rumble strips, etc.)		
	Second set present?		**Geometric Design Features**		
	LED border present?		Type of median on the crossroad?	Traversable?	
	Enlarged size?			Extended to intersection functional area to make left-turn wrong-way movements uncomfortable?	
	Present on both side of exit ramp?		Channelizing Island on the exit ramp approach?	None?	
ONE WAY (R6-1)	Present?			Traversable?	
	Enlarged size?			Length?	
KEEP RIGHT (R4-7)	Present?		Corner radius from crossroad?	< 50 ft	
	Located on the nose of median?			51-100 ft	
	Located on the gore area?			> 100 ft	
	Enlarged size?		Width of median between two-way ramp?	Traversable?	
Nearby Environments				< 30 ft	
Any obstruction to sight distance of entrance ramp?				30 - 60 ft	
Is there a grade change that may cause sight distance issue?				> 60 ft	
Exit ramp terminal is signalized?			Are there any access points/driveways close to the ramp terminal?	0	
Any bars or pub located nearby?				1 - 500 ft	
Any schools or colleges located nearby?				> 500 ft	
Any truck rest area nearby?			**Traffic Volume**		
Is there lighting around the exit ramp terminal?			Entrance Ramp		
Red delineators on the median concrete barrier?			Exit Ramp		
Is there a median opening at the on/off ramp gore area?					
Yield line or stop bar at the end of the off ramp?					

Approaches to Implementation

- Tier System
  - Tier 1 Sign and pavement marking package at interchanges.
  - Tier 2 Locations with increased exposure to WWD incidents—in-laid pavement markers with arrows.
  - Tier 3 Unique geometrics – Detection systems.

- Multi-phase ITS implementation
  - Implementing WWD mitigation on every project..
  - Incident
  - Using “close call” data
  - Customer concern calls
  - Crashes

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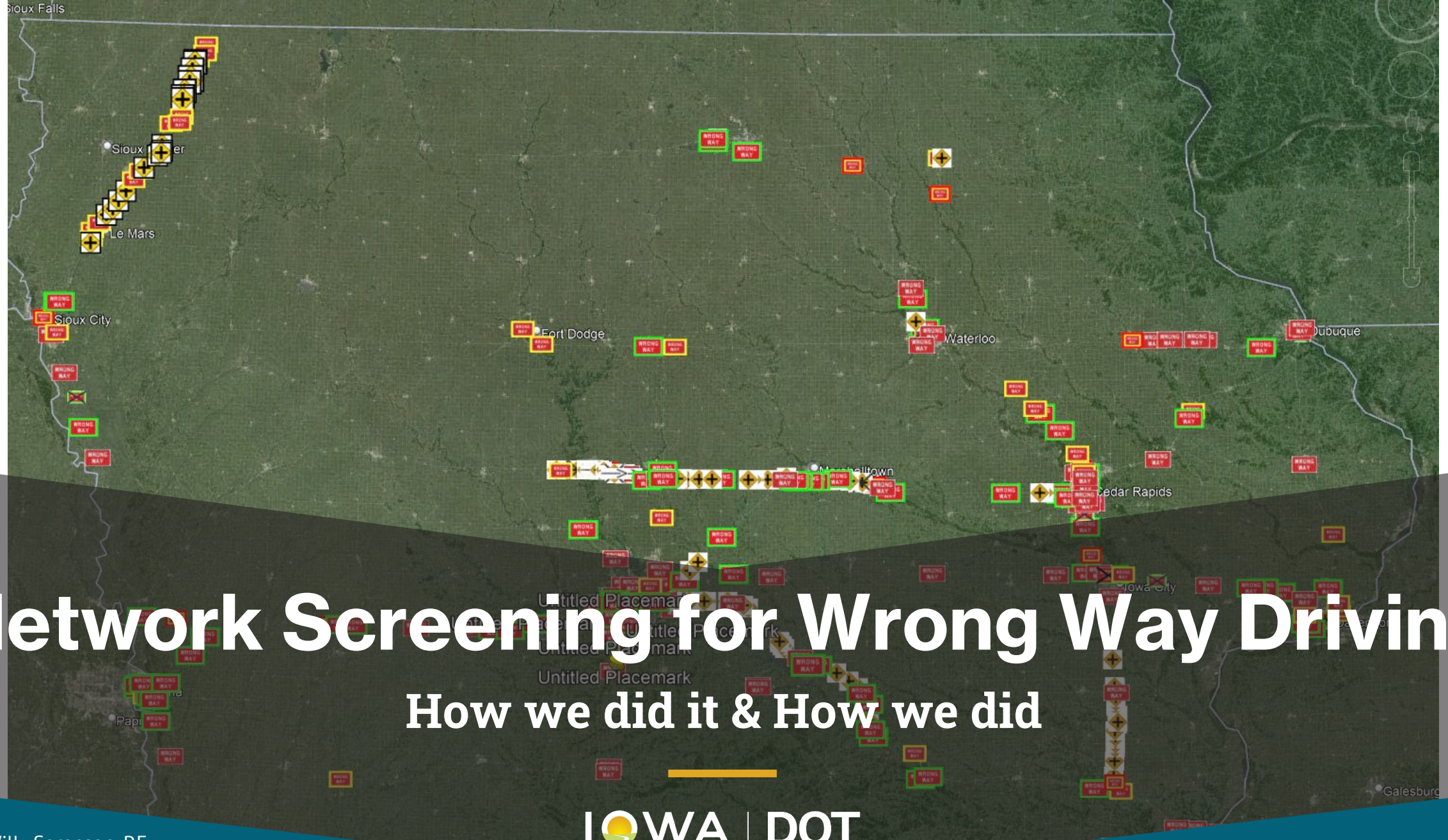


Network Screening for Wrong Way Driving

How we did it & How we did

IOWA | DOT

Willy Sorenson, P.E.
Special Projects Engineer

March 27, 2024

Agenda

Network Screening
How we ranked 472 Interchanges

What we did
Brief overview of our Signing and Pavement Markings layouts

How we measured success/failure
Installed wrong way detection 62 cameras

How we did after 2 ½ years
A before/after overview of WWD events and crash history

Additional Treatments
When initial treatments needed more

What to take notes on and tell your boss
2 low-cost treatments that showed very good success

3 other low-cost treatments that showed promise (just need more time)

After collection WWD Data for 10 years with $0 budget…

- We got $1.5 Million of Safety funding (HSIP)
  - Choice:
    - 340 locations enhanced signing & pavement markings

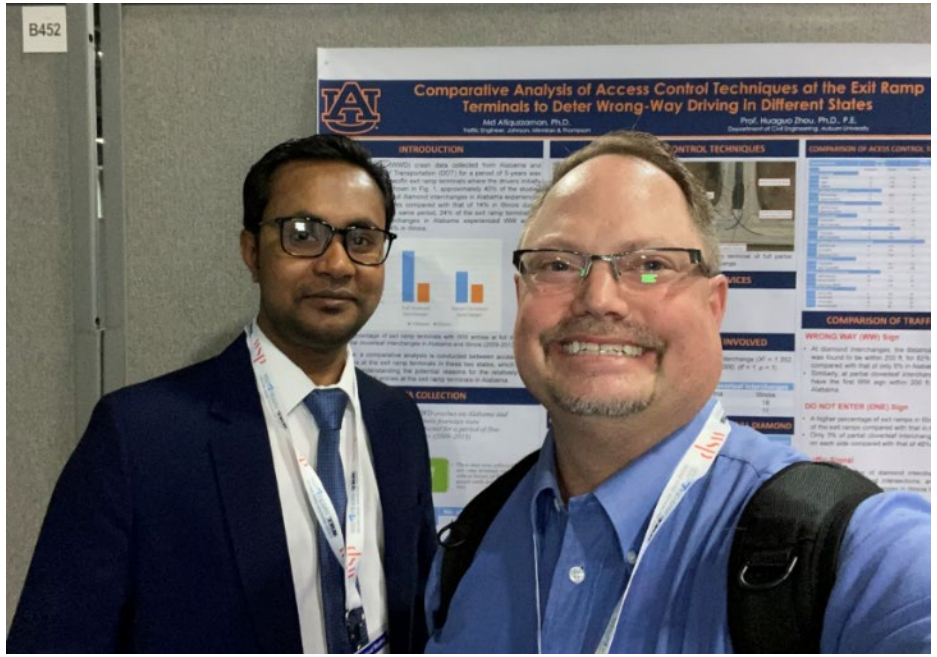
      OR
    - 15 locations Full ITS camera detection and LED Blinking signs
  - We went with Systemic approach
    - (Enhanced Signing & Pavement Markings)

Network Screening

Where to Spend?

Use our Study!

- By Dr. Huaguo Zhou & Md Atiquzzaman
  - Auburn University
  - Based on Risk Factors



Article

TRR

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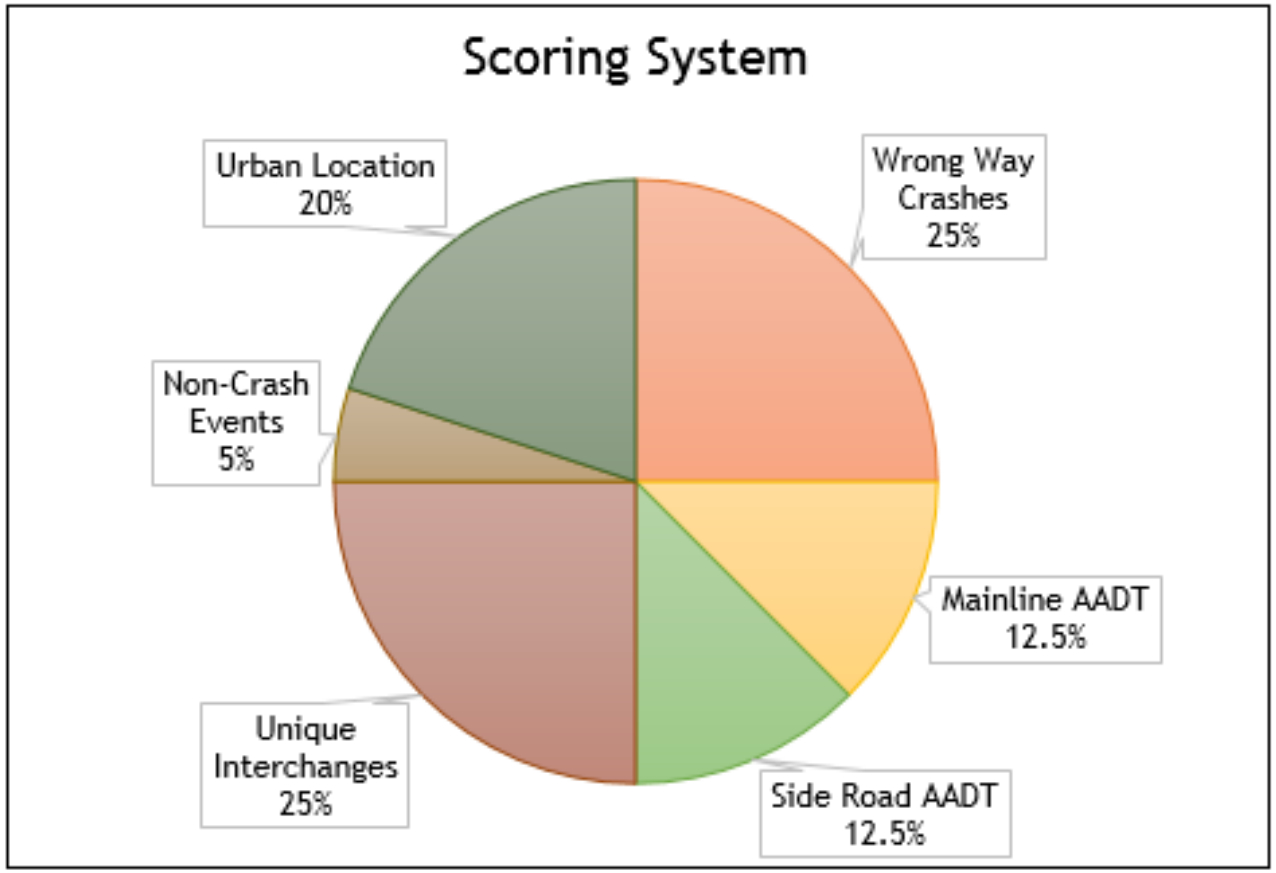
Modeling the Risk of Wrong-Way Driving Entry at the Exit Ramp Terminals of Full Diamond Interchanges

Md Atiquzzaman[1] and Huaguo Zhou[1]

https://journals.sagepub.com/doi/pdf/10.1177/0361198118783152

Iowa's Modifications

- WWD Crash History
- Traffic Volumes
  - (Mainline and Sideroad)
- Interchange Geometry
- Proximity to Liquor License
  - (Urban/Rural)
- Non-crash WWD Reports

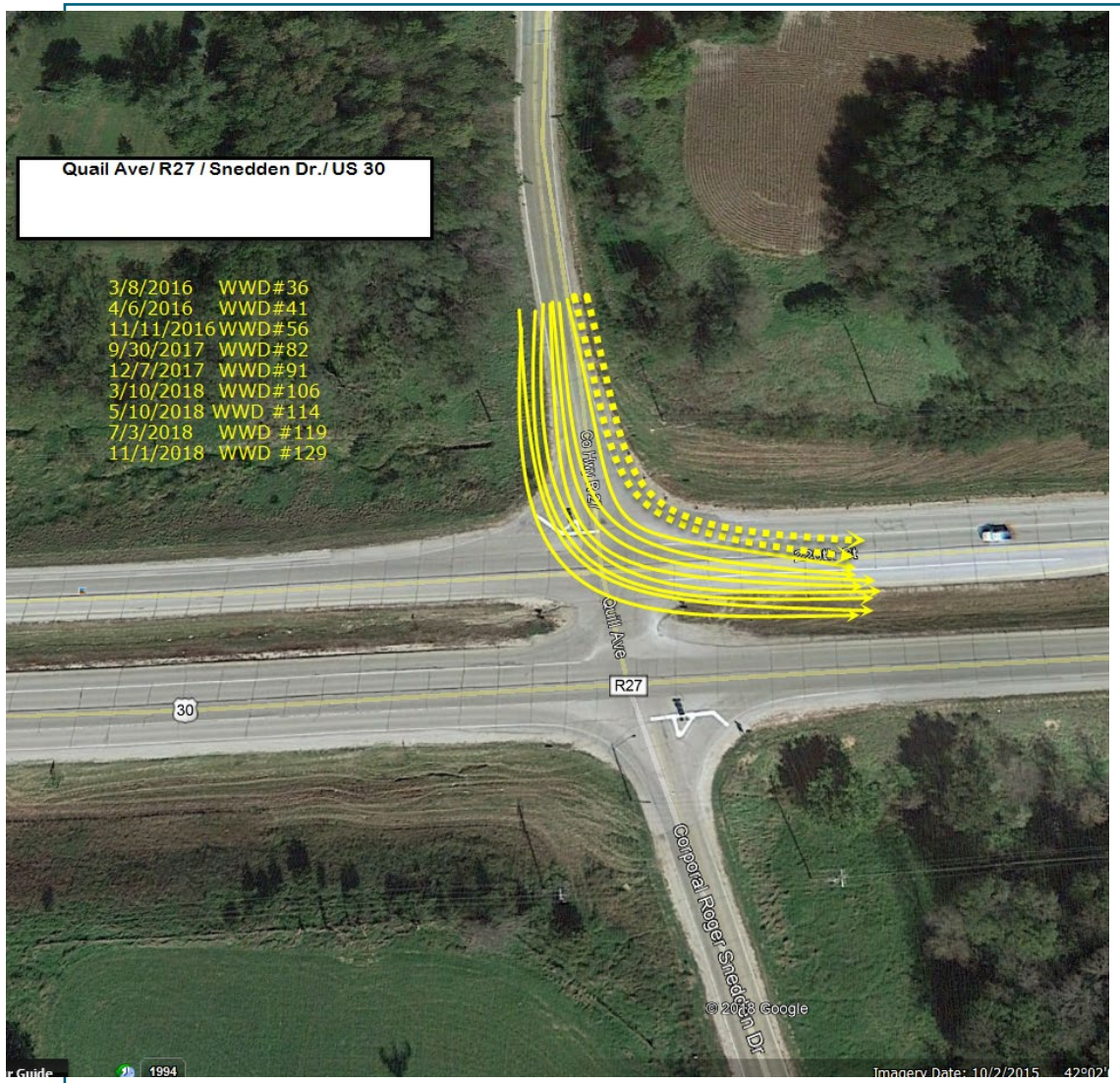


Scoring Process

- Pages 17 – 20 of the Handbook
- Geometry example
  - Folded Diamond (Parclo) & ‘Unique’ get 50 points

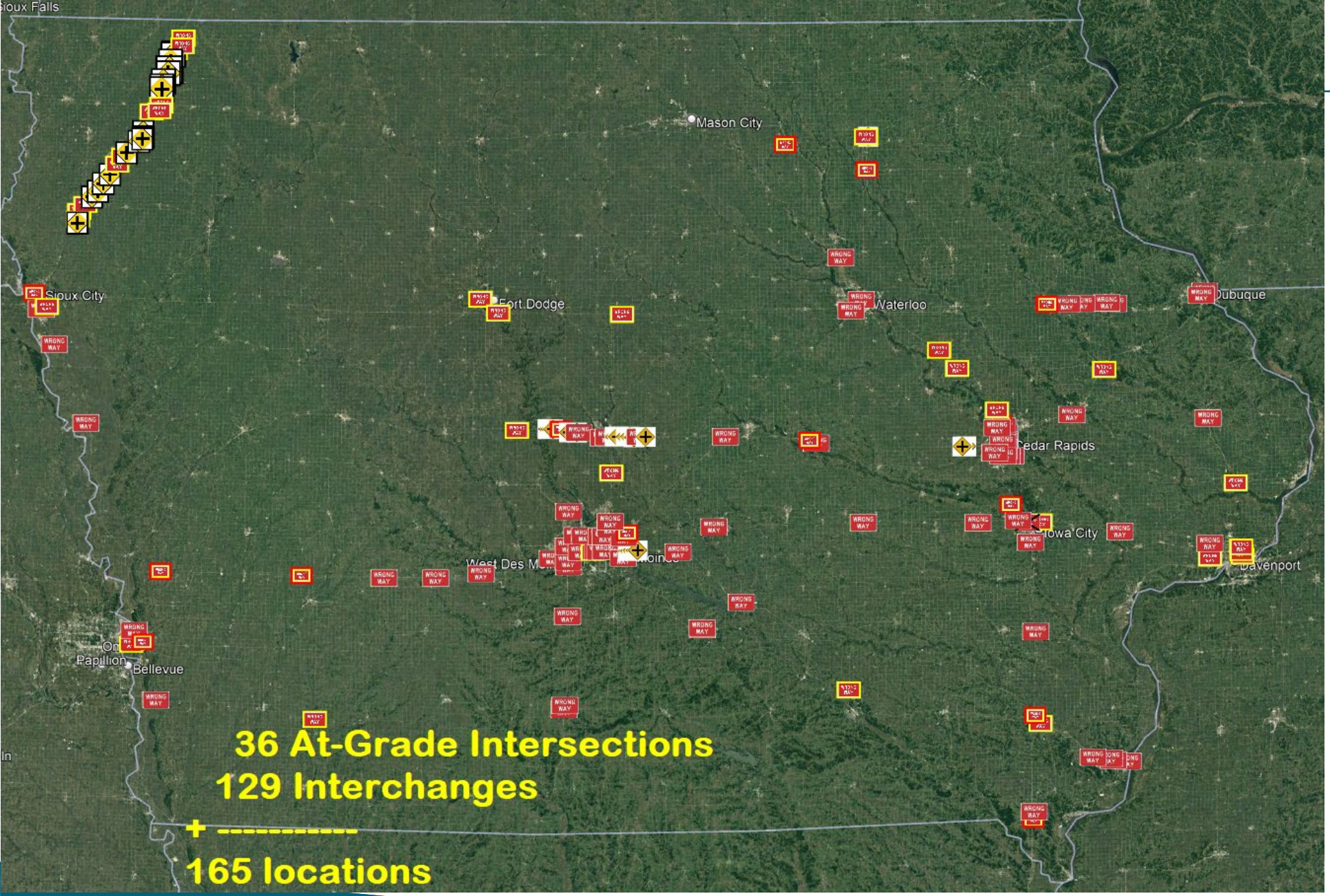
Table 2-2. Sample spreadsheet of scoring criteria.

Category		Points
Crash history		
No history	add 0 points	
0.125 to 0.25 crashes	add 5 points	
0.25 to 0.5 crashes	add 10 points	
0.5 to 0.99 crashes	add 15 points	
0.99 to 1.5 crashes	add 20 points	
1.5 crashes or more	add 25 points	
Fatal crash	add 75 points	
History of noncrash events		
Per event (first five events)	add 10 points	
Interchange geometry		
Unique design	add 50 points	
Folded diamond with exit ramp on inside	add 50 points	
Split interchange	add 25 points	
Other design	add 0 points	
Proximity to an address with a liquor license		
Within 0.7 miles	add 10 points	
Between 0.7 and 2.0 miles	add 5 points	
Over 2.0 miles	add 0 points	
Traffic Volume		
Mainline AADT		
10th percentile [1 to 7,820]	add 1 point	
20th percentile [7,821 to 9,600]	add 2 points	
30th percentile [9,601 to 11,930]	add 3 points	
40th percentile [11,931 to 15,800]	add 4 points	
50th percentile [15,801 to 20,400]	add 5 points	
60th percentile [20,401 to 24,820]	add 6 points	
70th percentile [24,821 to 29,770]	add 7 points	
80th percentile [29,771 to 36,180]	add 8 points	
90th percentile [36,181 to 67,180]	add 9 points	
100th percentile [≥67,181]	add 10 points	
Side road AADT		
10th percentile [1 to 826]	add 1 point	
20th percentile [827 to 1,662]	add 2 points	
30th percentile [1,663 to 2,589]	add 3 points	
40th percentile [2,590 to 3,400]	add 4 points	
50th percentile [3,401 to 4,670]	add 5 points	
60th percentile [4,671 to 6,500]	add 6 points	
70th percentile [6,501 to 8,400]	add 7 points	
80th percentile [8,401 to 11,160]	add 8 points	
90th percentile [11,161 to 19,400]	add 9 points	
100th percentile [≥19,401]	add 10 points	
Both mainline and side road in the top 30%	add 5 points	
	TOTAL SCORE	



Don't Forget about At-Grade Intersections

- Expressways
- This Point of Entry is more common than you think!
- About 99.5% of At-Grade WWD start by "Turning Short" (Left)
- About 0.5% start by "Turning Long" and Right



- Locations have been set

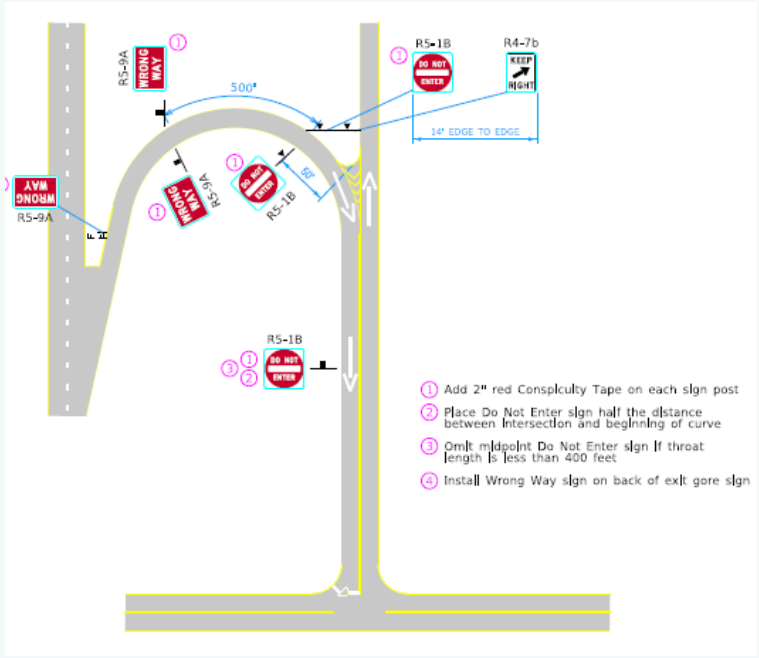
General Signing Philosophy

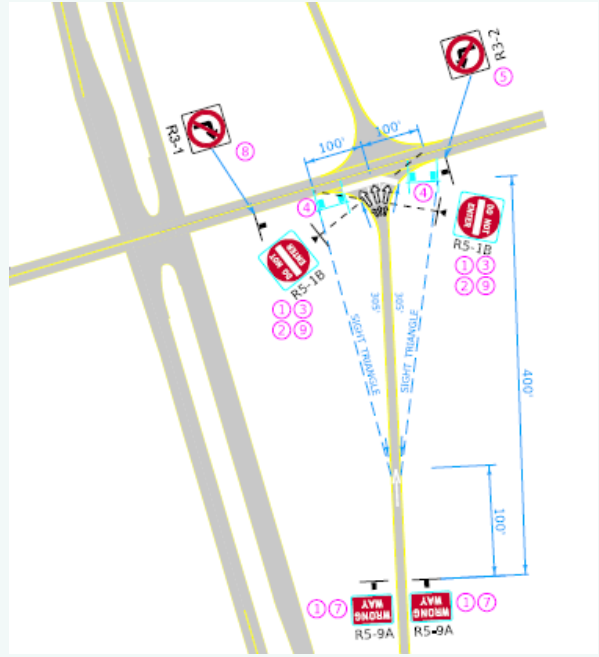
Signs:

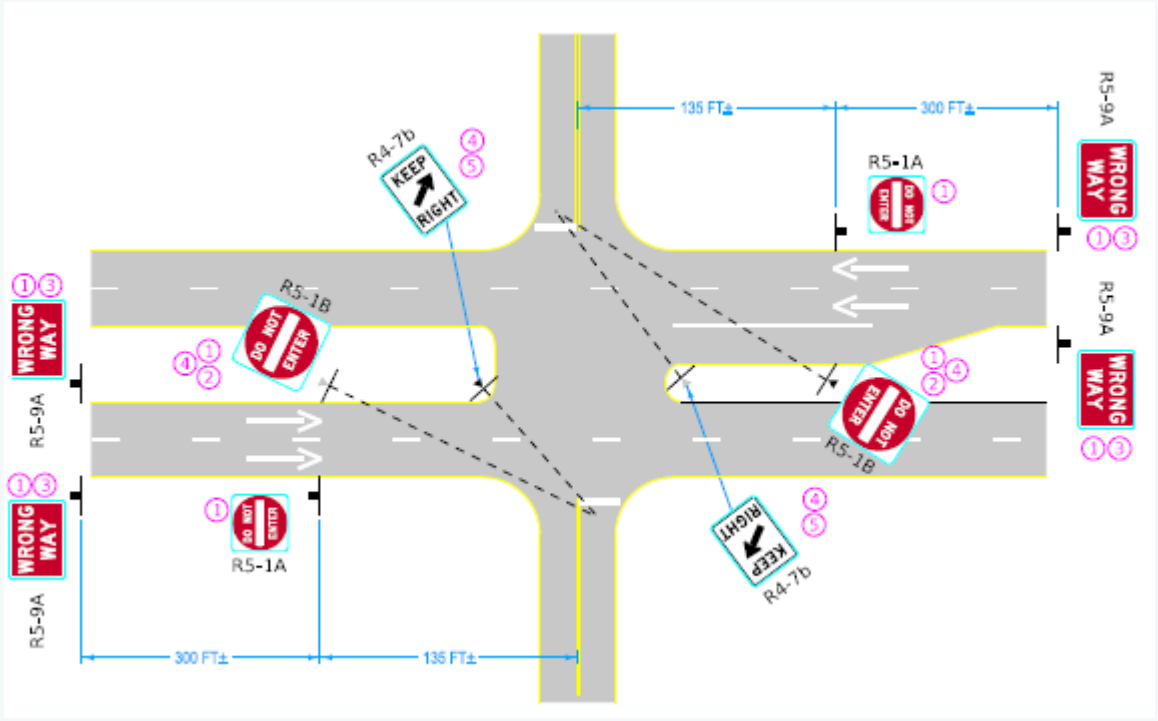
- **Placement**
- **Angle**
- **Size**

Pavement Markings:

- **Wrong Way Arrows**
- **Edge Line**
- **Extensions**

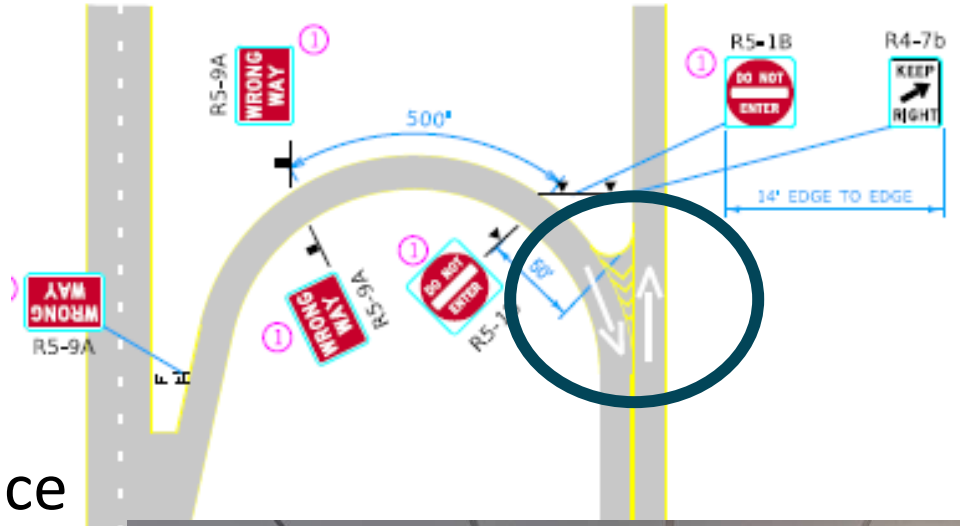






Parclo Interchange

- Create a “Gateway”
- Provide “Positive Guidance” also
  - We tend only to give negative guidance
  - …and assume drivers will figure it out
- Double up important signs
- Upsize to 48”x48”
  - (Do Not Enters)



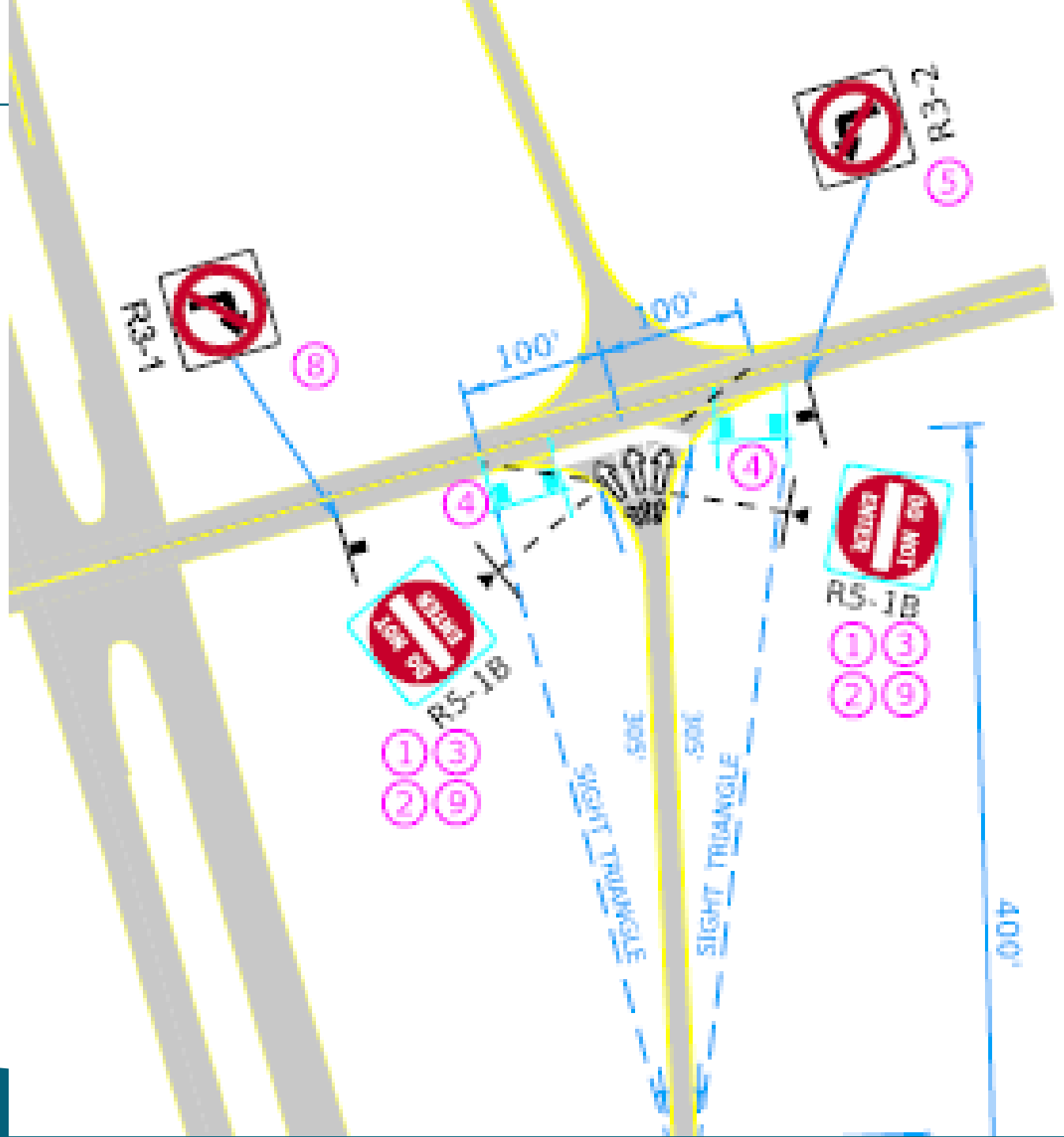
- Before

- After

- After part 2

Diamond Interchange

- Who do you want to see the signs?
- Set them back from Stop Line
- Angle to the approaching Traffic
- Upsize to 48”x48” (Do Not Enters)
- No Right Turn 36”x36”

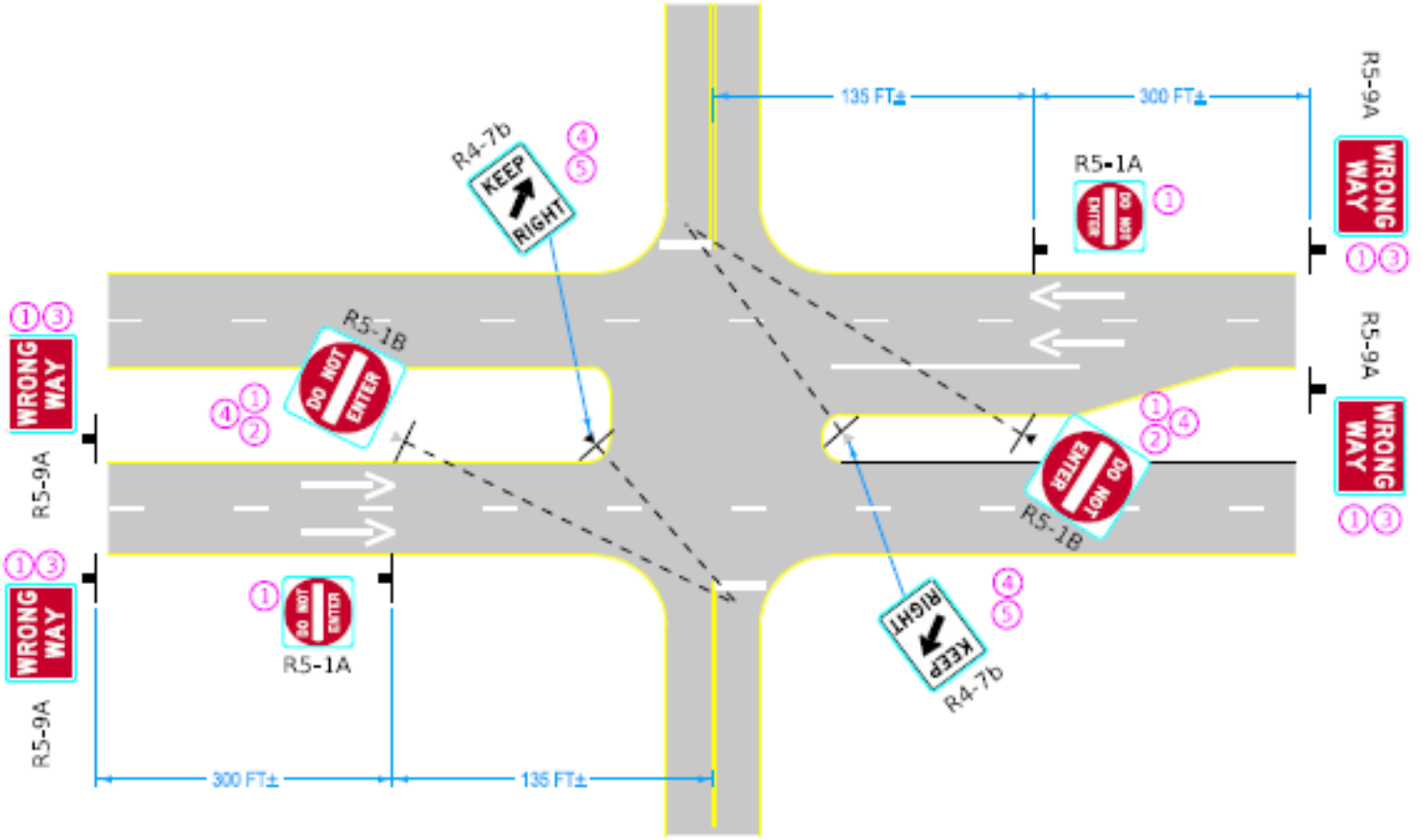


Diamond Interchange

- Who do you want to see the signs?
- Set them back from Stop Line
- Angle to the approaching Traffic
- Upsize to 48”x48”
  - (Do Not Enters)
- No Right Turn 36”x36”

At-Grade Intersections

- Positioned & Angled the “Keep Right”
- Converting to Text Version of “Keep Right”
- Angle Do Not Enter to the approaching Traffic
- Upsize to 48”x48” (Do Not Enters)
- Added Wrong Way Signs
- Added Wrong Way Arrows

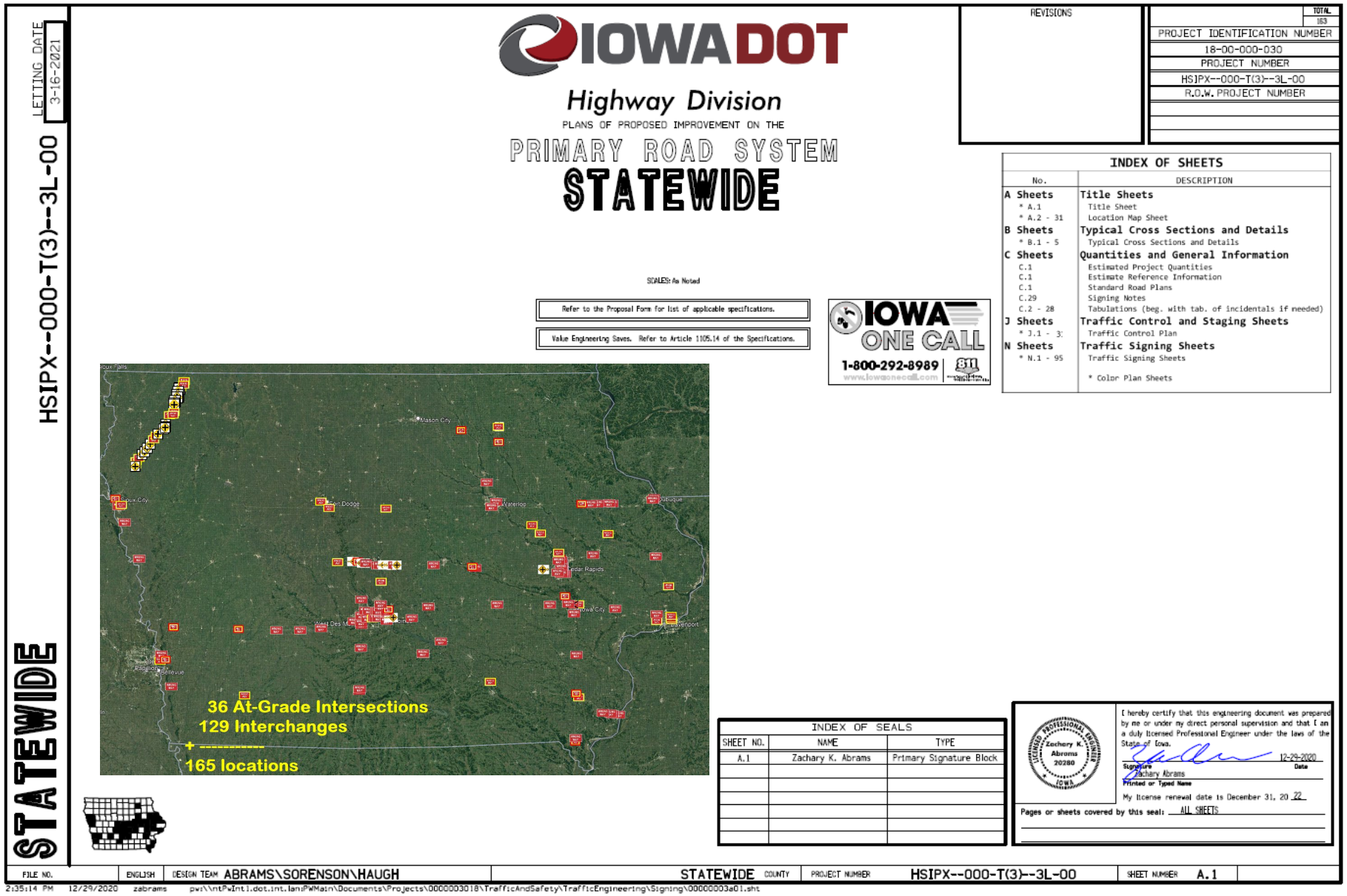


Updated from image on page 67 / 153 of Handbook

- Before

- After

- After w/ Text Version



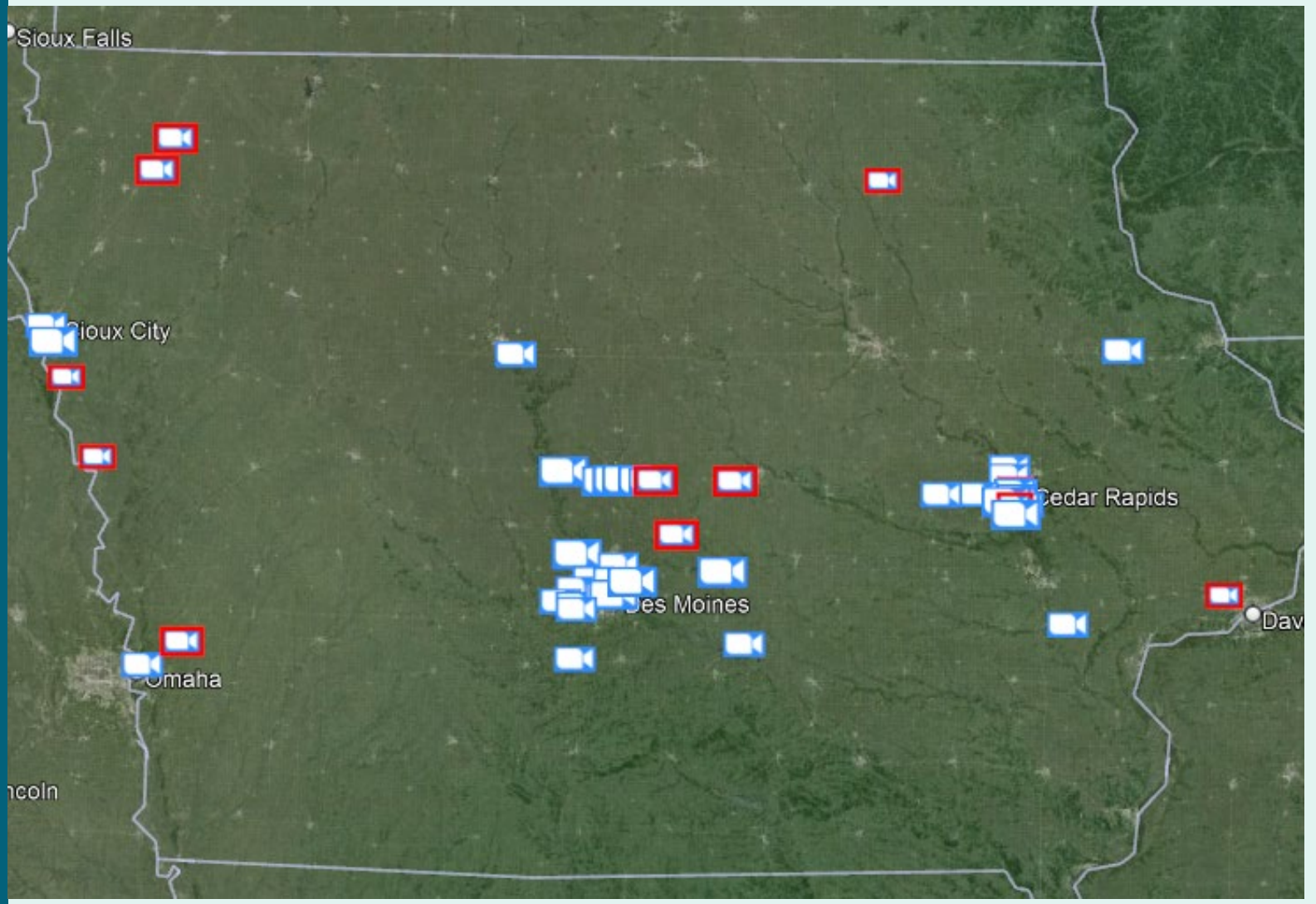
- Locations have been set
- Plans Created

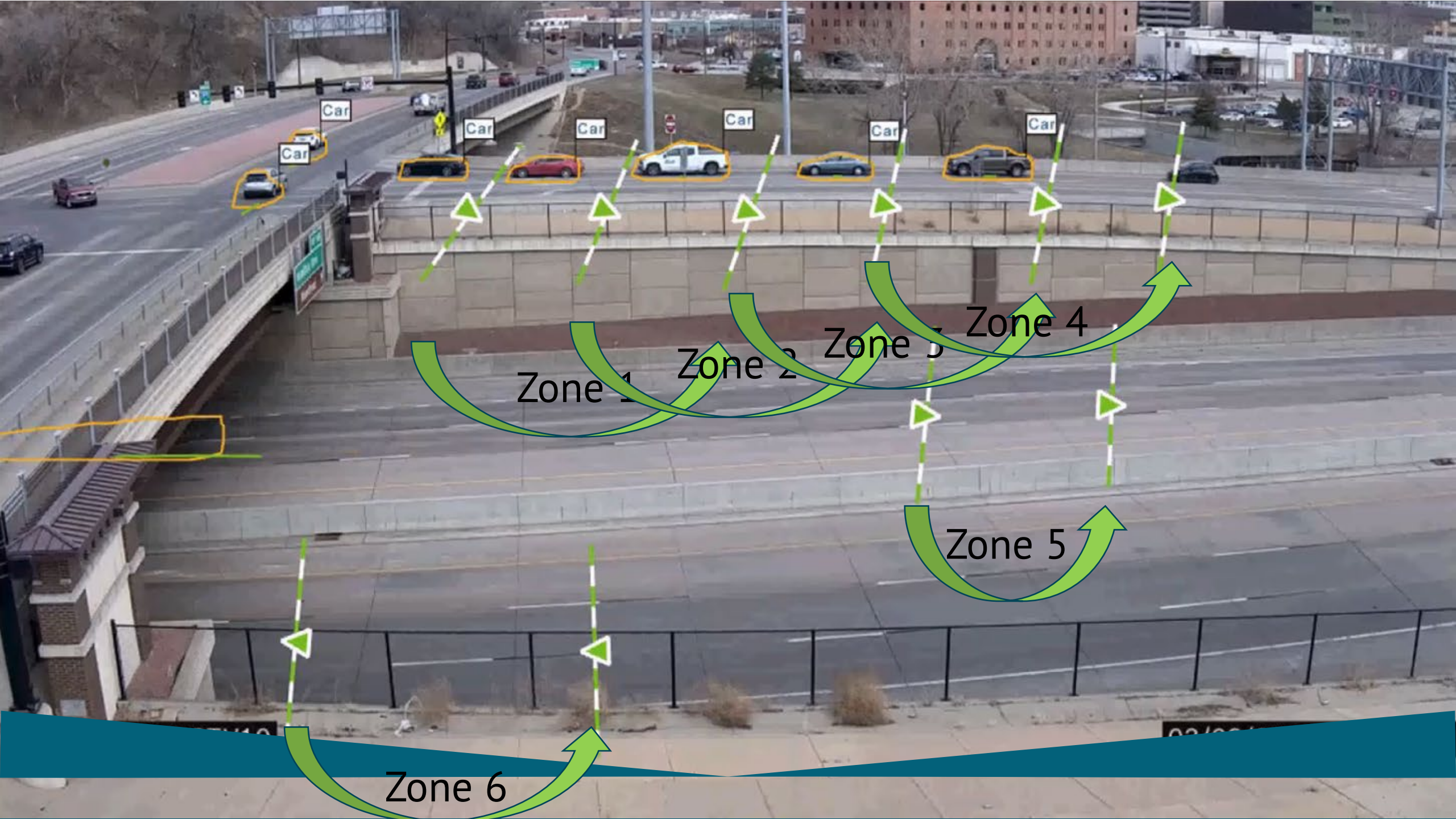
How we Measured

Success or Failures using:

62 WWD Detection Cameras

WWD Crash Reports




Car
Car
Car
Car
Car
Car
Car
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6

4 e-mails show up within seconds

BoschWWD70_I@iowadot.us	WWD Detected at I-29 & Wesley Pkwy (I)	Fri 3/8/2024 11:51 AM	32...
BoschWWD70_II@iowadot.us	WWD Detected at I-29 & Wesley Pkwy (II)	Fri 3/8/2024 11:51 AM	32...
BoschWWD70_III@iowadot.us	WWD Detected at I-29 & Wesley Pkwy (III)	Fri 3/8/2024 11:51 AM	33...
BoschWWD70_IV@iowadot.us	WWD Detected at I-29 & Wesley Pkwy (IV)	Fri 3/8/2024 11:51 AM	37...

WWD Detected at I-29 & Wesley Pkwy (I)

B BoschWWD70_I@iowadot.us
To Sorenson, Willy

20240308_115042_Image I.jpg
253 KB

Alarm Mail from BoschWWD70_I@iowadot.us

Unit name: WWD70-SCTV10

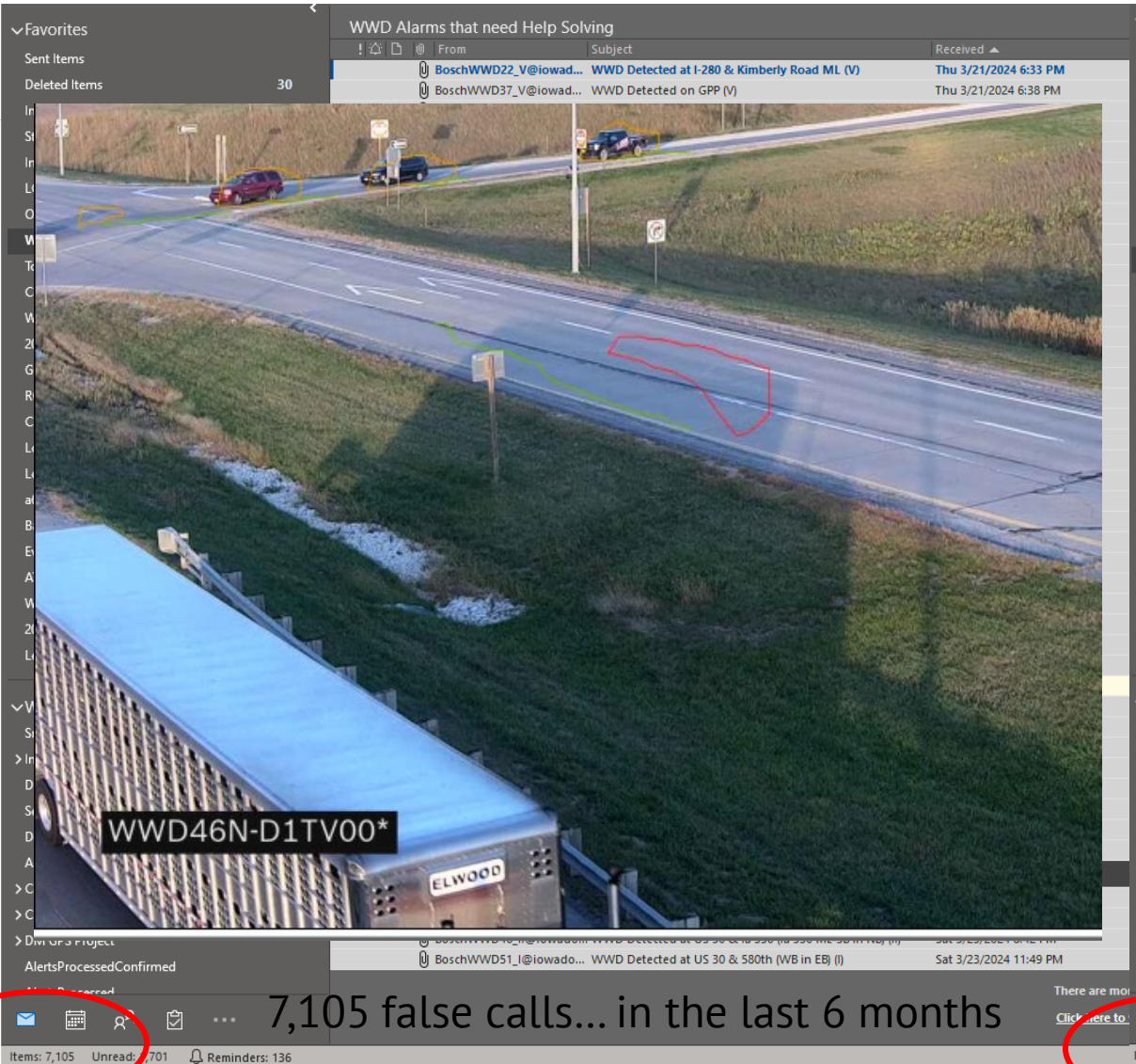
Local Unit time: 03/08/2024 11:50:42

Condition of the alarm inputs (logical states):
Local Input 01 'Input 1 ': idle
Local Input 02 'Input 2 ': idle
VCA alarm cam 1: : idle
Virtual alarm input 1: : idle
Virtual alarm input 2: : idle
Virtual alarm input 3: : idle
Virtual alarm input 4: : idle
Virtual alarm input 5: : idle
Virtual alarm input 6: : idle
Virtual alarm input 7: : idle
Virtual alarm input 8: : idle
Virtual alarm input 9: : idle
Virtual alarm input 10: : idle
Virtual alarm input 11: : idle
Virtual alarm input 12: : idle
Virtual alarm input 13: : idle
Virtual alarm input 14: : idle
Virtual alarm input 15: : idle
Virtual alarm input 16: : idle
Audio alarm input 1: : idle
Manipulation alarm 1: : idle
Manipulation alarm 2: : idle

Too Many False Calls to Dispatch 911

(From these 3 year old cameras/firmware & position)

- Shadows, Clouds, Reflections, Headlight blooming, etc.
- Maintenance vehicles, mowers, tow trucks, law enforcement, helpful neighbors, etc.



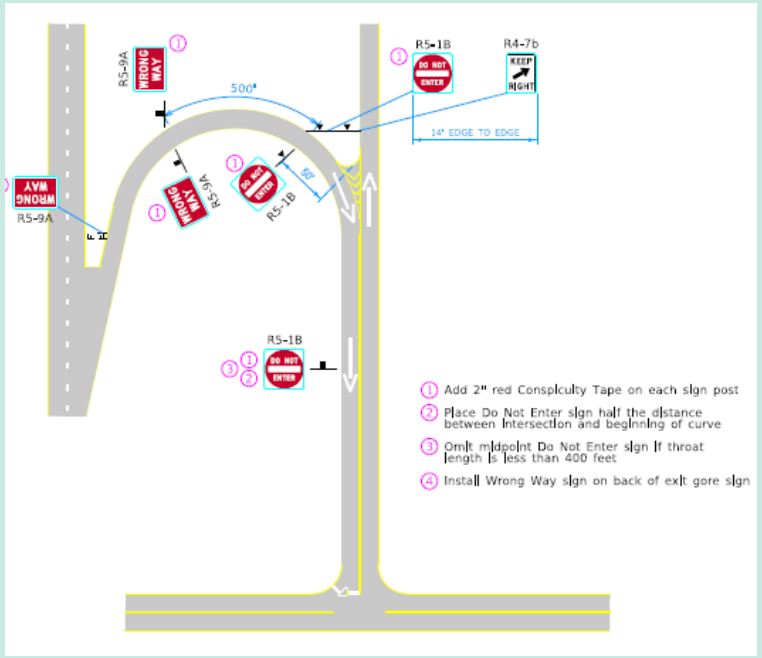
7,105 false calls… in the last 6 months

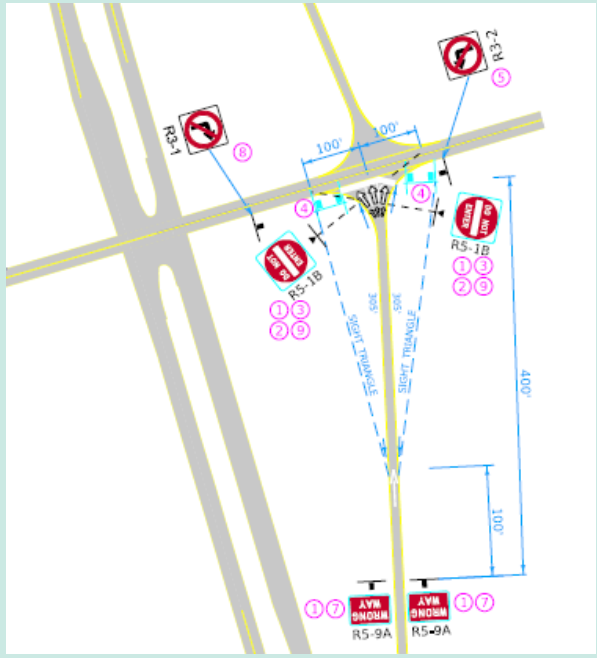
1,905 false calls… in the last 6 months

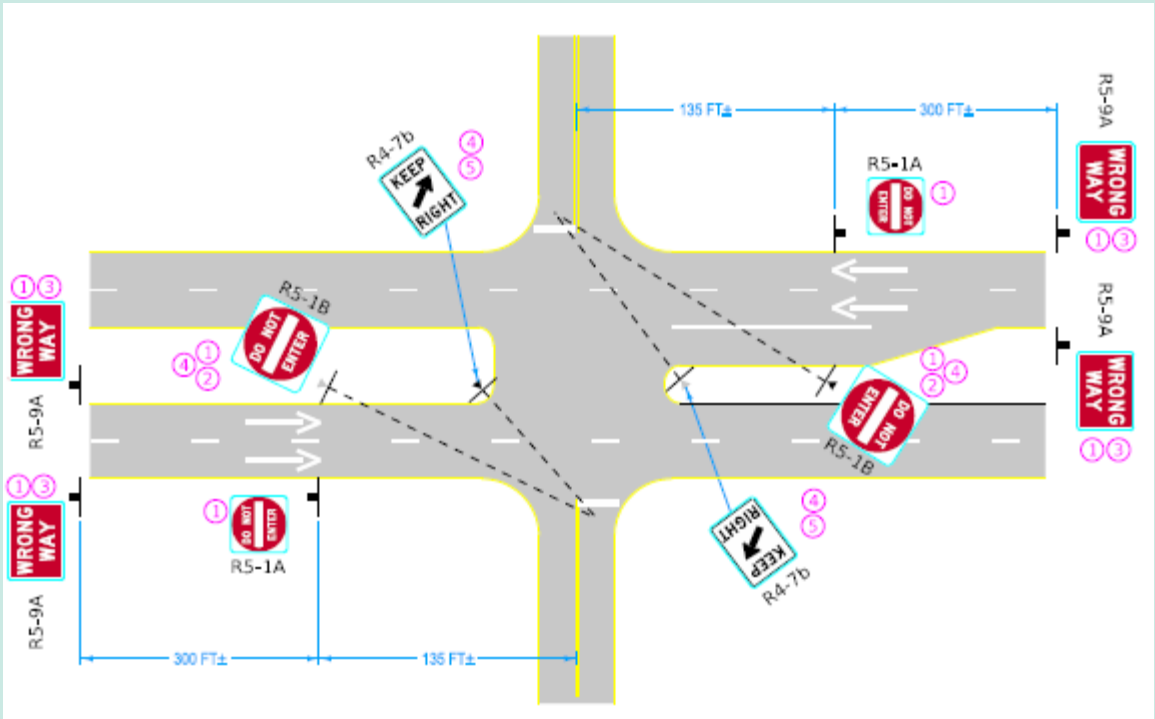
Results after 2 ½ years

Camera Data

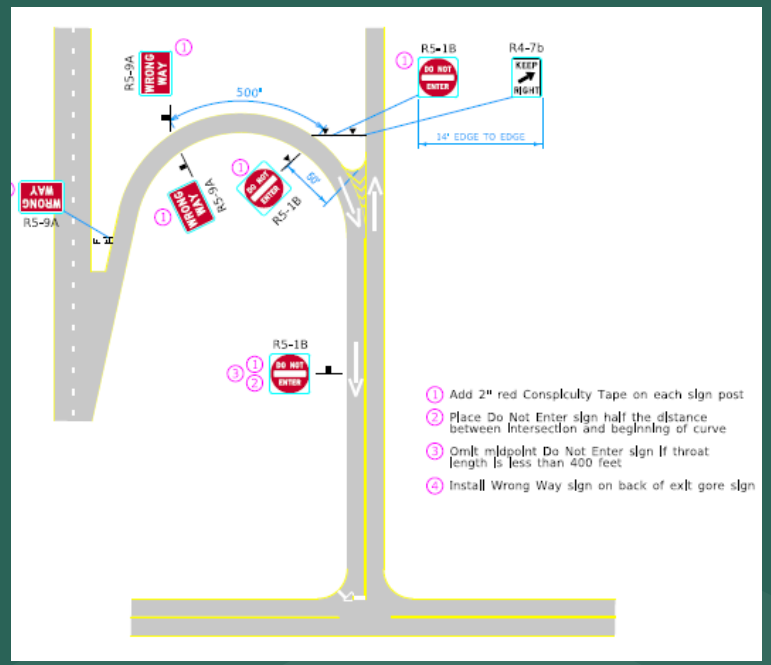
Deployed 80% in 2021
19.9% more in 2022
Final 0.1% in 2023







Parclo “B” / Folded Diamonds



Interchange	Type of Uniq	Camera	# Months "Before" Signing Added *	# WWD Events Before Signing Adde	# Months "After" Signing Added	# WWD Events After Signing Adde
I-35 & US-34	Parc-Lo "AB"	WWD55	1	1	18	0
US-151 & IA-1	Parc-Lo "B"	WWD04	1	1	15	1
US-30 & C St (WB Exit loop)	Parc-Lo "B"	WWD18	2	2	19	1
US-30 & C St (EB Exit Loop)	Parc-Lo "B"	WWD19	2	0	19	0
US-30 & WACONIA AVE/6TH ST SW	Parc-Lo "AB"	WWD09	3	4	18	4
IA-141 & IA-415	Parc-Lo "AB"	WWD40	1	2	19	0
US-30 & 19th St	Parc-Lo "AB"	WWD62	6	2	23	0
* Only the months where the WWD detection camera		Totals	16	12	131	6
detection camera was installed before signing added.						
			Before		After	
			WWD/Month		WWD/Month	
			0.76		0.05	
			94% Decrease		Updated 1/17/2023	

QUICK FACTS

Existing Conditions

- Iowa has 55 Parclo “B” or Parclo “AB” interchanges.
- In 2021, 43 of them received enhanced signing and pavement markings.

Crashes the last 10 years

- Between 2010-2020, there were 36 WWD crashes associated with a Parclo “B” or “AB.”
- January 1, 2021 to October 1, 2022, there have been 0 WWD crashes where the POE was from one of these 43 treated interchanges.

WWD Events Recorded using Video Analytics

- In Summer 2021, cameras with the ability to detect WWD were installed at 7 locations and record constantly.

- Adding all of the months where a camera was monitoring existing conditions and comparing to approximately 18 months of monitoring after enhanced signing was added shows a 93.9% decrease of WWD events.

93.9%↓
DECREASE IN WWD EVENTS

"Before"

"After"

Enhanced Signing and Pavement Marking Package

"After"

Adding RAMP sign under DNE

Location	WWD/Month	WWD/Month	Reduction	WWD/Month	Reduction Sign | Total
I-29 & Ia 175	0.91	0.42	-54%	0.42	0% | -54%
I-29 & Singing Hills	2.31	0.91	-61%	0.42	-21% | -82%
Ia 60 & US 18	3.08	2.85	-7%	1.71	-37% | -44%

Carefully consider when adding the RAMP Sign.

We only tested in urban areas when an access point to was nearby.

May not want to use in areas where drivers are looking for a ramp entrance.

"Before"

"After"

Enhanced Signing and Pavement Marking Package

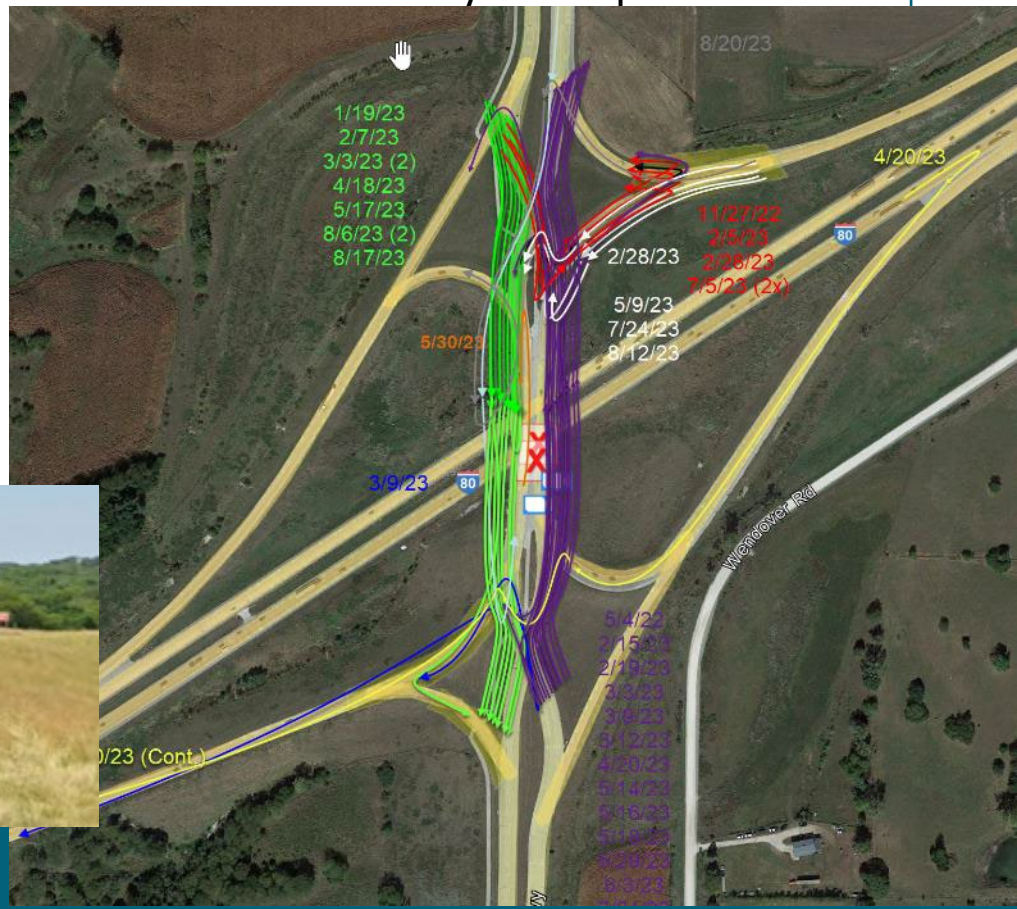
"After"

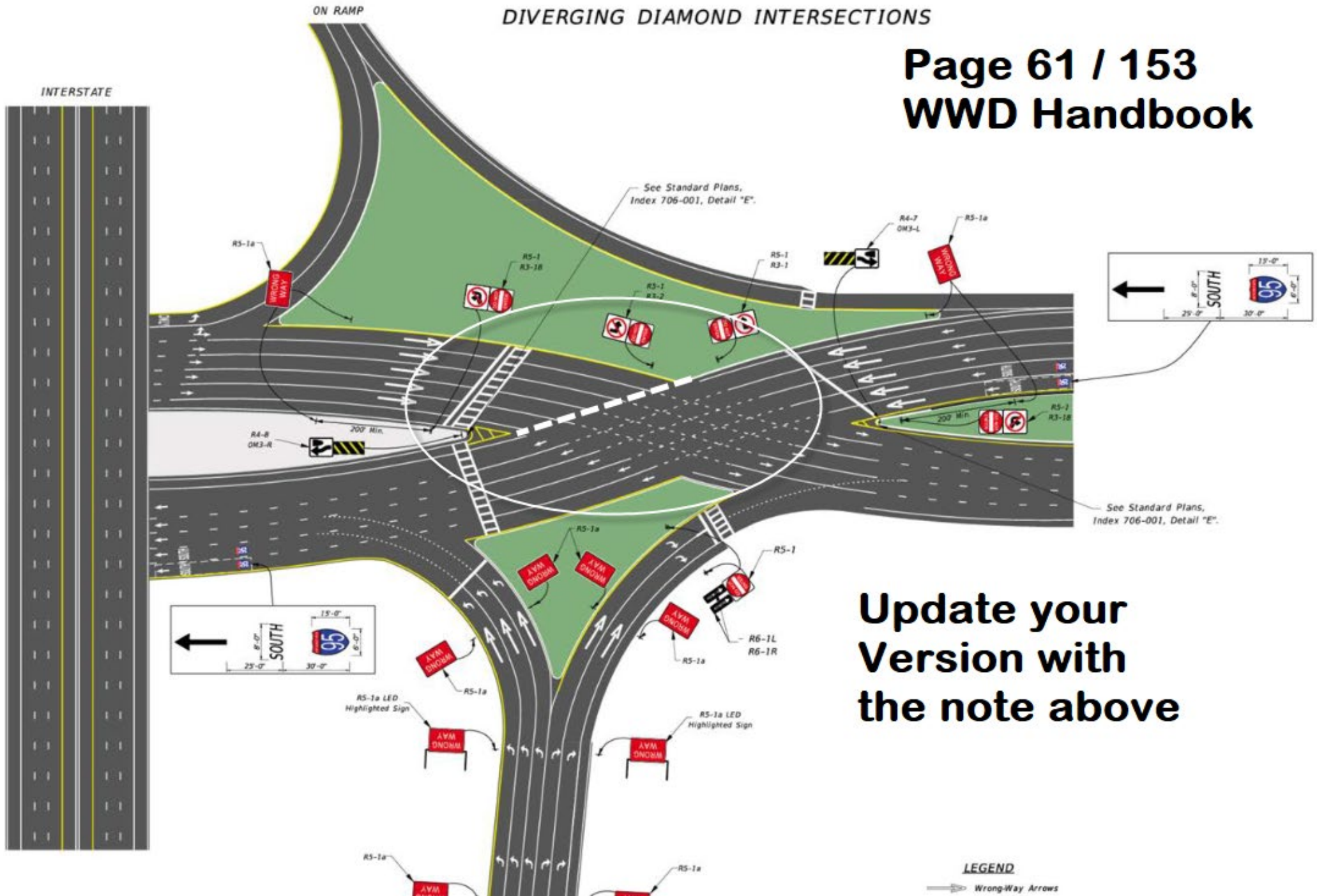
Switching Keep Right Sign from Graphic to Text version

Location	WWD/Month	WWD/Month	Reduction	WWD/Month	Reduction Sign / Total
Ia 60 & 400th	2.41	1.81	-25%	0.92	-37% / -62%
Need more time.					
Swapping 10 more locations in 2024					

Additional Treatments Attempted

- Diverging Diamond Interchanges
- Lane Line Extensions
- Add Do Not Enters for Drivers already WWD and last ability to stop them.





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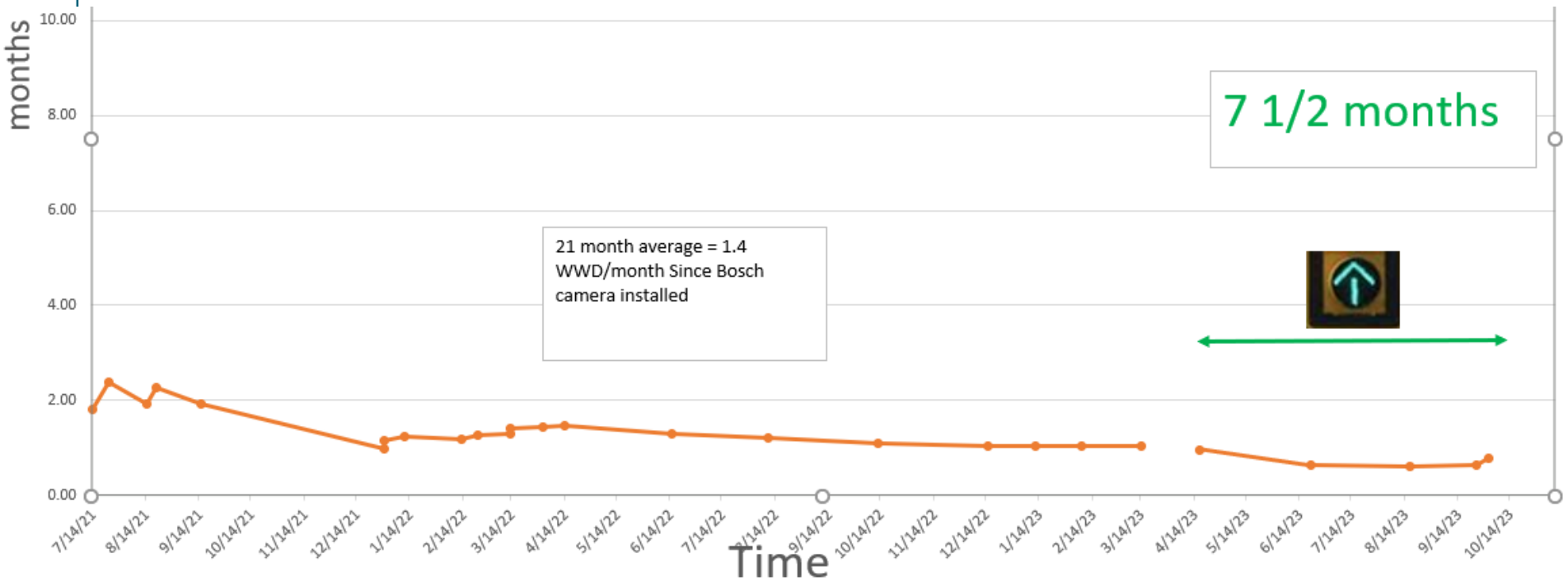
WWD Handbook

Update your Version with the note above

Additional Treatments Attempted

- Green Up Arrows
- 3 locations
- 21 months of “Before data”
- 7 ½ month of “After data”



"Before"

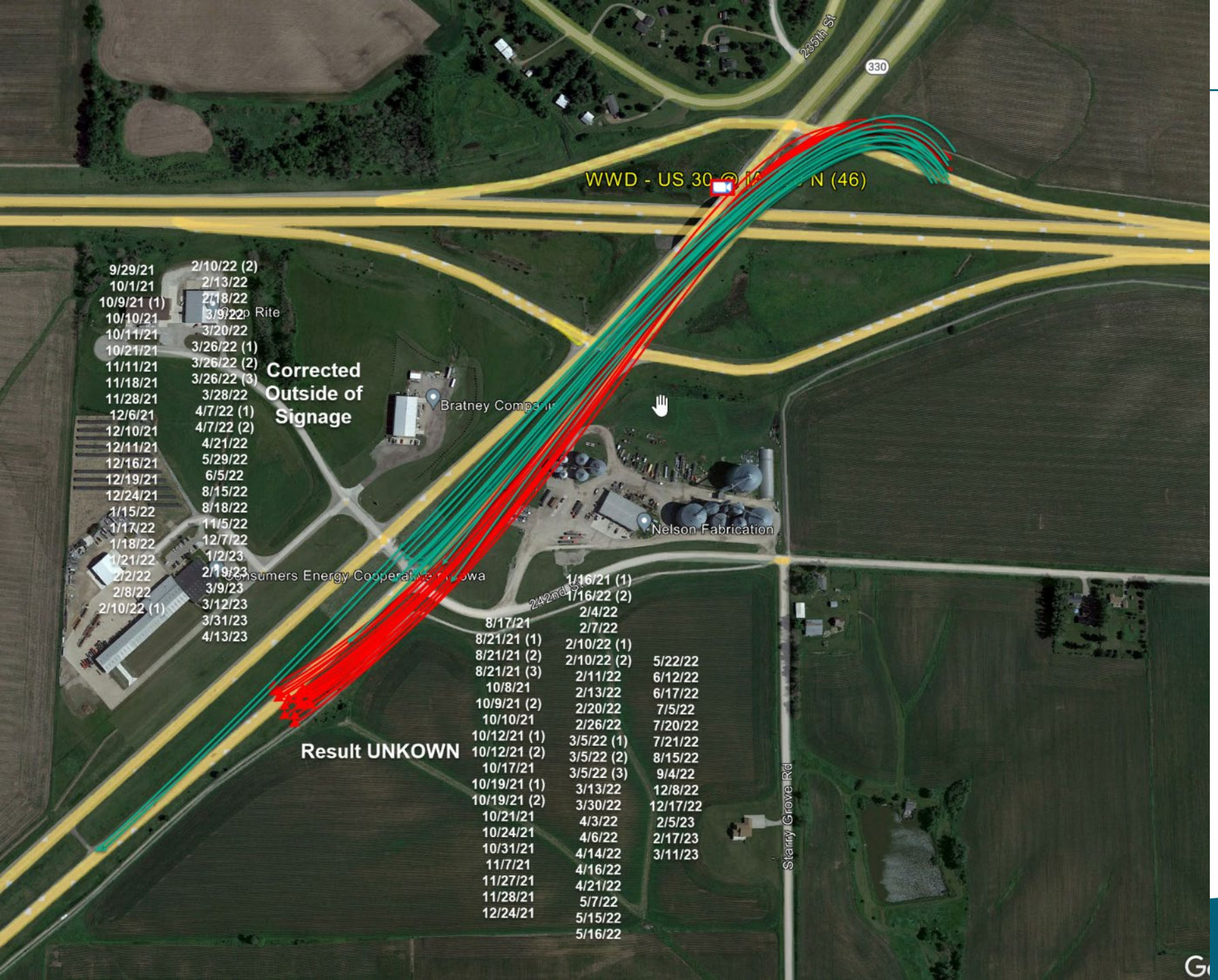
"After"

Green Up Arrows

"After"

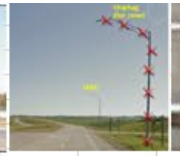
Adding RAMP sign under DNE

Location	WWD/Month	WWD/Month	Reduction	WWD/Month	Reduction Sign | Total
US 30 & University	1.02	0.68	33%	0.30	37% | 70%
US 30 & Duff Ave	1.06	0.56	47%	0.08	39% | 86%
US 30 & Dayton	1.55	1.36	12%	0.40	59% | 71%



Case Study

- US 30 & Ia 330
- Hypothesis to test:
- Can you use daytime WWD events that self correct within 1,000’ as a surrogate to reducing WWD events that “Keep going”?



Baseline Average = 15.1 WWD/Month

Disconnected Street Light 3/4/22

WWD46-47 US 30 & IA 330

Snow - 14.9

Yellow Edge Line Added 5/5/23

Keep Right (Text Version) Added 10/1/23

Snow - 18.6

Night = 9.1

Kept Going = 3.7

Night = 6.2

Kept Going = 4.4

"After WWD" = 7.1 WWD/Month 62% Reduction

Night = 4.9

Kept Going = 2.4

Night = 9.0

Kept Going = 4.8

After - 4.0

Night = 1.7

Kept Going = 1.15

After 3.0

Night = 1.8

Kept Going = 1.15

After 3.4

Night = 1.8

Kept Going = 1.8

Night = 6.3

Kept Going = 6.3

AXIS TITLE

15.00
13.00
11.00
9.00
7.00
5.00
3.00
1.00
-1.00

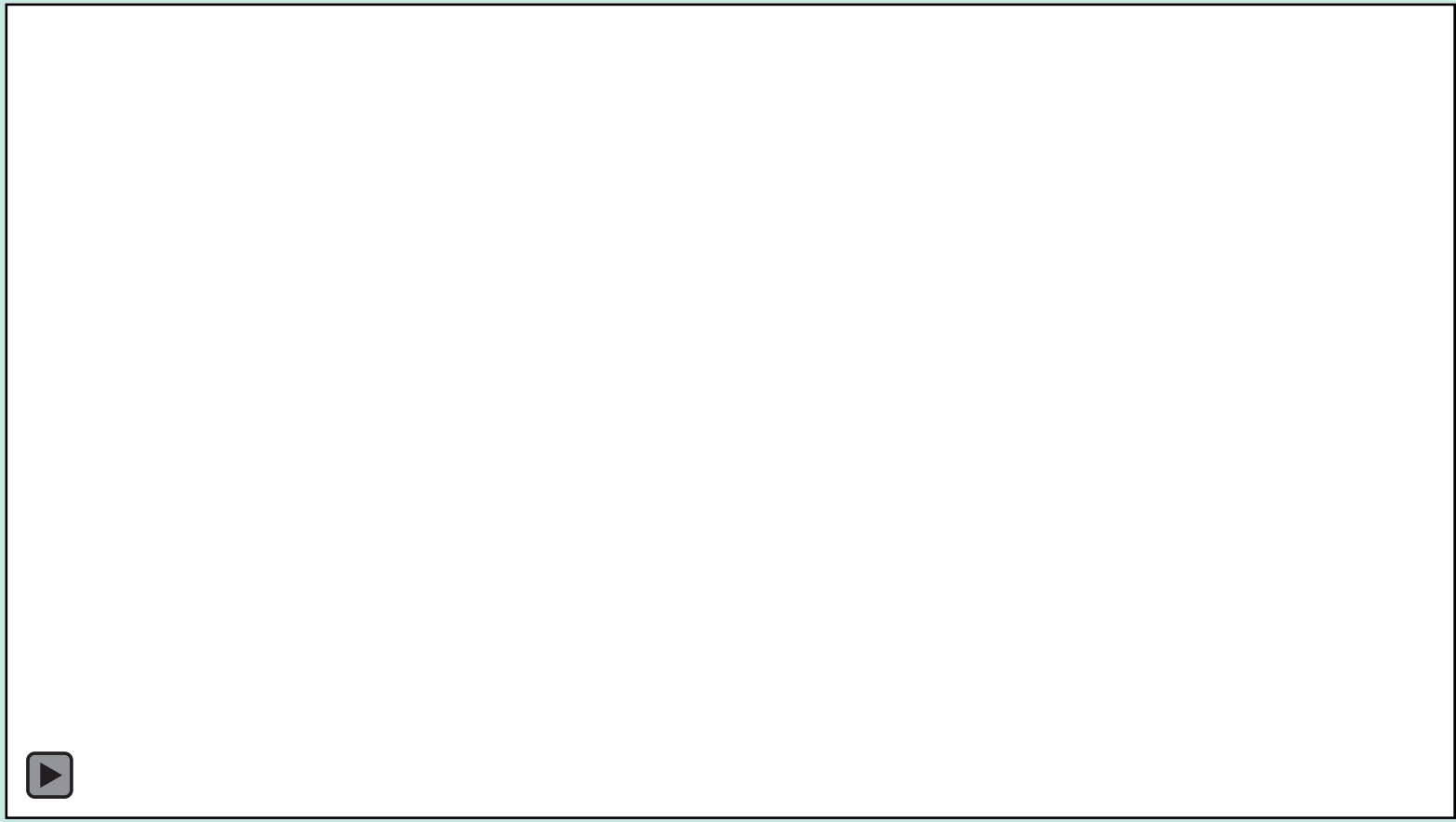
7/27/2021 8/27/2021 9/27/2021 10/27/2021 11/27/2021 12/27/2021 1/27/2022 2/27/2022 3/27/2022 4/27/2022 5/27/2022 6/27/2022 7/27/2022 8/27/2022 9/27/2022 10/27/2022 11/27/2022 12/27/2022 1/27/2023 2/27/2023 3/27/2023 4/27/2023 5/27/2023 6/27/2023 7/27/2023 8/27/2023 9/27/2023 10/27/2023 11/27/2023 12/27/2023 1/27/2024 2/27/2024

Nightime (w/ Streetlight) Average = 9.1 WWD/Month

Nightime (w/o Streetlight) Average = 6.2 WWD/Month 32% Reduction

When you have a known Impairment problem location Over 2x limit
(around 0.16 and up)

Consider ITS



Summary Items to tell your Boss

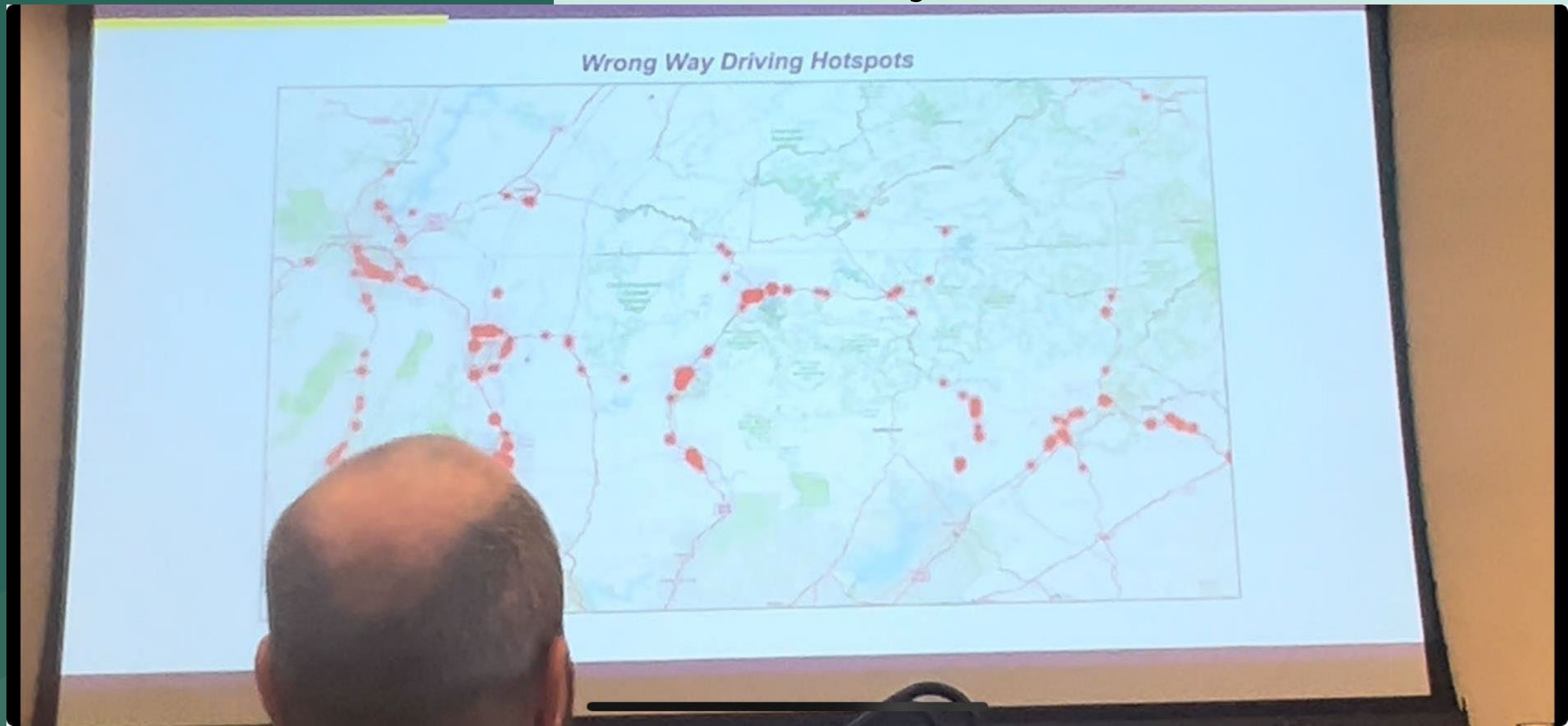
- Add this “Gateway” countermeasure to your Parclo “B” interchanges
- Look at your Diverging Diamond Interchanges
  - Add Lane Line Extensions at DDI Cross overs
  - Add the 2 Do Not Enters for WWD on the sideroad to stop them from getting on Mainline

Connected Vehicle Data

The future of network screening!!

Example from Michelin Vehicle Smart Phone Data

Iowa will be looking into this



Questions?

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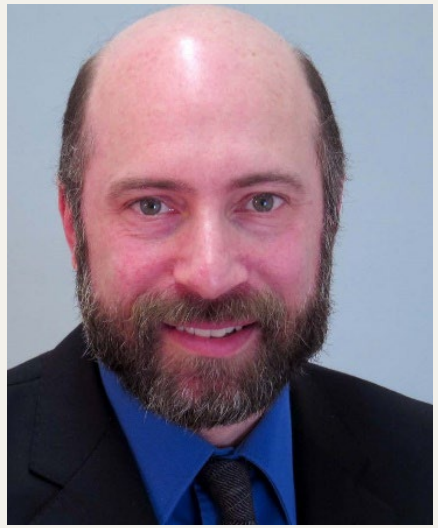
Willy.Sorenson@Iowadot.gov

Iowadot.gov

Today's presenters



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TRB Webinar: Design Strategies for Stated Choice Experiments

June 23-26, 2024

2nd International Roadside Safety Conference

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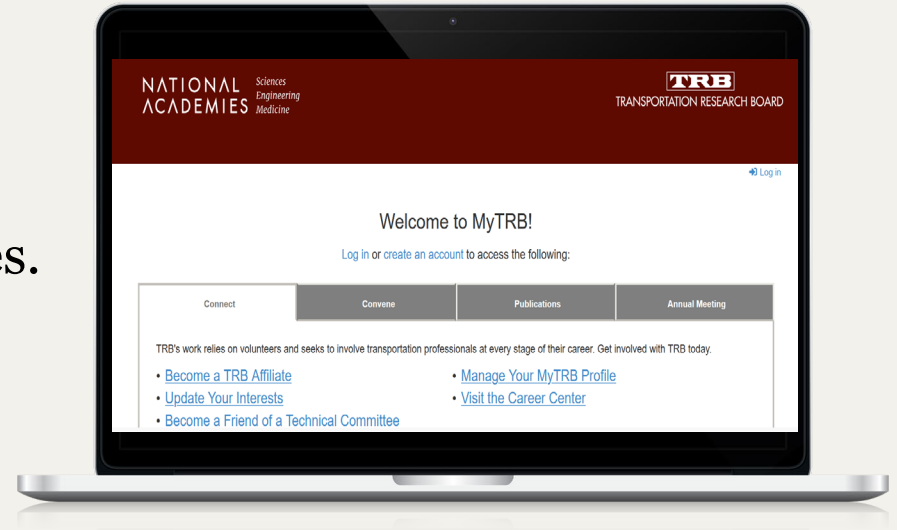

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