WSDOT

WRONG-WAY DRIVING
2023-2025
PROVISO REPORT

JUNE 2025

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Under 23 U.S. Code § 148 and 23 U.S. Code § 407, safety data, reports, surveys, schedules, lists compiled or collected for the purpose of identifying, evaluating, or planning the safety enhancement of potential crash sites, hazardous roadway conditions, or railway-highway crossings are not subject to discovery or admitted into evidence in a Federal or State court proceeding or considered for other purposes in any action for damages arising from any occurrence at a location mentioned or addressed in such reports, surveys, schedules, lists, or data.

1. OVERVIEW

A. Proviso & need

Wrong-way driving is a rising concern that can lead to serious consequences including serious injury or fatal crashes. In the United States wrong-way driving fatalities make up 3.7% of total fatalities. There were 445 fatal wrong-way crashes in 2018, this has increased to 704 fatal wrong-way crashes in 2022 nationwide. The four most common factors in the US have been impairment, older age, distraction and road design. This data was provided by STV Inc and is included in Appendix A with their data analysis memo.

With this alarming trend moving upward the legislature directed the Washington State Department of Transportation to implement safety measures to address wrong-way driving with the following proviso found in ESHB 2134, Section 217 (10):

"$2,000,000 of the highway safety account—state appropriation is provided solely for the department, in consultation with the Washington Traffic Safety Commission, to evaluate and identify geographical locations in both urban and rural highway settings to install and implement wrong-way driving prevention strategies. Such prevention strategies may include improved signage and pavement markings as recommended by the traffic safety commission's report on wrong-way driving, "Strategies and Technologies to Prevent and Respond to Wrong-Way Driving Crashes." The department must report to the legislature any crash data or wrong-way violations that occur at the selected locations by June 30, 2025."

B. Implementation & challenges

With a short period of one year, three areas of action became the focus. 1. All six regions statewide were asked to identify locations that would benefit from signing and striping low-cost improvements. 2. Regions were asked to identify locations that would benefit from detection technology, and 3. STV Inc. and Parisa Hosseini, Ph.D., who is one of the authors for the NCHRP report 1050 on wrong-way driving, were hired for research on best practices and data analysis for future investments for wrong-way driving prevention. Regions identified locations based on crash data, and input from Washington State Patrol (WSP) and the maintenance division.

It was determined there was a statewide need for signing and pavement marking improvements. $150,000 in funding was distributed to each region. Locations were identified so planning could continue and materials could be acquired. In most cases, pavement marking upgrades were delayed due to weather conditions, with the work complete in May/June 2025. This timeline means there is no "after implementation" crash analysis on the effectiveness in this report.

Three of the regions identified 10 locations that would benefit from detection and warning systems. Delays occurred working with vendors and acquiring materials, in addition to spending freezes at the end of calendar year 2024. These locations will be completed in May/June 2025, leaving no time for an analysis of effectiveness for this report.

STV Inc. was hired for expertise in wrong-way driving prevention, best practices in countermeasures, and data analysis. Due to the timeline, they were able to help with best practices and design layouts, but their analysis of crash data was not complete until after locations had already been identified to move forward with acquiring materials and installations. The analysis and work they provided can be used in the future if further funding is provided for wrong-way driving prevention.

C. Spending budget

- $900,000 was allocated for low-cost implementation, such as signing and pavement markings, $150,000 per region.
- $980,000 was allocated for Intelligent Transportation Systems and detection solutions, with $480,000 in Northwest Region, $100,000 in Olympic Region, and $400,000 in Southwest Region.
- $120,000 was allocated to STV Inc for their analysis and support work.

D. Best practices

While some design configurations have a higher potential for drivers going the wrong way, some steps can help mitigate these events or promote self-correction. These steps include having clear pavement markings, positioning signs at the proper angle for potential wrong-way drivers, additional signs, increasing sign size, lowering sign height to be better in line with driver eye lines, and Intelligent Transportation Systems (ITS) improvements. STV Inc. has provided a memo with information on best practices and information gathered from other states. See Appendix B for full details. The information provided is in alignment with the National Cooperative Highway Research Program (NCHRP) report 1050 on wrong-way driving and the Washington Traffic Safety Commission (WTSC) report previously provided to the legislature.

E. Other states

Information was gathered from Florida, California, Iowa, Michigan, Texas, Arizona, Rhode Island, Ohio and Nevada. LED illuminated signs, retroreflective pavement markings, and active detection have positively impacted on wrong-way driving events. In these states, wrong-way driving events have been reduced by 50-95%. Further details can be found in the attached memo in appendix B. Highlights include 98% of drivers now self-correcting in Florida once encountering LED illuminated signs, and California reducing incidents by half with high visibility markings, LED illuminated signs, and active detection.

2. DATA ANALYSIS

A. Crash data

There were 493 wrong-way crashes in Washington from 1/1/2019 through 12/31/2023, with 62 fatal crashes resulting in 84 fatalities. There were 7,549 recorded wrong-way events from WSP between 1/1/2019 and 12/31/2023 that include incidents that did not result in a crash. Data was chosen from 2019 through 2023 as it was the latest full five-year period for which data was available at the beginning of this project. As of this report, 2024 data has not been fully processed for analytical use.

WWD Data Analysis

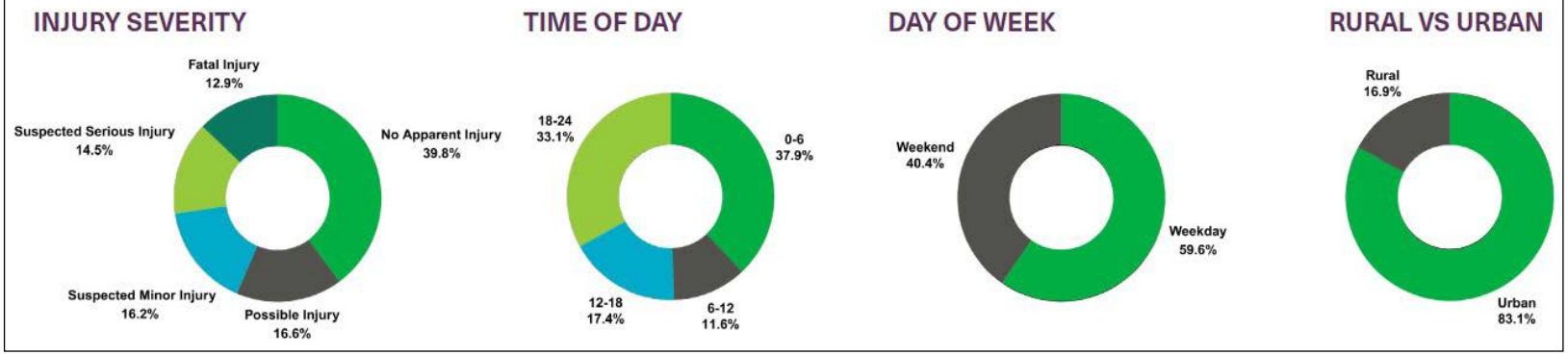
The table provides a summary of crash data from 2019 to 2023 in Wshington State, with a particular focus on Wrong-Way Driving (WWD) crashes and their severe consequences. Over this five-year period, a total of 509,310 crashes occurred statewide, of which 227,692 were specific to state routes. Within these totals, WWD crashes, though relatively infrequent, present significant safety concerns. There were 493 WWD crashes recorded, and 62 of these resulted in fatalities, meaning that approximately 12.6% of WWD crashes led to fatal outcomes. This highlights the disproportionately severe nature of WWD incidents when compared to other crash types.

Examining the annual trends, WWD crashes were at their lowest in 2019, with 64 crashes and 8 fatalities. However, the numbers sharply increased in 2020 to 106 WWD crashes, alongside a notable rise in fatalities to 17. The upward trend continued through 2023, when WWD crashes reached their peak at 116 incidents, accompanied by the highest number of fatalities at 19. These statistics indicate a concerning pattern of growth in both the frequency and severity of WWD crashes over the five-year period. They also align with a post-COVID-19 nationwide increase in fatal crashes.

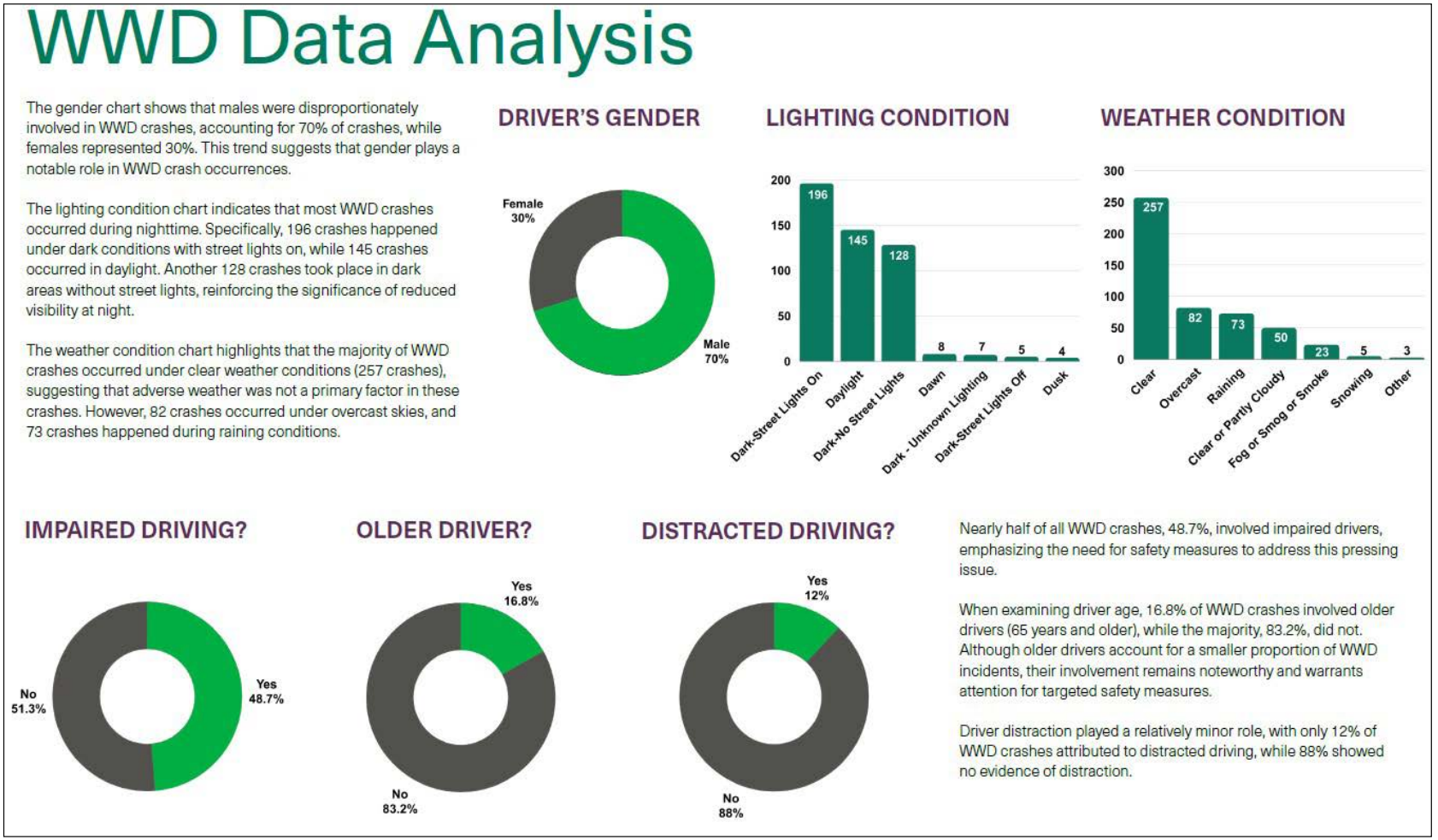
Year	Total Crashes	Total State Route Only Crashes	WWD Crashes	WWD Fatal Crashes
2019	111,708	49,504	64	8
2020	86,376	38,718	106	17
2021	103,384	48,168	101	8
2022	103,438	47,369	106	10
2023	104,404	43,933	116	19
Total	**509,310**	**227,692**	**493**	**62**

The following charts provide a detailed overview of WWD crashes, highlighting injury severity, time of day, day of the week, and location type. In terms of injury severity, 12.9% of WWD crashes resulted in fatalities, and 14.5% lead to suspected serious injuries, underscoring their severe nature. While 39.8% show no apparent injury, the remaining crashes involve minor and possible injuries.

Regarding the time of day, 37.9% of WWD crashes occurred during early morning hours (0-6), followed by a notable share during night hours (18-24). Weekday crashes account for 59.6%, with weekends at 40.4%. Location analysis reveals that 83.1% of WWD crashes occurred in urban areas, compared to 16.9% in rural settings, reflecting the complexity and traffic volumes of urban road networks.



STV Inc Data Analysis Memo – Appendix A – Figure 1



STV Inc Data Analysis Memo – Appendix A – Figure 2

3. LOCATIONS AND IMPROVEMENT TYPES

A. Detection

ITS solutions have positively impacted preventing wrong-way driving crashes when implemented across the nation. A detection system alerts the local Transportation Management Center (TMC) and WSP of a wrong-way driver, lowering response times significantly, and being able to trigger flashing warning signs, and potentially variable message signs if they are present to alert other drivers. While funding and time were not sufficient to implement a large-scale project like other states have done, it has allowed WSDOT to work with different vendors and manufacturers to determine viability and effectiveness with our TMCs.

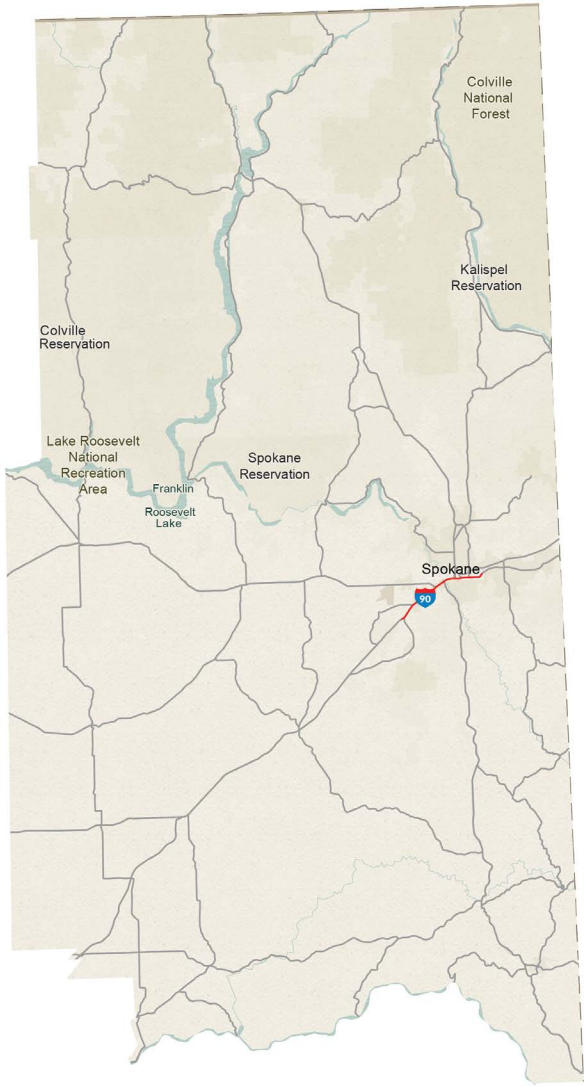
For this proviso effort, ten locations were chosen for detection implementation, four on SR 18 in Northwest Region, four in Vancouver in Southwest Region, two in Olympia in Olympic Region. All installations include detection that will trigger flashing beacons, signs, and alert the TMC. Further details are provided in the region-specific sections below.

B. Signing, pavement markings, and low-cost improvements

Improving sign placement and visibility, enhancing pavement markings, and adding LED highlighting have proven countermeasures for prevention. 122 locations, including over 1,000 new signs, were chosen for improvement. Further details are provided in the region-specific sections.

4. EASTERN REGION

A. Overview



Eastern Region wrong-way driving improvement areas

Eastern Region consulted with WSP and focused improvements on the Interstate 90 corridor in Spokane County. Specifically, the segment of I-90 between State Route 904 and Broadway was identified as having the most frequent reports of wrong-way drivers in the region. This also matched trends seen in available crash data, though the data alone was not enough to determine exactly where wrong-way drivers entered I-90. This is a particular challenge for wrong-way driving events. It is very difficult to know where the motorist came from. A systemic approach for replacing missing or faded pavement markings with more durable markings and improved signing was adopted, with 17 locations chosen in the segment.

From 2019 through 2023, Interstate 90 had a total of 43 wrong-way driving crashes, five of which were fatal, and 845 incident reports from WSP. I-90 Milepost 270 to milepost 290 had 18 wrong-way driving crashes, with one being fatal, and 92 WSP incident reports.

- 17 locations were chosen for improvements.
- 62 new signs were installed.
- The region worked with Trooper Jackson of the WSP to coordinate a “Problem and Partnership” project to address wrong-way driving.
- This resulted in five locations having red flashing beacons added as a trial.

As part of this project, the eastbound Exit 277A off-ramp intersection with Abbott Road and Garden Springs Road will be an all-way stop. This will now require free-flowing traffic on westbound Garden Springs to stop and potentially give drivers more time to see the wrong-way signs and markings on the off-ramp.

B. Locations

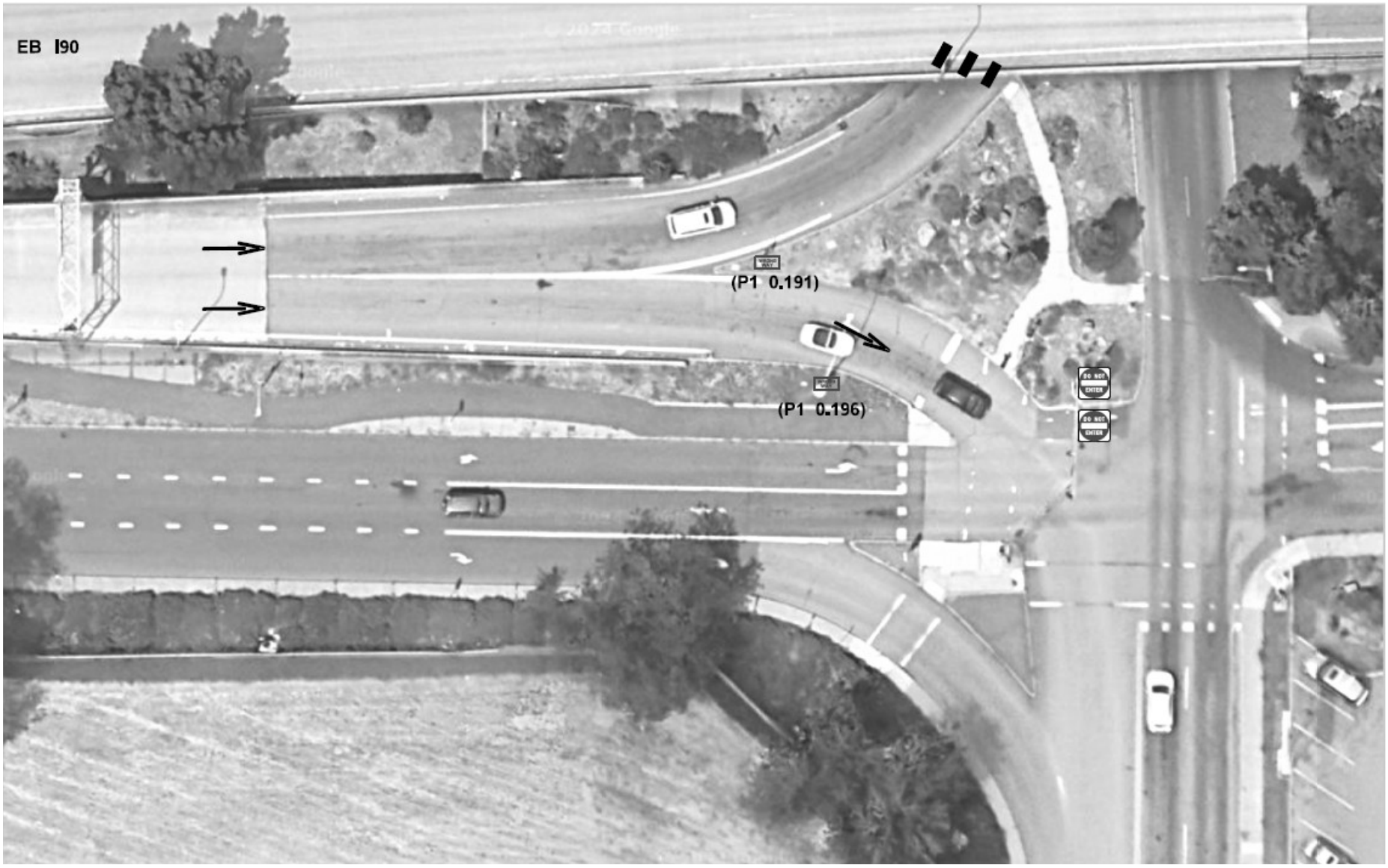
Locations for improvement in the Eastern Region:

Route	Milepost	Location	Improvement
I-90	270.5	WB Exit 270 – State Route 904	Signs/pavement markings
I-90	277.3	EB Exit 277A - Garden Springs	Signs/pavement markings
I-90	277.8	WB Exit 277 - Garden Springs	Signs/pavement markings
I-90	279.8	EB Exit 280 - Maple/Walnut	Signs/pavement markings
I-90	280.7	WB Exit 280A - Maple/Walnut	Signs/pavement markings
I-90	280.9	WB Exit 280B - Lincoln	Signs/pavement markings
I-90	281.6	EB Exit 281 - Division	Signs/pavement markings
I-90	281.6	WB Exit 281 - Division	Signs/pavement markings
I-90	282.6	WB Exit 282B - 2nd Avenue	Signs/pavement markings with flashers
I-90	283.3	EB Exit 283A - Altamont	Signs/pavement markings with flashers
I-90	283.3	WB Exit 283A - Altamont	Signs/pavement markings with flashers
I-90	283.4	EB Exit 283B - Thor/Freya	Signs/pavement markings with flashers
I-90	283.4	WB Exit 283B - Thor/Freya	Signs/pavement markings with flashers
I-90	285.1	EB Exit 285 - Appleway	Signs/pavement markings
I-90	285.5	WB Exit 285 - Sprague	Signs/pavement markings
I-90	286.2	EB Exit 286 - Broadway	Signs/pavement markings
I-90	286.2	WB Exit 286 - Broadway	Signs/pavement markings

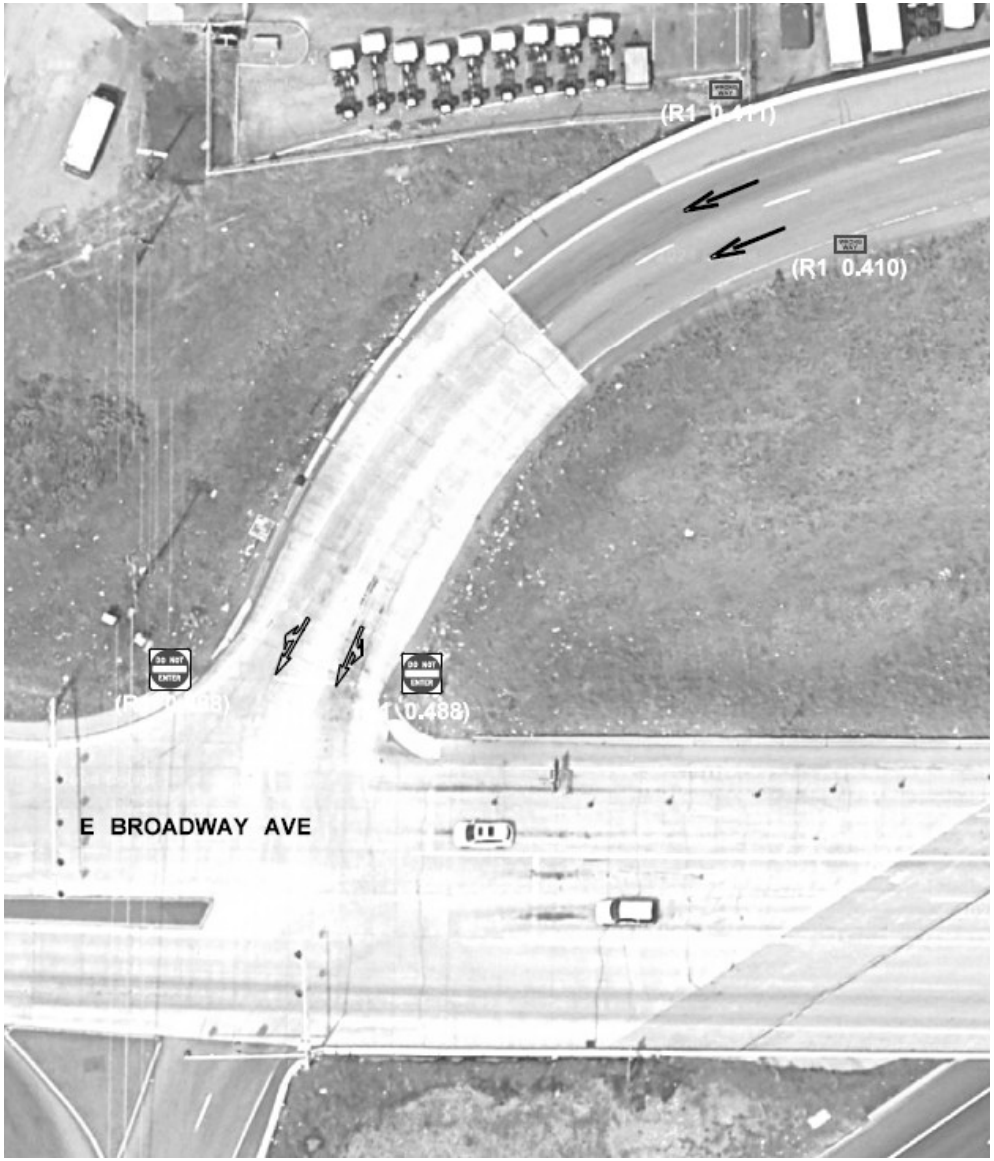
The following images are examples of improvement plans for signing and pavement markings at a few of the selected locations. Improvements include new “Do Not Enter” and “Wrong Way” signs and directional arrow pavement markings.

Eastern Region Figure 1 – Interstate 90 Exit 277A Eastbound – new signs and pavement markings

Eastern Region Figure 2 – Interstate 90 Exit 277 Westbound – new signs and pavement markings



Eastern Region Figure 3 – Interstate 90 Exit 281 Eastbound – new signs and pavement markings



Eastern Region Figure 4 – Interstate 90 Exit 286 Westbound – new signs and pavement markings

5. NORTH CENTRAL REGION

A. Overview

North Central Region wrong-way driving improvement areas

Crash data analysis alone was not enough to indicate a trend of wrong-way driving at any particular interchange. North Central Region chose to update signing and striping at all the rural interchanges on Interstate 90 with the available funding, prioritizing locations where the frontage road geometry had closely spaced intersections next to the interchange ramp intersections. Examples of that geometry can be seen at O Road, Q Road, and U Road east of Moses Lake. STV Inc's wrong-way driving expert concurred with this approach.

Twelve locations were chosen between Mileposts 139 and 189 on Interstate 90 to improve signing and pavement markings. From 2019 through 2023, there were four wrong-way driving crashes, two of which were fatal and 28 incident reports from WSP.

Improvements include:

Signing at ramps:

- Stacking Wrong Way and Do Not Enter Signs, Oversized signs, 3-foot bottom mounting height, angled toward the interchange crossroad
- Oversized Wrong Way signs further up the off-ramp at 4-foot mounting height
- Reflective red signposts on the back and sides of the Wrong Way signs – three-sided
- No left turn and No right turn signs on the interchange crossroad line near each off-ramp.
- Separating Stop Signs from the Do Not Enter Signs. Two separate posts
- Add Interstate 90 route shields below the angled freeway entrance signs on the on-ramps
- New Stop signs and one-way signs on top of stop signs.

Signing for frontage road at Interstate 90 at O Road, Q Road, and U Road due to frontage road geometry:

- Upsizing the frontage road street name signs on top of the nearby frontage road stop signs.
- Adding frontage road street name sign to all stop signs on the frontage road, not just on one stop sign.
- Add an advanced intersection warning sign with the frontage road street name on the county roads in advance of the interchange area.

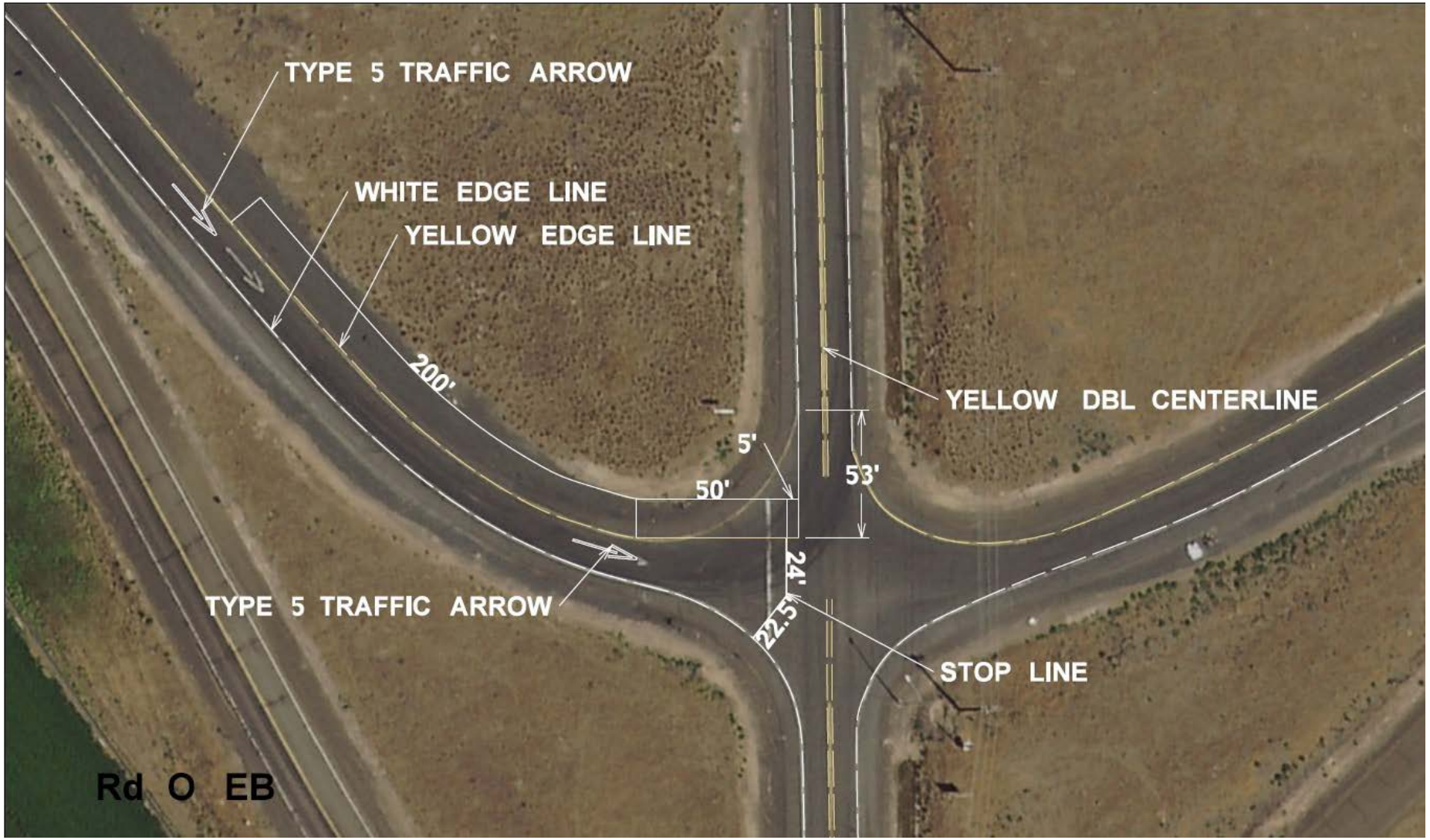
Striping and pavement markings:

- Ensuring the 90-degree striping at the end of the off-ramp is in place per current standard plan, removing the old existing radius line in that quadrant.
- Re-establish the edge line striping around all the nearby frontage road corners.
- Refreshing all striping within the interchange area.
- Extending the yellow double no-pass centerline to extend partially across the off-ramp intersection area to discourage left turns toward the ramp.
- Ensuring the wrong-way arrows are new and correctly placed per the standard plan.

B. Locations

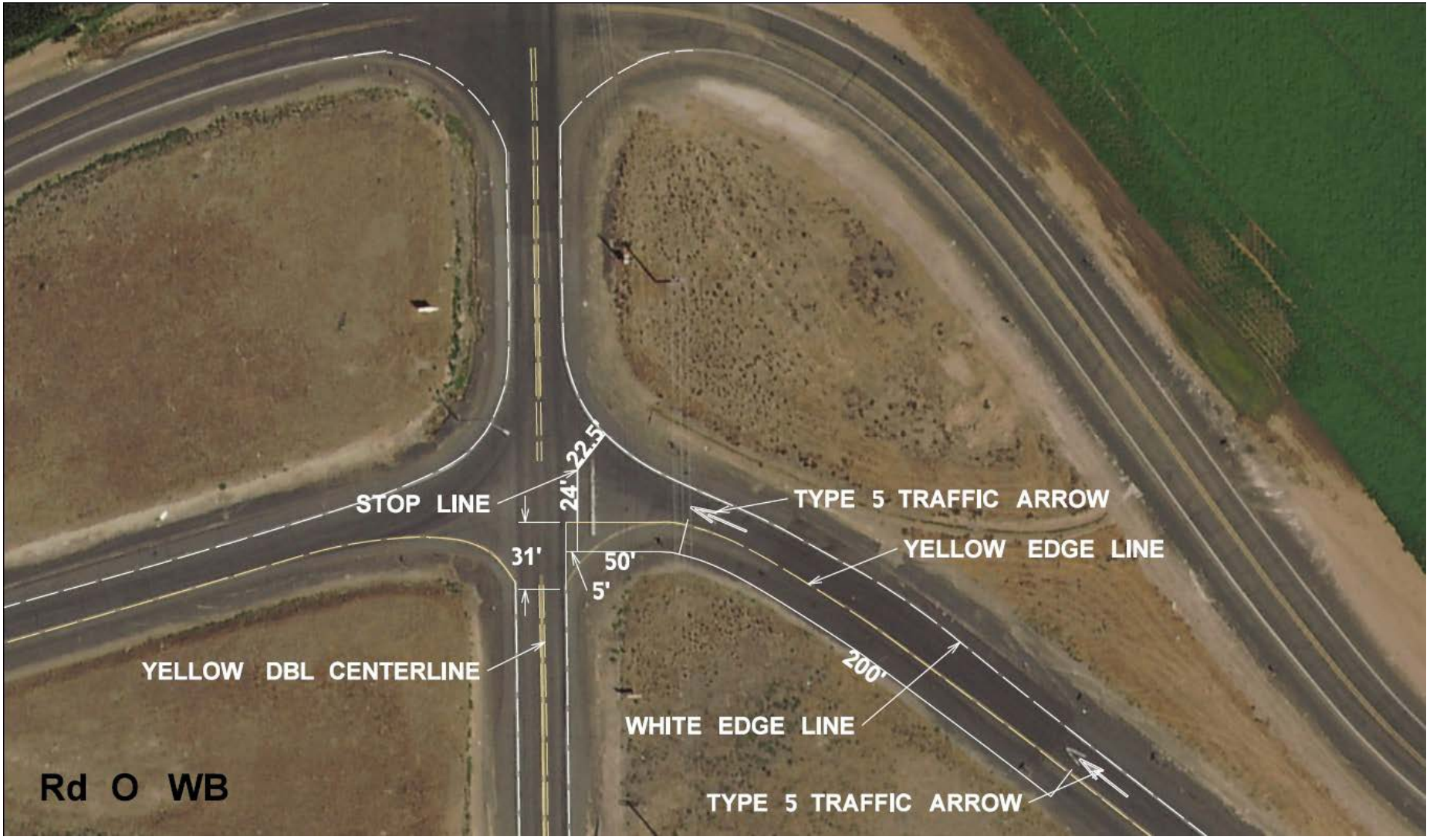
Locations for improvement in the North Central Region:

Route	Milepost	Location	Improvement
I-90	139.61	EB - Wild Horse Viewpoint	Signs/pavement markings
I-90	139.8	WB - Wild Horse Viewpoint	Signs/pavement markings
I-90	143.86	EB/WB - Silica Road SW	Signs/pavement markings
I-90	149.79	EB/WB – State Route 281	Signs/pavement markings
I-90	151.75	EB – State Route 281 Murphy's Corner	Signs/pavement markings
I-90	154.61	EB - Adams Road N	Signs/pavement markings
I-90	164.59	EB/WB - Dodson Road NW	Signs/pavement markings
I-90	169.67	EB/WB - Hiawatha Road NE	Signs/pavement markings
I-90	174.6	WB - Hansen Road	Signs/pavement markings
I-90	182.84	EB/WB - Road O NE	Signs/pavement markings
I-90	184.89	EB/WB - Road Q NE	Signs/pavement markings
I-90	188.89	EB/WB - Road U NE	Signs/pavement markings

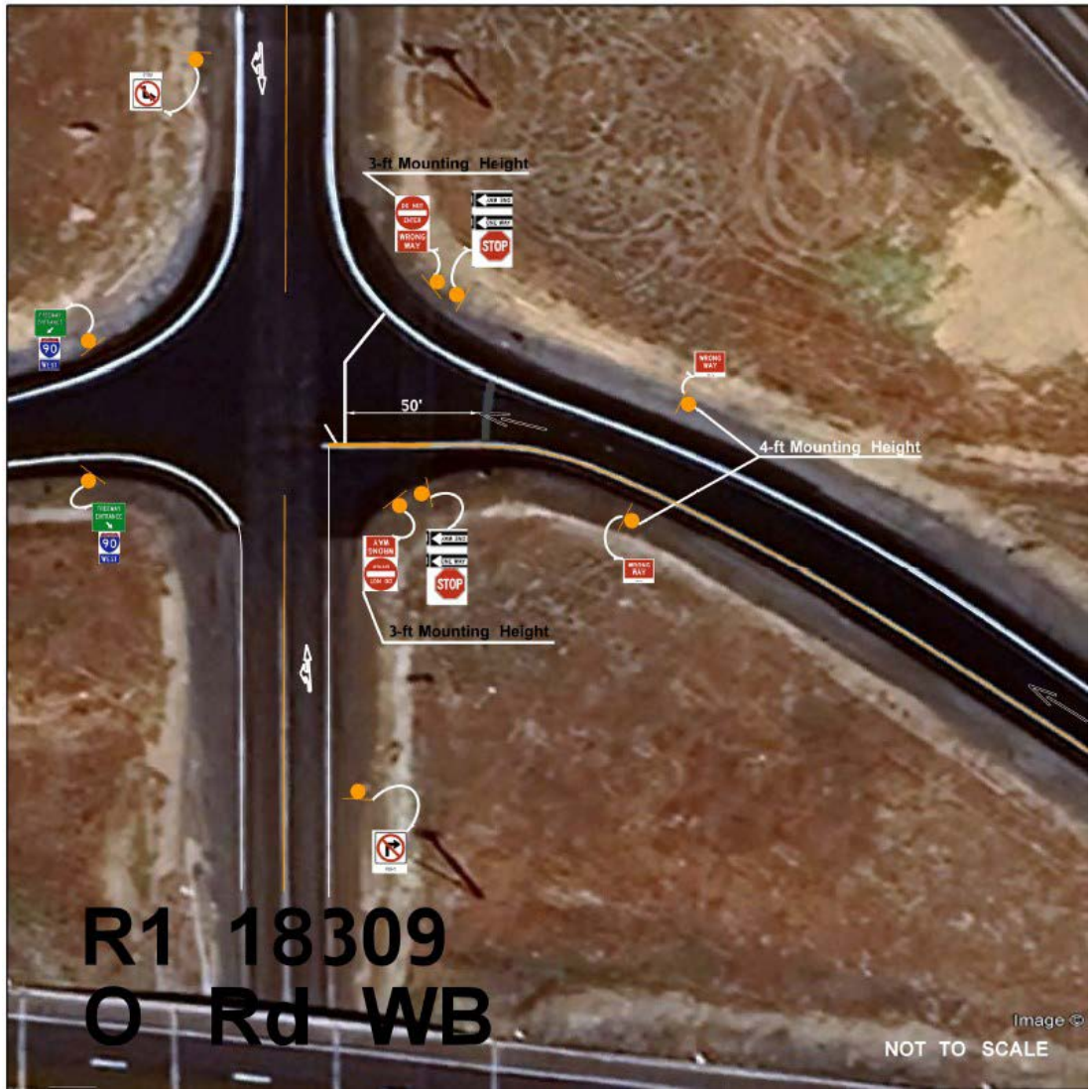


North Central Region Figure 1 – Interstate 90 Eastbound Road O – Improved Pavement Markings Plan, including updating directional arrows, centerline and edge line pavement markings

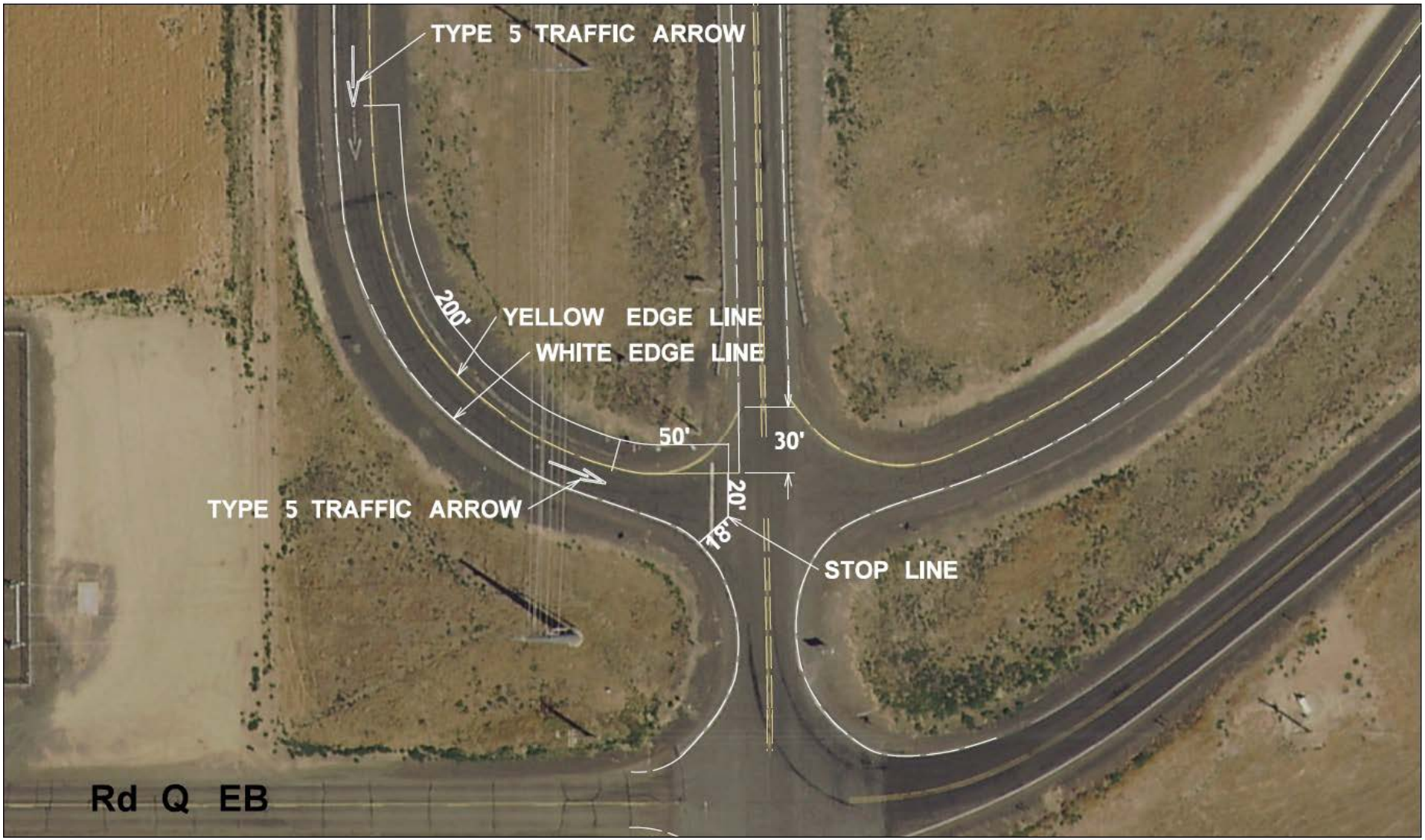
North Central Region Figure 2 – Interstate 90 Eastbound Road O – Signing Upgrade Plan, including "Do Not Enter", "Wrong Way", "No Left/Right Turn" and freeway entrance signs



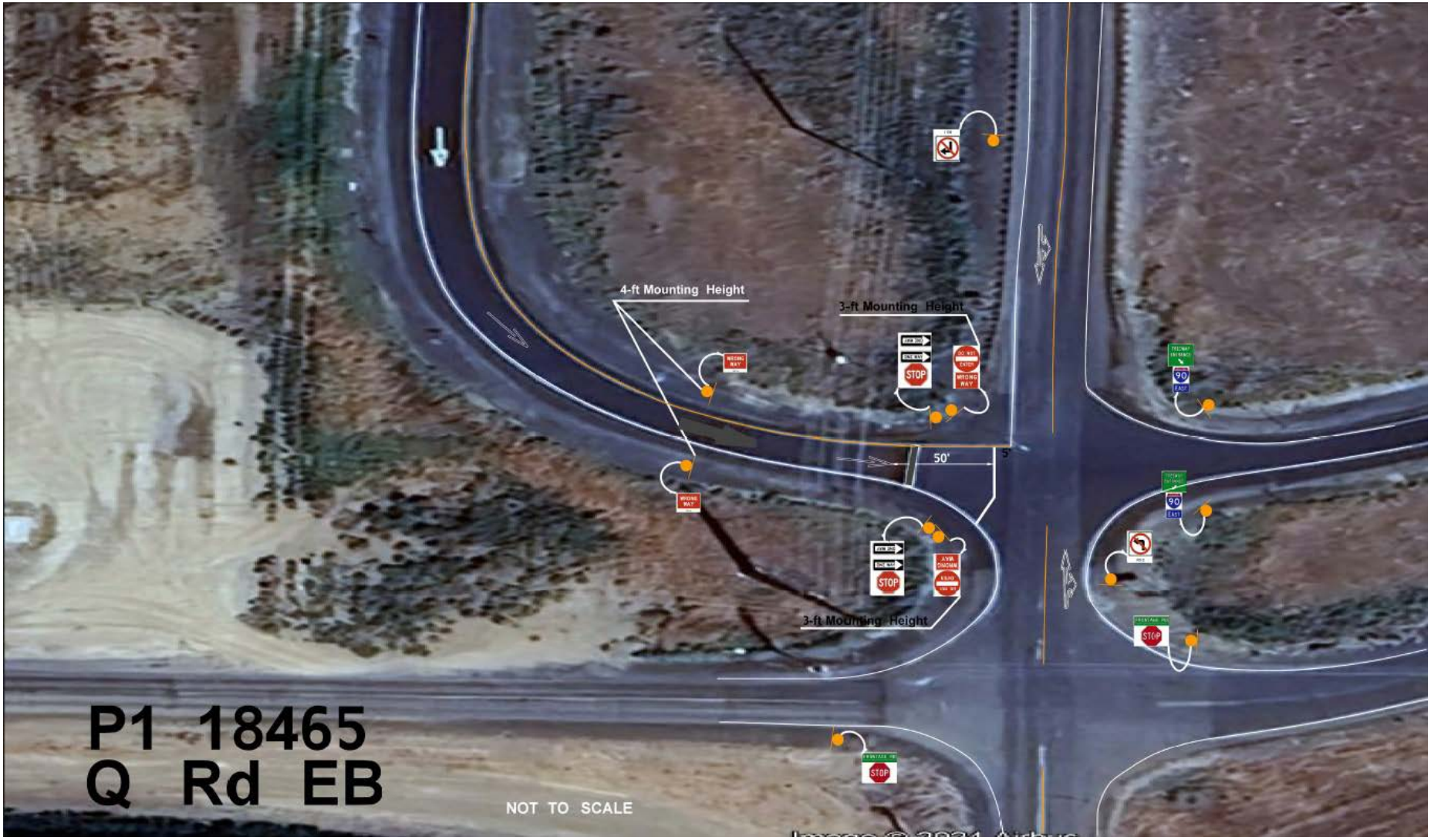
North Central Region Figure 3 – Interstate 90 Westbound Road O – Improved Pavement Markings Plan, including updating directional arrows, centerline and edge line pavement markings



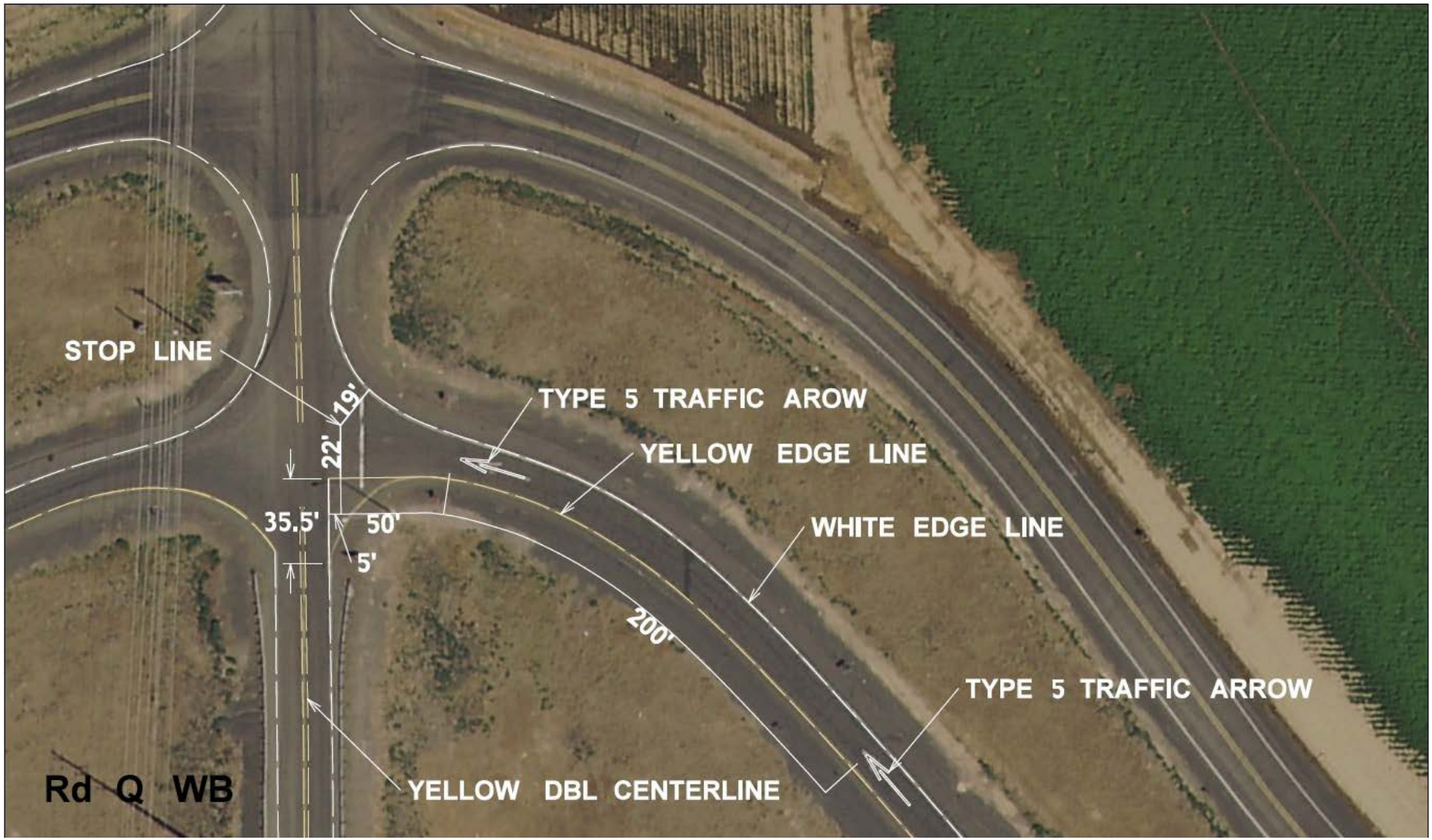
Interstate 90 Westbound Road O – Signing Upgrade Plan, including "Do Not Enter", "Wrong Way", "No Left/Right Turn" and freeway entrance signs



North Central Region Figure 5 – Interstate 90 Eastbound Road Q – Improved Pavement Markings Plan, including updating directional arrows, centerline and edge line pavement markings



North Central Region Figure 6 – Interstate 90 Eastbound Road Q – Signing Upgrade Plan, including "Do Not Enter", "Wrong Way", "No Left/Right Turn" and freeway entrance signs

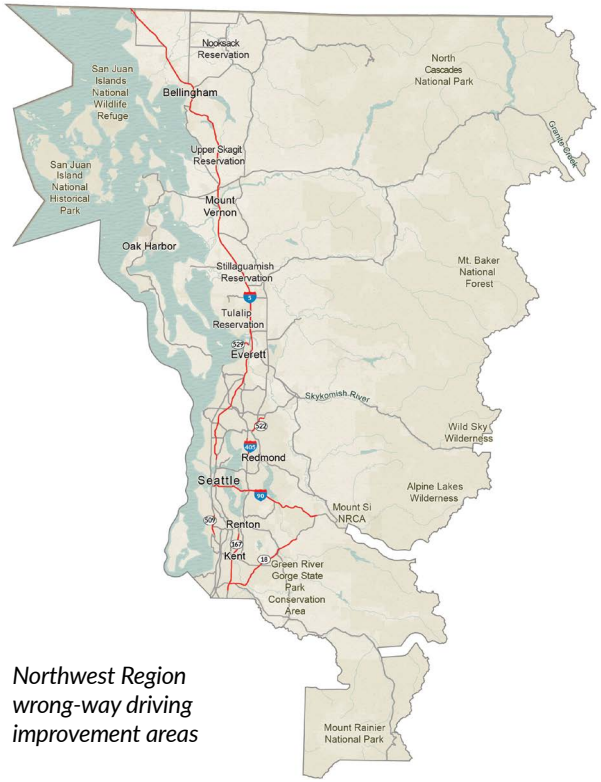


North Central Region Figure 7 – Interstate 90 Westbound Road Q – Improved Pavement Markings Plan, including updating directional arrows, centerline and edge line pavement markings

North Central Region Figure 8 – Interstate 90 Westbound Road Q – Signing Upgrade Plan, including "Do Not Enter", "Wrong Way", "No Left/Right Turn" and freeway entrance signs

6. NORTHWEST REGION

A. Overview



Northwest Region wrong-way driving improvement areas

Northwest Region provided lower cost solutions in the form of replacing and upgrading signs as well as ITS detection for wrong-way driving. There were 21 interchanges with over 400 new signs being installed. These locations were chosen to upgrade sizing and placement to match current guidelines, as well as replace damaged, missing, or old signs. Four locations on State Route 18 were chosen for detection that will trigger flashing signs and alert the TMC. The equipment being used is made by Carmanah Technologies Corp., and includes three detection zones. In the first zone, the driver will see flashing LED signs, and this is where most drivers self-correct. If the driver continues to the second zone, the Transportation Management Center is alerted for detection, and the system verifies the event. If the driver goes into the third zone the TMC is alerted so employees working in the TMC can check cameras and notify WSP. The detection system uses a 3rd party application to alert the TMC, using a cellular modem kit on each pole for communication as fiber was not available at these locations.

From 2019 through 2023 the following routes have experienced wrong-way driving crashes and non-crash events reported by WSP:

- State Route 18 – 17 crashes, 5 with fatal injuries, 293 WSP incident reports.
- Interstate 5 (Mileposts 170-280) – 30 crashes, 5 with fatal injuries, 82 WSP incident reports.
- Interstate 405 (Mileposts 18-22) – 3 crashes, 28 WSP incident reports.
- Interstate 90 (Mileposts 0-26) – 8 crashes, 1 with fatal injury, 122 WSP incident reports.
- State Route 167 (Milepost 13-25) – 12 crashes, 2 with fatal injuries, 79 WSP incident reports.
- State Route 509 (Milepost 26) – 2 crashes, 23 WSP incident reports.
- State Route 522 (Milepost 14) – no reported crashes, 1 WSP incident report.
- State Route 529 (Milepost 3.8) – 1 crash, no WSP incidents reported.

Green Zone

0-150' foot segment from intersection to first pairing of WW100 R5-1a LED signs. This is where most wrong-way drivers will realize their mistake and are likely to self-correct. The multi-zone radar will send detection alert to TMC.

WWD countermeasure: awareness, detection, self-correction and *Detection Alert* to TMC.

Yellow Zone

Upstream from the Green Zone. Wrong-way driver has missed R5-1 and first pair of R5-1a LED signs. If driver continues past detector pole, the 2nd camera runs video analytics to determine if self-correction occurs or the vehicle is proceeds to Red Zone.

WWD countermeasure: awareness, detection, self-correction, validation, and *Detection Alert* to TMC.

Red Zone

Where the wrong way driver would meet high-speed traffic transferring from main line. Video analytics have validated that the wrong-way driver does not self-correct

WWD countermeasure: *Validation Alert* to TMC for human verification, VSM boards to alert right-way drivers, dispatch of emergency services.

Carmanah Technologies Corp. Wrong-Way Driving Countermeasure Proposal, an example of the 3 detection zones that the equipment uses

B. Locations

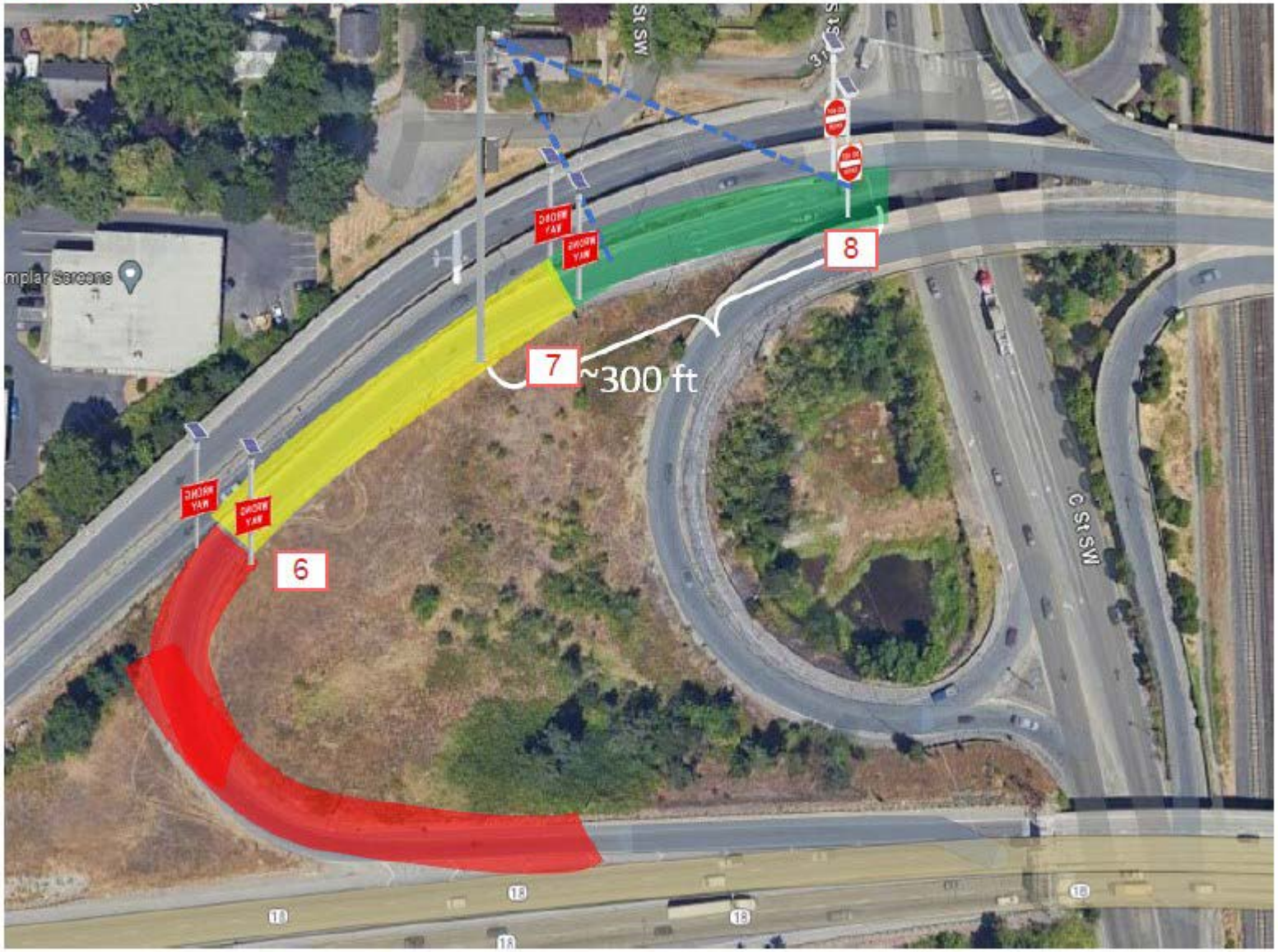
Locations for improvement in the Northwest Region:

Route	Milepost	Location	Improvement
I-405	20	NB/SB - NE 124th Street / Totem Lake Boulevard	Signs/pavement markings
I-5	173	NB/SB - Northgate Way	Signs/pavement markings
I-5	187	NB/SB - South Everett Freeway Station Park and Ride	Signs/pavement markings
I-5	207	NB/SB - Smokey Point Rest Area	Signs/pavement markings
I-5	210	NB/SB - 236th Street NE	Signs/pavement markings
I-5	215	NB/SB - 300th Street NW	Signs/pavement markings
I-5	225	NB/SB - Anderson Road	Signs/pavement markings
I-5	230	NB/SB – State Route 20	Signs/pavement markings
I-5	237.77	NB - Bow Hill Rest Area	Signs/pavement markings
I-5	253	NB/SB - Lakeway Drive	Signs/pavement markings
I-5	255	NB/SB - Sunset Drive	Signs/pavement markings
I-5	262	NB/SB - Main Street	Signs/pavement markings
I-5	274-275	NB/SB - Peach Portal Drive & State Route 543	Signs/pavement markings
I-90	3.5	EB/WB - Rainier Avenue S	Signs/pavement markings
I-90	26	EB/WB – State Route 509	Signs/pavement markings
SR 167	13.5	NB/SB - 15th Street SW	Signs/pavement markings
SR 167	22	NB/SB - 212th Street	Signs/pavement markings
SR 167	24.5	NB/SB - S 180th Street / SW 43rd Street	Signs/pavement markings
SR 18	3.55	EB - C Street SW	ITS - Detection
SR 18	6.06	EB - Auburn Black Diamond Road	ITS - Detection
SR 18	8.2	EB - SE 304th Street	ITS - Detection
SR 18	20.77	EB - Issaquah-Hobart Road	ITS - Detection
SR 509	26	NB/SB – State Route 518	Signs/pavement markings
SR 522	14	EB/WB – State Route 9	Signs/pavement markings
SR 529	3.8-4.82B	NB/SB - Marine View Drive	Signs/pavement markings

Northwest Region Figure 1 – Interstate 5 Northbound Off-ramp to Anderson Road – Signing Upgrade Plan

Northwest Region Figure 2 – I-5 Southbound Off-ramp to Anderson Rd – Signing Upgrade Plan

Off-Ramp 2: SR-18 E Bound at C St SW



Northwest Region Figure 3 – State Route 18 Eastbound at C Street SW – Planned ITS Wrong-Way Driving Detection

7. OLYMPIC REGION

A. Overview

Olympic Region wrong-way driving improvement areas

Olympic Region focused on improving signing, pavement markings and signals to improve factors that could lead to wrong-way driving events. Based on crash and WSP data, locations were prioritized and addressed, for a total of 21 locations for lower-cost solutions, installing 91 new signs. Two ITS detection systems were installed on Interstate 5 at the Trosper interchange.

From 2019-2023 the following routes have experienced wrong-way driving crashes and non-crash events reported by WSP:

- State Route 512 – 13 crashes, 137 WSP incident reports.
- Interstate 5 (Milepost 99-125) – 16 crashes, 3 with fatal injuries, 218 WSP incident reports.
- State Route 3 (Mileposts 37-52) – 3 crashes, 61 WSP incident reports.
- State Route 303 (Milepost 8.3) – 1 crash, 2 WSP incident reports.
- State Route 16 (Mileposts 8-26) – 7 crashes, 1 with a fatal injury, 110 WSP incident reports.

B. Locations

Locations for improvement in the Olympic Region:

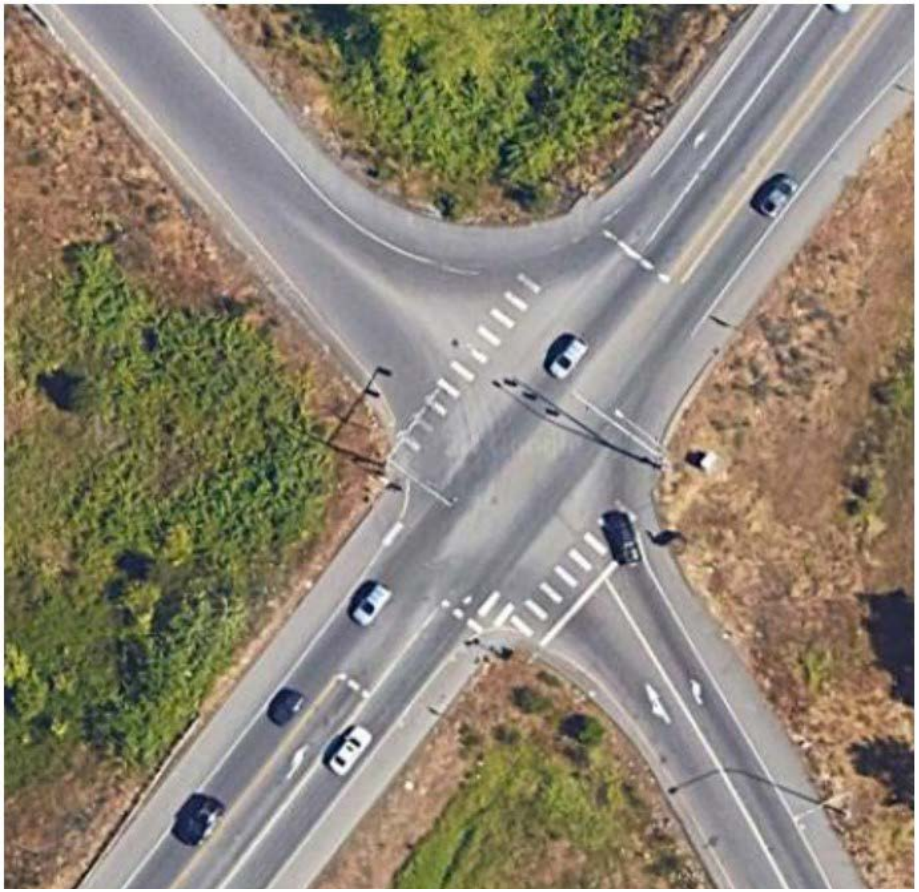
Route	Milepost	Location	Improvement
SR 512	0.62	EB/WB - Steele Street S	Signs/pavement markings
SR 512	2.22	EB – State Route 7 / Pacific Avenue	Signs/pavement markings/signal improvement
SR 512	3.71	EB/WB - Portland	Signs/pavement markings/signal improvement
SR 512	5.86	EB/WB - Canyon	Signs/pavement markings/signal improvement
SR 512	8.37	EB - 94th Avenue E	Signs/pavement markings/signal improvement
SR 512	8.73	EB – State Route 161 / 31st Avenue SW	Signs/pavement markings/signal improvement
SR 512	10.09	EB/WB - S Meridian	Signs/pavement markings/signal improvement
SR 512	11.13	EB/WB - Pioneer	Signs/pavement markings
I-5	99	NB/SB – State Route 121 / Maytown	Signs/pavement markings
I-5	99.5	NB/SB – State Route 121 / 93rd	Pavement markings
I-5	102.5	NB/SB - Trosper	ITS - detection
I-5	114	NB/SB - Nisqually	Pavement markings
I-5	124	NB/SB - Gravelly Lake	Pavement markings
I-5	125.5	NB/SB - Bridgeport	Pavement markings
SR 3	37.31	NB - Loxie Eagans	Signs/pavement markings/signal improvements
SR 3	43	NB/SB - Newberry Hills	Signal improvements
SR 3	45.58	NB – State Route 303 / Kitsap Mall	Signs/pavement markings/signal improvements
SR 3	52	NB/SB – State Route 305	Signal improvements
SR 303	8.3	NB/SB – Silverdale	Signal improvements
SR 16	8.4	EB - 24th	Signal improvements
SR 16	10.3	EB/WB - Olympic Drive	Signal improvements
SR 16	25.13	EB/WB – State Route 160 / Sedgwick	Signs/pavement markings/signal improvements

Olympic Region Figure 1 – State Route 512 Example of Improved Pavement Marking with Direction and Route Shield

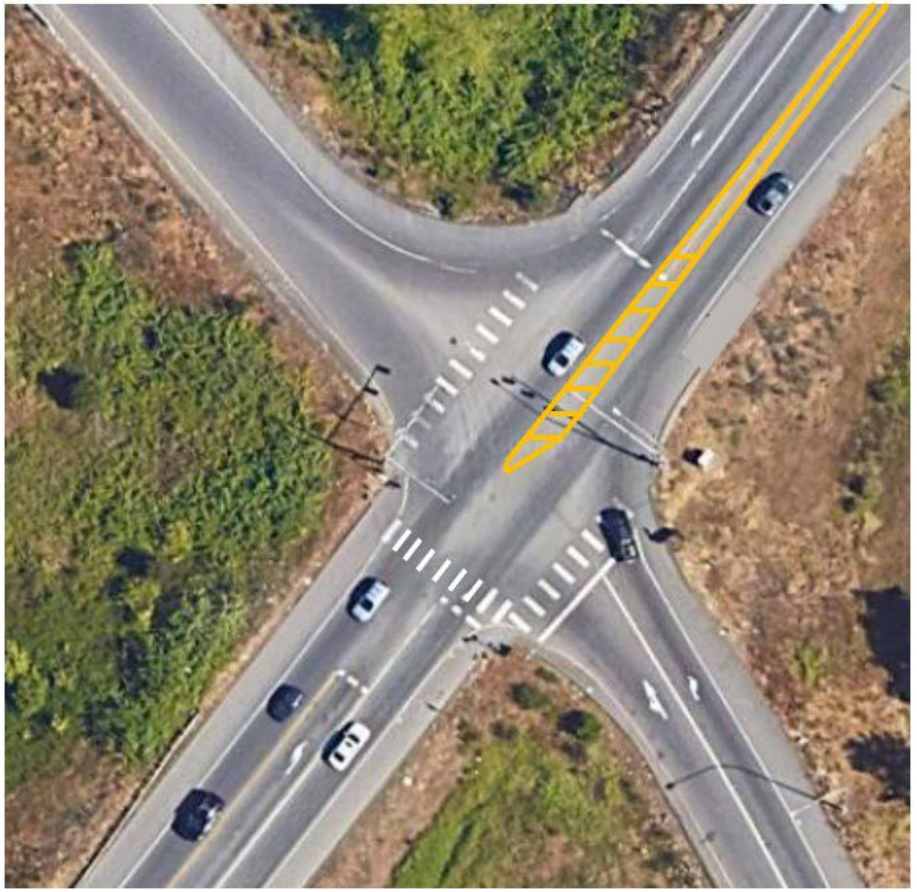
Olympic Region Figure 2 – Northbound State Route 3 at Kitsap Mall – Upgrading Signal to Through Arrow Before and After

Olympic Region Figure 3 – Northbound State Route 3 at State Route 303 / Kitsap Mall – Striping Before

Olympic Region Figure 4 – Northbound State Route 3 at State Route 303 / Kitsap Mall – Striping Improvement Plan



Olympic Region Figure 5 – Westbound State Route 16 at State Route 160 / Sedgwick – Striping Before



Olympic Region Figure 6 – Westbound State Route 16 at State Route 160 / Sedgwick – Striping Improvement Plan

8. SOUTH CENTRAL REGION

A. Overview

South Central Region wrong-way driving improvement areas

South Central Region analyzed crash data and worked with WSP to determine priority routes for implementing wrong-way driving improvements. Improvements include improving pavement markings, upsizing and repositioning signs, adding LED illumination, and post reflectors. There were 23 locations selected, installing 258 new signs. STV Inc's wrong-way driving expert reviewed and concurred with the approach being taken by these improvements.

From 2019 through 2023 the following routes have experienced wrong-way driving crashes and non-crash events reported by WSP:

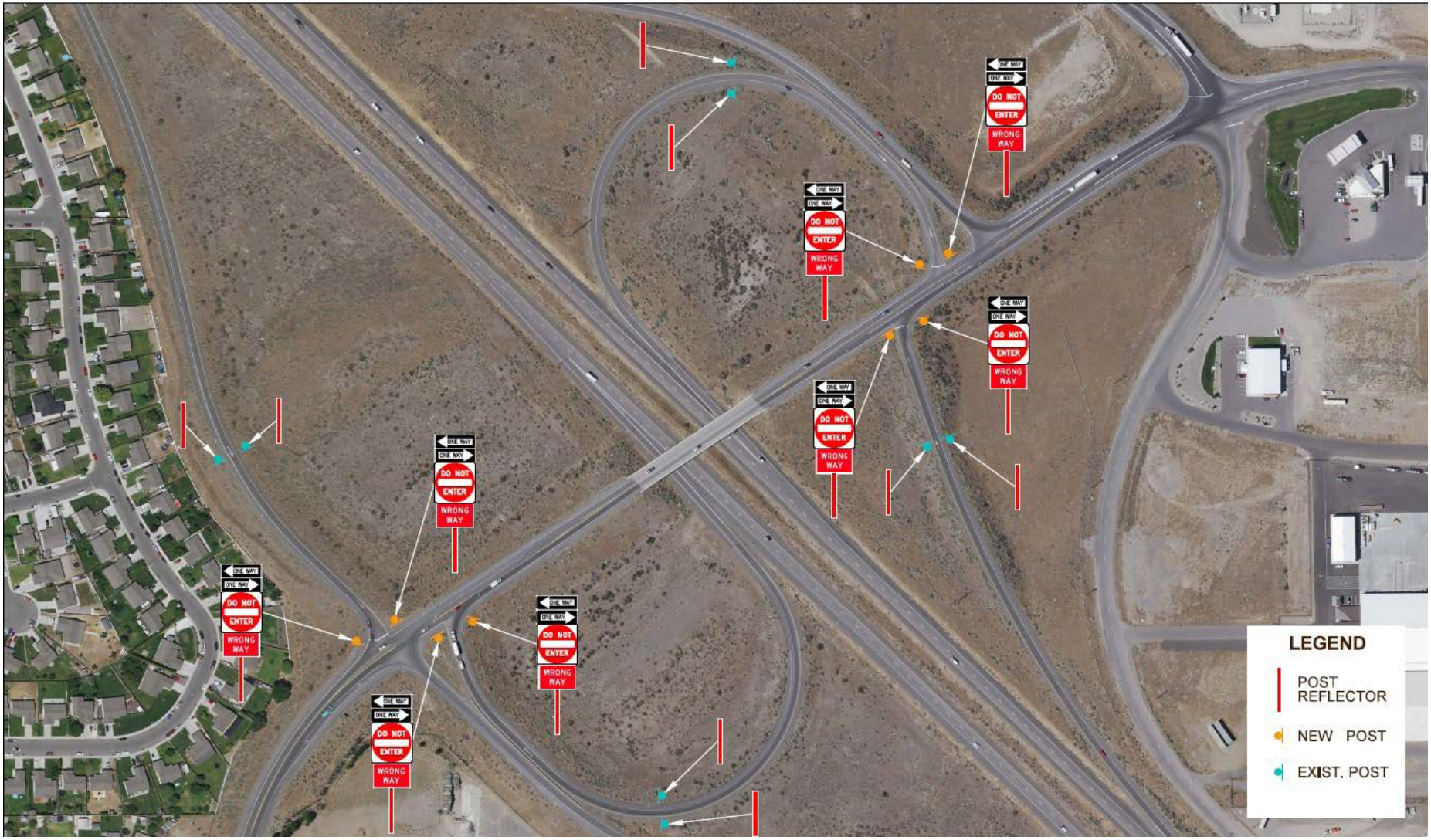
- US Highway 12 (Mileposts 200-201) – 1 crash, 52 WSP incident reports.
- US Highway 12 (Milepost 292) – 2 crashes, 14 WSP incident reports.
- Interstate 82 (Mileposts 26-114) – 32 crashes, 7 with fatal injuries, 636 WSP incident reports.
- US Highway 97 (Milepost 69) – 1 fatal crash, 4 WSP incident reports.
- Interstate 182 (Mileposts 3-13) – 3 fatal crashes, 178 WSP incident reports.
- US Highway 395 (Milepost 12) – no crashes, 9 WSP incident reports.

B. Locations

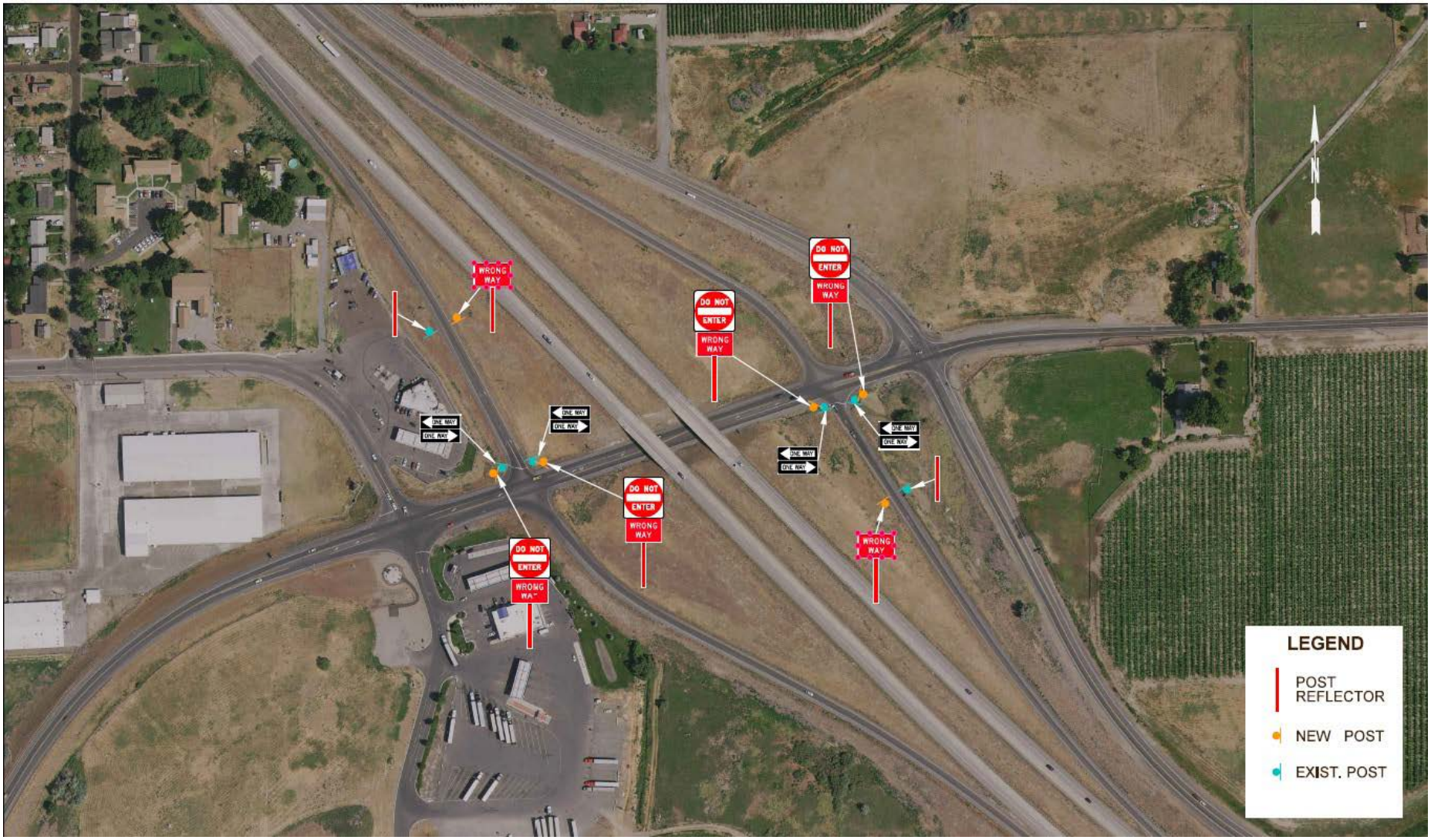
Locations for improvement in the South Central Region:

Route	Milepost	Location	Improvement
US 12	200	State Route 12 at 40th Avenue	Signs/pavement markings
US 12	201	State Route 12 at 16th WB off ramp	Signs/pavement markings
US 12	292	State Route 12 at Lewis	Signs/pavement markings
I-82	26	Interstate 82 at State Route 821 Junction	Signs/pavement markings
I-82	44	Interstate 82 at Donald Wapato Road	Signs/pavement markings
I-82	50	Interstate 82 at Buena Way	Signs/pavement markings
I-82	52	Interstate 82 at Meyers Road	Signs/pavement markings
I-82	54	Interstate 82 at Yakima Valley Highway	Signs/pavement markings
I-82	58	Interstate 82 at Van Belle Road (State Route 223)	Signs/pavement markings
I-82	63	Interstate 82 at Sunnyside Road	Signs/pavement markings
I-82	67	Interstate 82 at Midvale Road	Signs/pavement markings
I-82	69	Interstate 82 at State Route 241	Signs/pavement markings
I-82	96	Interstate 82 at Benton City	Signs/pavement markings
I-82	104	Interstate 82 at Dallas	Signs/pavement markings
I-82	109	Interstate 82 at Badger Canyon	Signs/pavement markings
I-82	114	Interstate 82 at Locust Grove	Signs/pavement markings
US 97	69	State Route 97 at Wapato Road	Signs/pavement markings
I-182	3	Interstate 182 at Queensgate	Signs/pavement markings
I-182	7	Interstate 182 at Road 100	Signs/pavement markings
I-182	9	Interstate 182 at Road 68	Signs/pavement markings
I-182	12	Interstate 182 at 20th Avenue	Signs/pavement markings
I-182	13	Interstate 182 at 4th Avenue	Signs/pavement markings
US 395	12	State Route 395 at W Argent Road	Signs/pavement markings

South Central Region Figure 1 – Eastbound US Highway 12 at 40th Avenue – Signing and Pavement Marking Improvement Plan



South Central Region Figure 2 – US Highway 12 Interchange at Lewis Street – Signing and Pavement Marking Improvement Plan



South Central Region Figure 3 – Interstate 82 Interchange at Exit 58 – Signing and Pavement Marking Improvement Plan

9. SOUTHWEST REGION

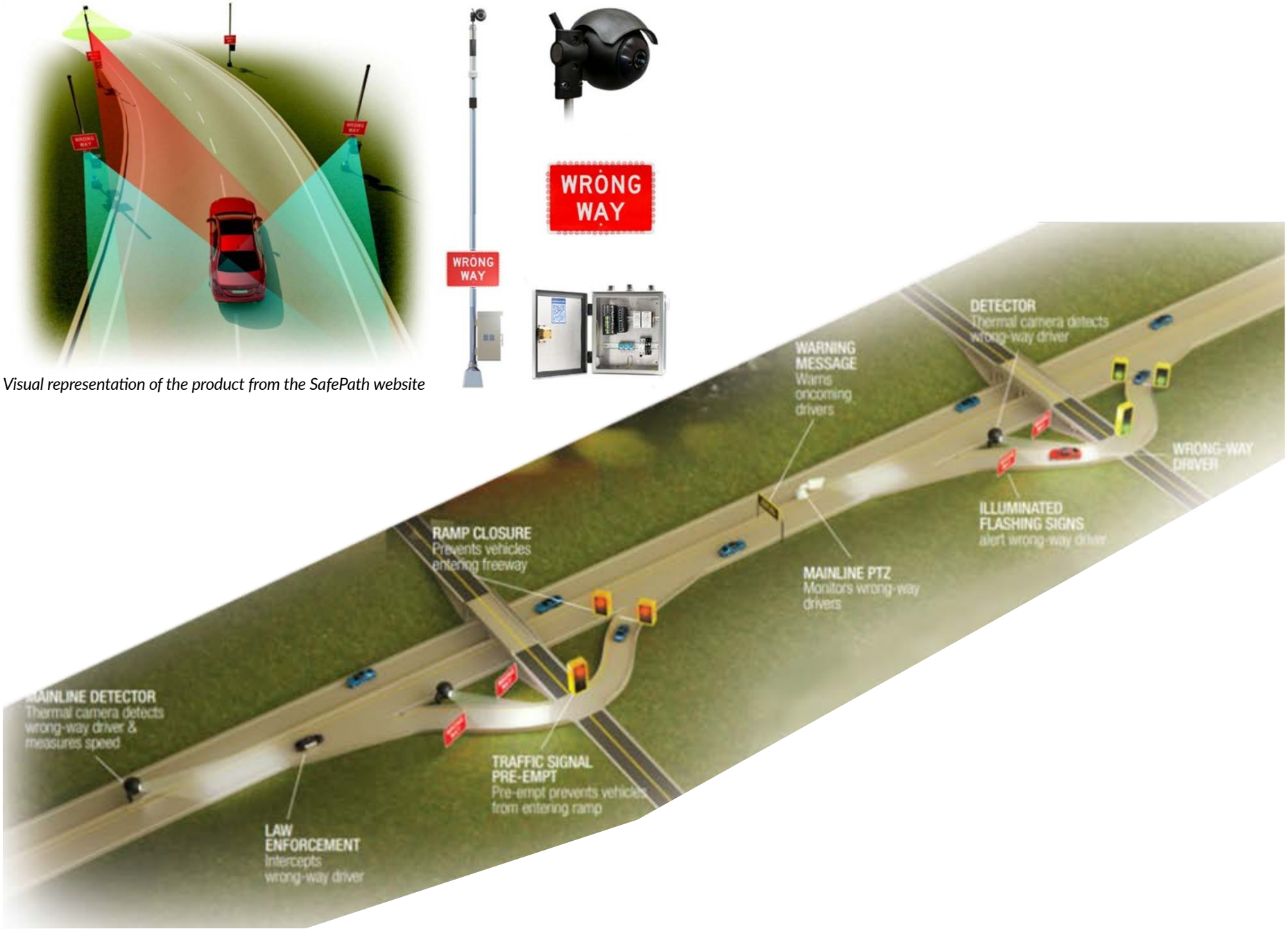
A. Overview

Southwest Region wrong-way driving improvement areas

Southwest Region analyzed crash data and worked with WSP and maintenance to determine priority routes for implementing wrong-way driving improvements. The region focused on locations that had 12 or more wrong-way driving incidents. Improvements include improving pavement markings, updating and repositioning signs, and adding wrong-way raised pavement markers and post reflectors. There were 139 new signs installed over 19 locations. Four of these locations were also selected for ITS-detection implementation. This included installing the SafePath detection system consisting of radar and thermal camera detection that activates flashing LED signs and alerts the TMC.

From 2019 through 2023 the following routes have experienced wrong-way driving crashes and non-crash events reported by WSP:

- Interstate 5 (Mileposts 0-12) – 10 crashes, 1 with fatal injury, 138 WSP incident reports.
- Interstate 5 (Milepost 39-40) – 4 crashes, 28 WSP incident reports.
- State Route 14 (Mileposts 0-8.5) – 5 crashes, 1 with fatal injury, 70 WSP incident reports.
- Interstate 205 (Entire Route) – 1 crash, 110 WSP incident reports.
- State Route 500 (Mileposts 0-4) – 3 crashes, 69 WSP incident reports.



Visual representation of the product from the SafePath website

Visual representation of the SafePath system

B. Locations

Locations for improvement in the Southwest Region:

Route	Milepost	Location	Improvement
I-5	2.9	Main Street	Signs/pavement markings
I-5	5.4	99th Street – north and southbound ramps	Signs/pavement markings
I-5	9.5	179th Street	Signs/pavement markings/ITS-detection
I-5	11-11.62	State Route 502	Signs/pavement markings/ITS-detection
I-5	11.62	Gee Creek Rest Area – northbound	Signs/pavement markings/ITS-detection
I-5	39.6-39.9	Allen Street	Signs/pavement markings
SR 14	0	Milepost 0 and Interstate 5 (C Street)	Signs/pavement markings/ITS-detection
SR 14	1	Columbia House	Signs/pavement markings
SR 14	3	Evergreen	Signs/pavement markings
SR 14	4.3	Leiser	Signs/pavement markings
SR 14	6	Interstate 205	Signs/pavement markings
SR 14	8.5	164th Avenue – east and westbound ramps	Signs/pavement markings
I-205	28.3	Mill Plain / 112th Avenue	Signs/pavement markings
SR 500	1.1	Saint Johns	Signs/pavement markings
SR 500	3.1	Andresen – east and westbound ramps	Signs/pavement markings
SR 500	3.9	Thurston	Signs/pavement markings
SR 500	3.1	Andresen	Signs/pavement markings
SR 500	3.9	Thurston	Signs/pavement markings

Southwest Region Figure 1 – Northbound Interstate 5 at 99th Street – Signing and Pavement Marking Improvement Plan

Southwest Region Figure 2 – Westbound State Route 500 at Saint Johns – Signing and Pavement Marking Improvement Plan

Southwest Region Figure 3 – Northbound Interstate 5 at 17th Street – Signing and Pavement Marking Improvement Plan

10. CONCLUSION

Wrong-way driving countermeasures have proven effective in other states, and we expect similar results from the work done with this project. While the timing of this report and the installation of the various strategies do not allow for reporting the performance results, the WSDOT regions will monitor and analyze the before and after impacts. This is a good start to address wrong-way driving in Washington State. In the last year 122 locations had wrong-way driving countermeasures implemented, including over 1,000 new and upgraded signs, LED illumination, updated pavement markings and detection.

At the time of developing this report in early May, some work is not complete. This includes pavement markings that were delayed by weather and ITS-detection systems delayed by acquiring equipment. Work is scheduled to be completed by mid-June.

Funding spent:

- $513,000 of $900,000 for low-cost implementation.
- $160,000 of $980,000 for ITS – detection implementation.
- $105,000 of $120,000 for STV Inc consultation.

Funding is anticipated to be entirely spent by the conclusion of this project.

Wrong-way driving remains a serious issue in Washington State; fully addressing these behaviors would require significant investment in the future. With an average of 1500 wrong-way driving events happening a year, there are opportunities for implementing more countermeasures, whether systemic signing and pavement markings or ITS detection systems. The most effective approaches will be when entire corridors can be addressed at the same time.

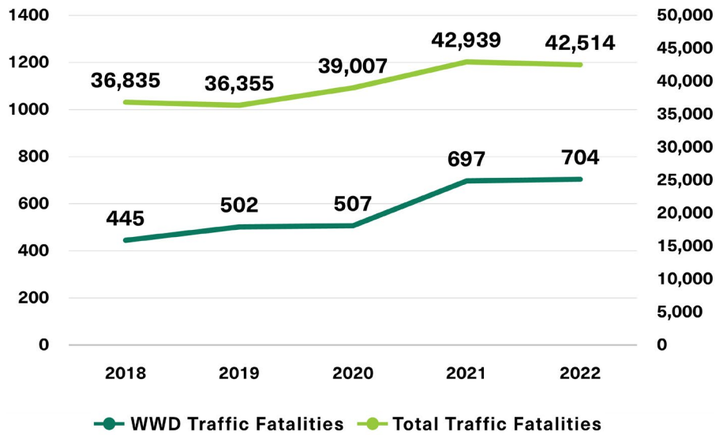
Prepared for:

Washington State Department of Transportation

12/30/2024

Background

Wrong-way driving is a serious traffic safety issue that occurs when a vehicle travels in the opposite direction of traffic flow on a roadway. This dangerous behavior often leads to head-on collisions, which are among the most severe and deadly types of crashes. In the United States, wrong-way driving crashes account for around 3.7% of fatal crashes on divided highways[1]. Moreover, recent data reveals a concerning rise in wrong-way driving fatalities nationwide. Between 2018 and 2022, a total of 2,855 people lost their lives—an average of 570 deaths each year—in wrong-way crashes on divided highways[2]. This upward trend highlights the urgent need for enhanced preventative measures, targeted enforcement, and broader public awareness to address the escalating risks associated with wrong-way driving.



Research has shown that several factors contribute to wrong-way driving incidents, with some of the most common causes including[1]:

Alcohol Impairment: Alcohol consumption impairs judgment, reaction time, and coordination, making it a major contributor to wrong-way driving. As blood alcohol concentration (BAC) increases, so does the odds of being a wrong-way driver. Studies have shown that nearly 60% of drivers of wrong-way crashes involve alcohol-impaired drivers.

Older Age: Age significantly influences the occurrence of wrong-way driving incidents, with older drivers and young adults being particularly at risk. Older drivers may face cognitive or visual impairments, while young adults often display risk-taking behaviors due to inexperience. Statistics also reveal that about 70% of wrong-way drivers are male, and solo drivers are more prone to such incidents compared to those with passengers, who tend to drive more cautiously.

Distracted Driving: Distractions, such as using a cell phone, eating, or adjusting the radio, can take a driver's attention away from the road and increase the risk of wrong-way driving. In 2022 alone, the National Highway Traffic Safety Administration (NHTSA) reported 3,308 deaths linked to driver distraction[3].

Road Design: Effective road design is essential to preventing wrong-way driving, as poor signage and confusing layouts often lead to driver disorientation and errors. Insufficiently marked exit ramps and poorly designed interchanges make it easier for drivers to enter highways incorrectly, while the absence of large, clear "Do Not Enter" signs and reflective markers compounds the problem.

Across the United States, a variety of preventive measures and technological innovations are being introduced to mitigate wrong-way driving and its serious public safety implications. Enhanced signage—such as larger, illuminated "Do Not Enter" signs and flashing LED warnings—has reduced wrong-way incidents by up to 44% in some areas, with certain regions seeing a 60% drop in wrong-way crashes. In addition, advanced detection systems are now alerting authorities and oncoming drivers to these dangers in real time. Reflective markers and improved signage further boost safety, while public awareness campaigns stress the dangers of impaired driving and underscore the risks of navigating roads in reverse.

In the United States, WWD crashes account for around 3.7% of fatal crashes on divided highways and they are more likely to result in serious injuries and fatalities than other types of crashes.

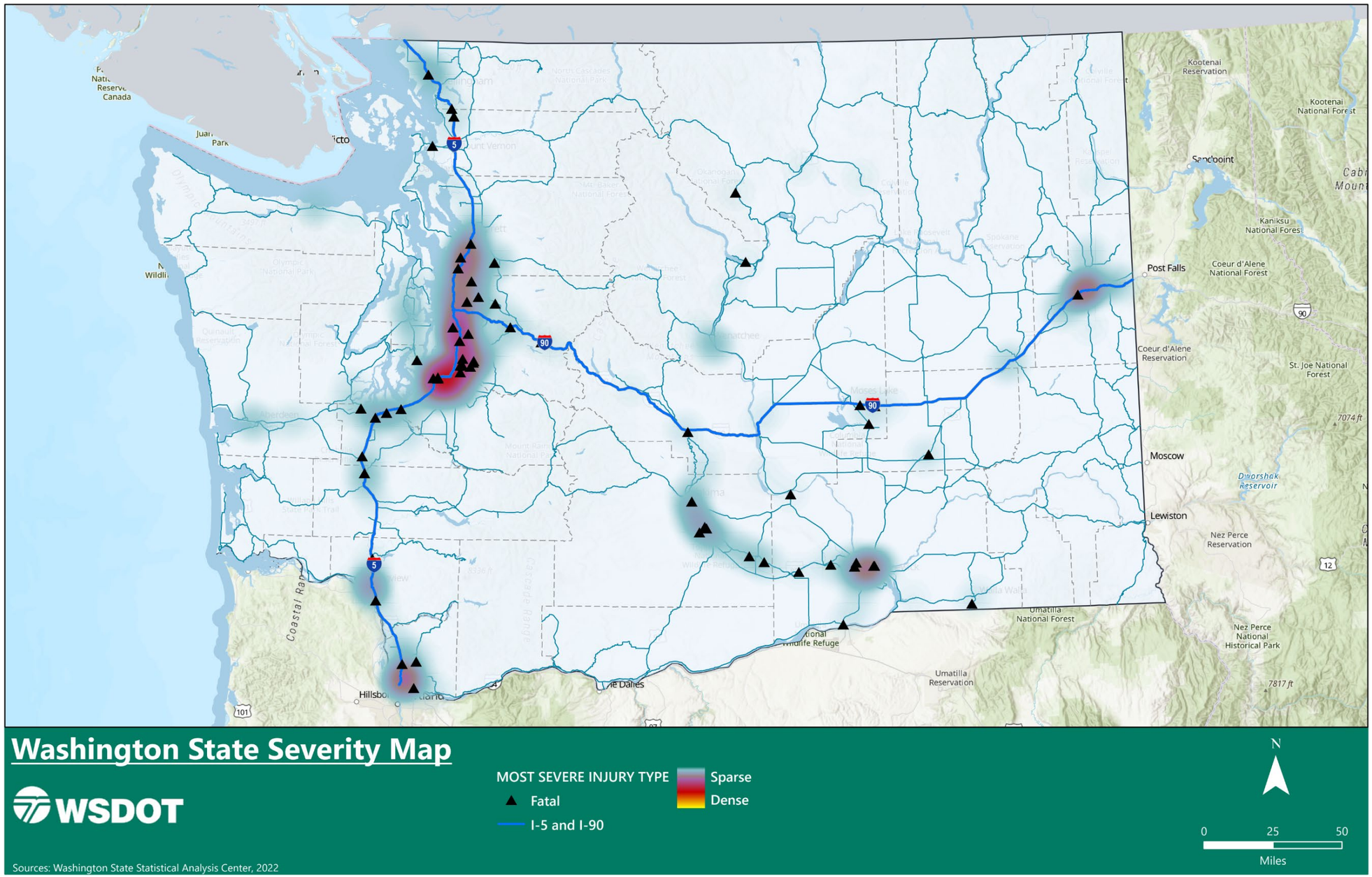
[1] What Are the Latest US Statistics on Wrong-Way Driving Incidents, Fatalities, and Injuries? https://govcomm.us/us-statistics/

[2] US Department of Transportation (USDOT) Federal Highway Administration (FHWA) Highway Safety Programs, https://highways.dot.gov/safety/intersection-safety/about

[3] National Highway Traffic Safety Administration (NHTSA) Distracted Driving, https://www.nhtsa.gov/risky-driving/distracted-driving

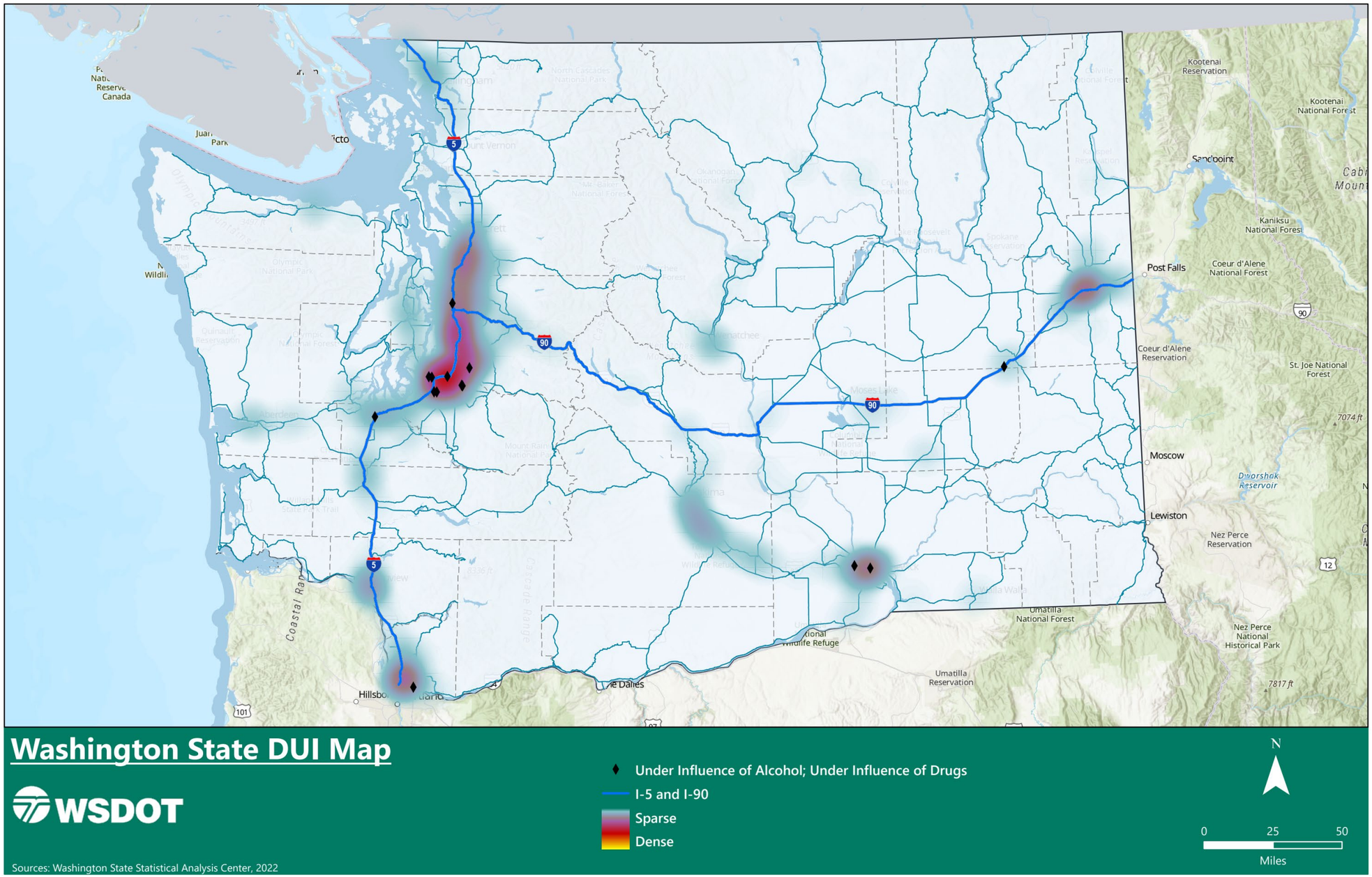
WWD Data Analysis

This heatmap illustrates WWD crashes as well as the crashes with Fatal Injury Severity in Washington State from 2019 to 2023, revealing a higher concentration of crashes in the Seattle-Tacoma region and additional clusters in the southern, south-central, and eastern parts of the state near Spokane.



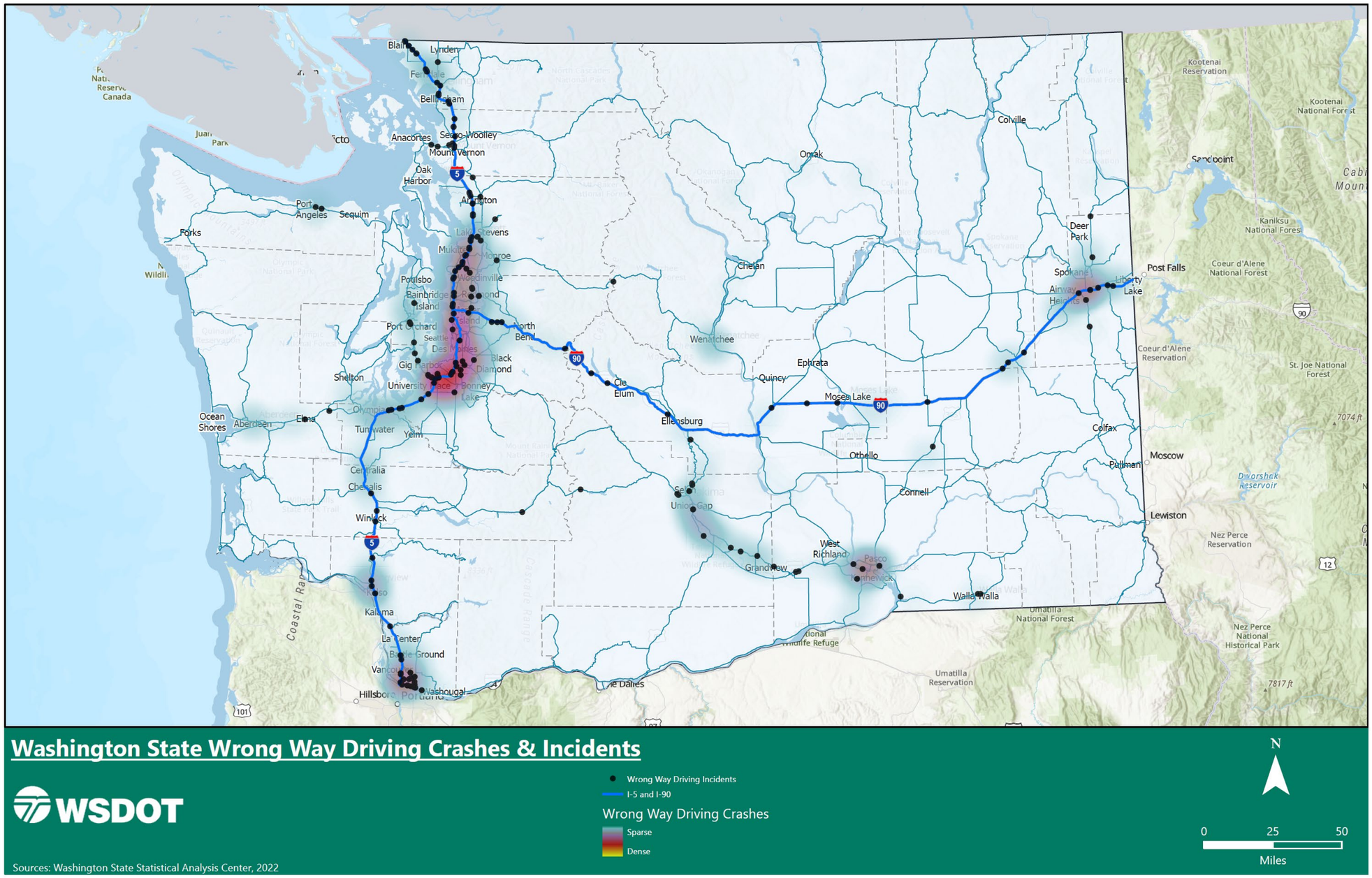
WWD Data Analysis

The following heatmap depicts WWD Crashes along with the distribution of DUI crashes across Washington State, highlighting higher concentrations in the Seattle-Tacoma area, as well as in southern and south-central regions.



WWD Data Analysis

Finally, this heatmap illustrates WWD Crashes as well as the distribution of WWD incidents over the same five-year period (2019–2023), mirroring the heatmap's trend of higher concentrations in the Seattle-Tacoma region and additional clusters in the southern, south-central, and eastern parts of the state near Spokane.



WWD Data Analysis

The table provides a summary of crash data from 2019 to 2023 in Wshington State, with a particular focus on Wrong-Way Driving (WWD) crashes and their severe consequences. Over this five-year period, a total of 509,310 crashes occurred statewide, of which 227,692 were specific to state routes. Within these totals, WWD crashes, though relatively infrequent, present significant safety concerns. There were 493 WWD crashes recorded, and 62 of these resulted in fatalities, meaning that approximately 12.6% of WWD crashes led to fatal outcomes. This highlights the disproportionately severe nature of WWD incidents when compared to other crash types.

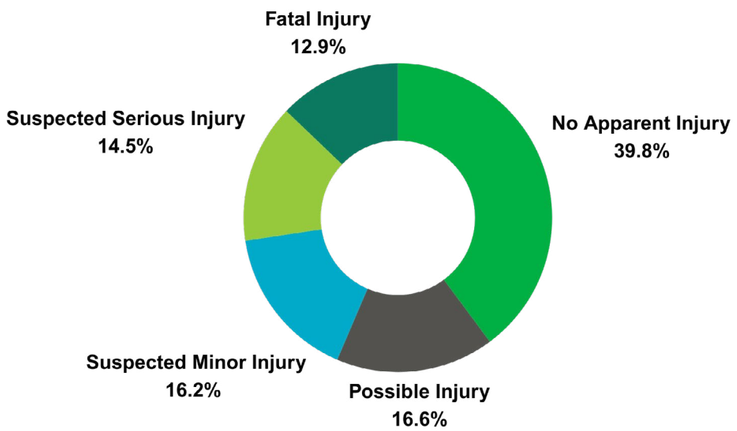
Examining the annual trends, WWD crashes were at their lowest in 2019, with 64 crashes and 8 fatalities. However, the numbers sharply increased in 2020 to 106 WWD crashes, alongside a notable rise in fatalities to 17. The upward trend continued through 2023, when WWD crashes reached their peak at 116 incidents, accompanied by the highest number of fatalities at 19. These statistics indicate a concerning pattern of growth in both the frequency and severity of WWD crashes over the five-year period. They also align with a post-COVID-19 nationwide increase in fatal crashes.

Year	Total Crashes	Total State Route Only Crashes	WWD Crashes	WWD Fatal Crashes
2019	111,708	49,504	64	8
2020	86,376	38,718	106	17
2021	103,384	48,168	101	8
2022	103,438	47,369	106	10
2023	104,404	43,933	116	19
Total	**509,310**	**227,692**	**493**	**62**

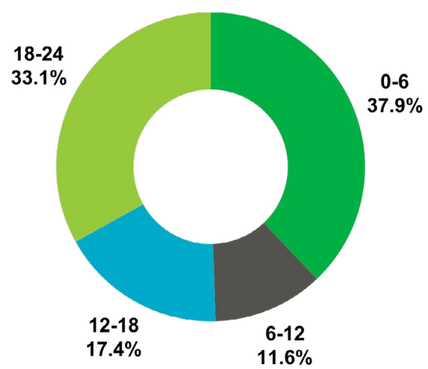
The following charts provide a detailed overview of WWD crashes, highlighting injury severity, time of day, day of the week, and location type. In terms of injury severity, 12.9% of WWD crashes resulted in fatalities, and 14.5% lead to suspected serious injuries, underscoring their severe nature. While 39.8% show no apparent injury, the remaining crashes involve minor and possible injuries.

Regarding the time of day, 37.9% of WWD crashes occurred during early morning hours (0-6), followed by a notable share during night hours (18-24). Weekday crashes account for 59.6%, with weekends at 40.4%. Location analysis reveals that 83.1% of WWD crashes occurred in urban areas, compared to 16.9% in rural settings, reflecting the complexity and traffic volumes of urban road networks.

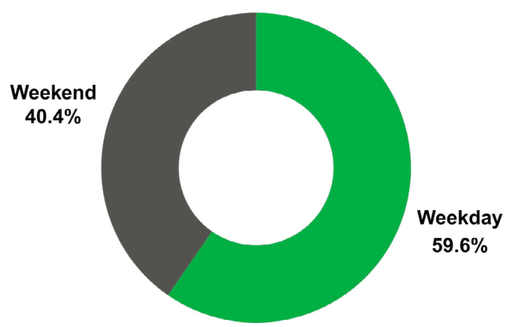
INJURY SEVERITY



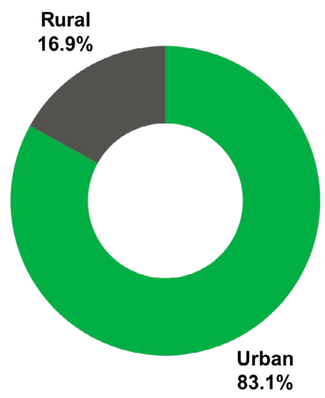
TIME OF DAY



DAY OF WEEK



RURAL VS URBAN



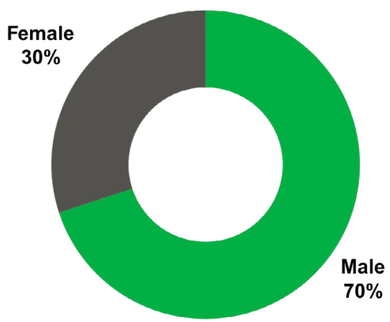
WWD Data Analysis

The gender chart shows that males were disproportionately involved in WWD crashes, accounting for 70% of crashes, while females represented 30%. This trend suggests that gender plays a notable role in WWD crash occurrences.

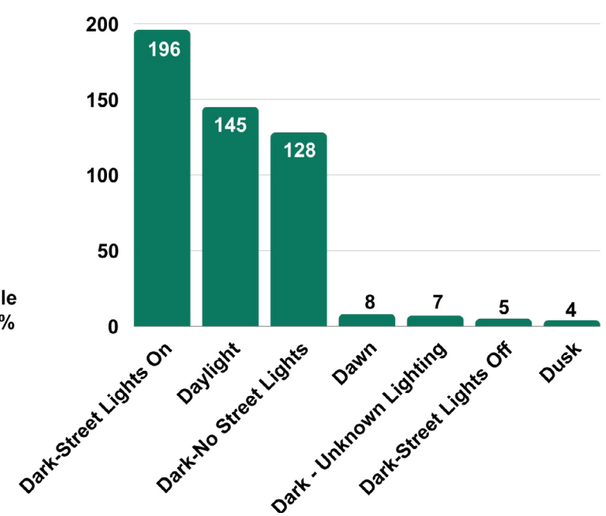
The lighting condition chart indicates that most WWD crashes occurred during nighttime. Specifically, 196 crashes happened under dark conditions with street lights on, while 145 crashes occurred in daylight. Another 128 crashes took place in dark areas without street lights, reinforcing the significance of reduced visibility at night.

The weather condition chart highlights that the majority of WWD crashes occurred under clear weather conditions (257 crashes), suggesting that adverse weather was not a primary factor in these crashes. However, 82 crashes occurred under overcast skies, and 73 crashes happened during raining conditions.

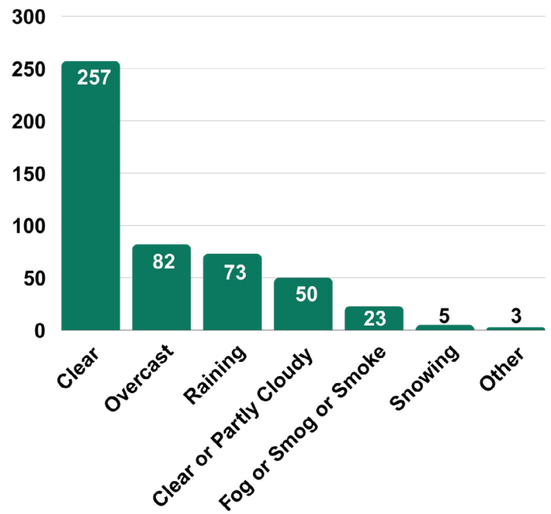
DRIVER'S GENDER



LIGHTING CONDITION

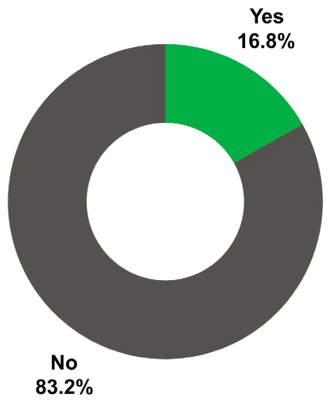


WEATHER CONDITION

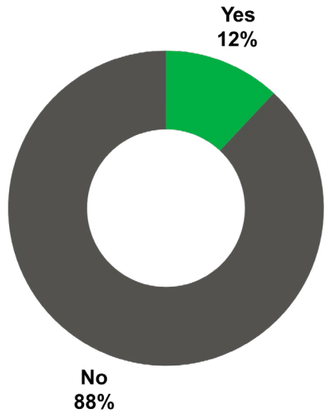


IMPAIRED DRIVING?

OLDER DRIVER?



DISTRACTED DRIVING?



Nearly half of all WWD crashes, 48.7%, involved impaired drivers, emphasizing the need for safety measures to address this pressing issue.

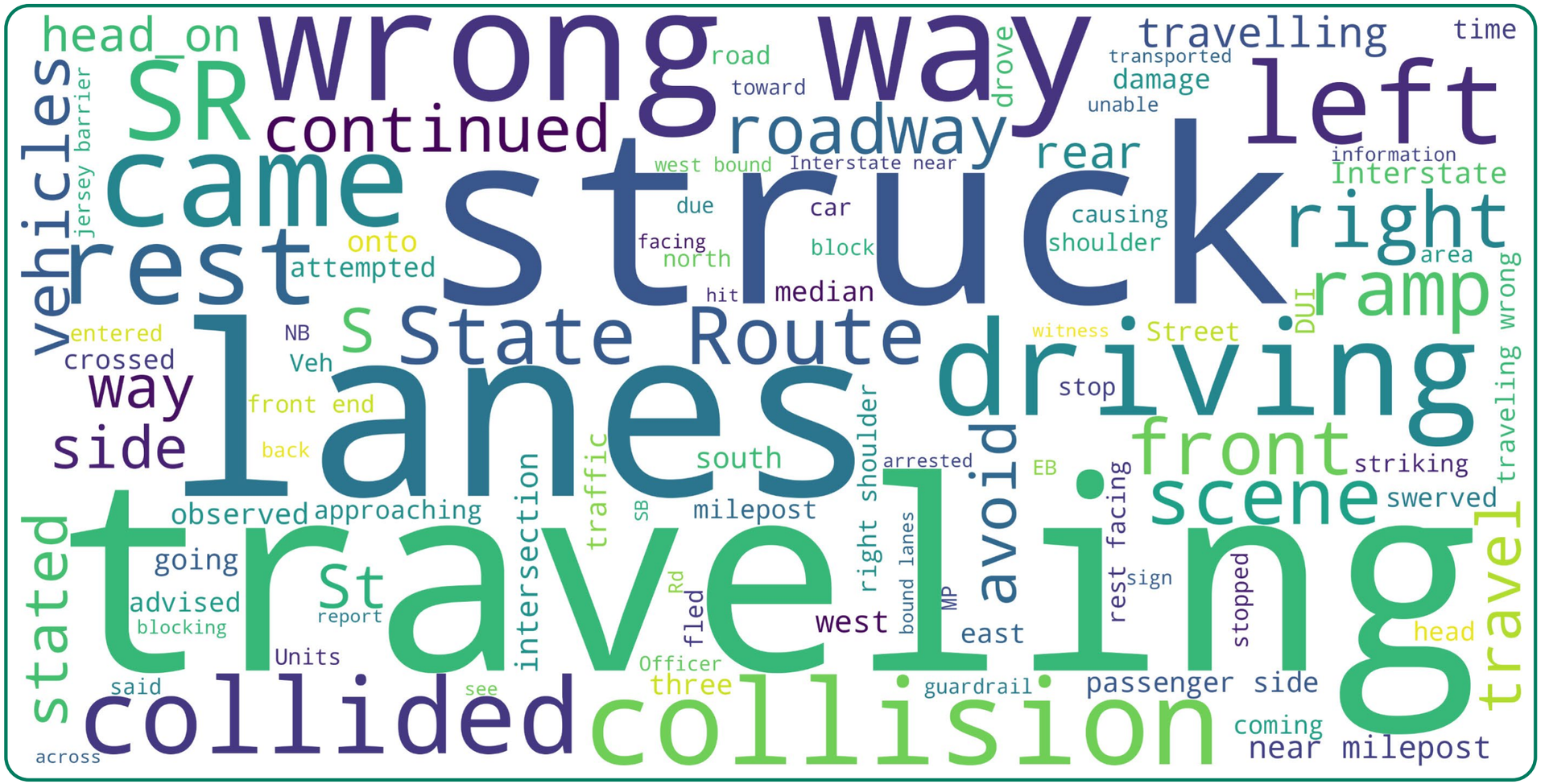
When examining driver age, 16.8% of WWD crashes involved older drivers (65 years and older), while the majority, 83.2%, did not. Although older drivers account for a smaller proportion of WWD incidents, their involvement remains noteworthy and warrants attention for targeted safety measures.

Driver distraction played a relatively minor role, with only 12% of WWD crashes attributed to distracted driving, while 88% showed no evidence of distraction.

WWD Data Analysis

As part of the analysis of WWD crashes, police crash narratives provide valuable insight into the circumstances and contributing factors associated with these incidents. To identify recurring themes, a word cloud was generated based on WWD police crash report narratives.

This word cloud, generated from Wrong-Way Driving (WWD) police crash report narratives, highlights the most frequently used terms associated with these incidents. The prominent appearance of words like “wrong,” “way,” “struck,” “lanes,” “traveling,” and “collision” reflects the common characteristics of WWD crashes, including vehicles traveling in the wrong direction and colliding with others. Key terms such as “head-on” and “DUI” emphasize the severe nature of these crashes, where head-on collisions and impaired driving are recurring themes. Words like “ramp,” “left,” “right,” and “roadway” suggest that WWD incidents frequently occur on access ramps, divided highways, or involve navigation errors related to directional confusion. The recurring themes suggest a critical focus on impaired driving, directional errors, and severe outcomes like head-on collisions, which can inform strategies for prevention and mitigation of WWD incidents.



Washington State Wrong-Way Driving (WWD)

Task 3
Research Best Practices (Final Memo)

Prepared for:

Washington State Department of Transportation

01/31/2025

Introduction

Wrong-way driving (WWD) remains a critical concern for transportation agencies worldwide due to its high rate of severe and fatal collisions.

When drivers inadvertently enter a highway, ramp, or roadway in the opposite direction - often because of confusion, impaired judgment, or unclear signage - the results can be catastrophic. Crashes involving WWD frequently involve head-on or high-speed impacts, increasing the likelihood of serious injuries or fatalities. In response, transportation authorities have developed and implemented various countermeasures, including engineering, education, and enforcement, that aim to reduce the frequency and severity of WWD incidents. Examining these measures in a broader, evidence-based context is essential for finding the cost-effective and impactful solutions.

The primary objective of this memo is to conduct a review of literature and case studies on WWD mitigation. By identifying best practices and successful implementations from other regions, this effort aims to gather insights that can be adapted and applied to enhance WWD mitigation in the identified sites. Ultimately, consolidating these proven techniques and lessons learned will help inform effective policies, design improvements, and technological advancements that address the pressing issue of WWD.

Background

Wrong-way driving (WWD) is a complex issue that requires a multifaceted approach to mitigate effectively. Safety countermeasures for WWD can be broadly categorized into **engineering improvements, education, and enforcement strategies**. These countermeasures aim to address the root causes of WWD, such as driver errors, environmental factors, and geometric design flaws, by providing clear guidance, improving road infrastructure, and promoting safe driving behaviors.

ENGINEERING IMPROVEMENTS

Enhanced Signage and Markings

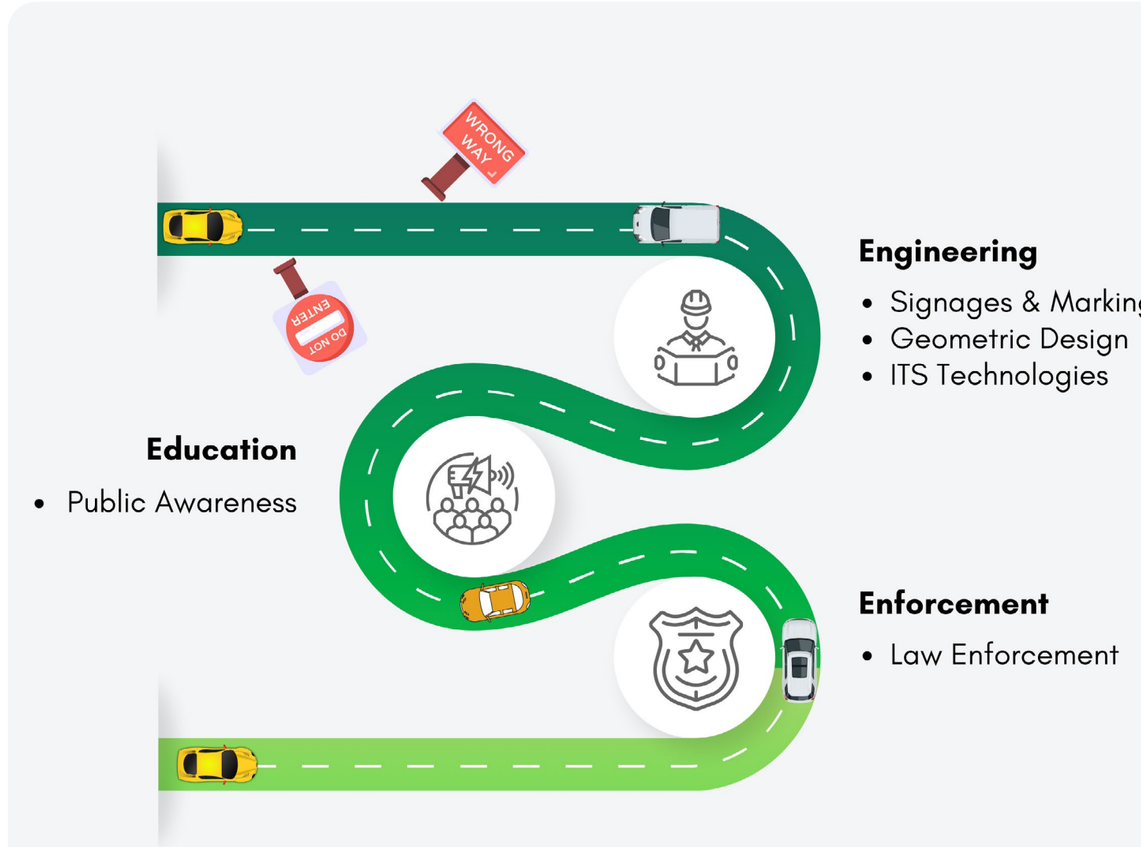
Effective signage and road markings are fundamental in preventing WWD incidents. They serve as the first line of defense by providing clear, unambiguous guidance to drivers, especially in high-risk areas such as interchanges and ramps. Key strategies include:

- **High-Visibility Signs:** Larger, more reflective "Do Not Enter" and "Wrong Way" signs are critical for capturing drivers' attention, particularly in low-light or adverse weather conditions. These signs are often placed at the entrance of exit ramps and other locations prone to WWD.
- **LED-Embedded Signs:** Advanced signage solutions, such as LED-embedded signs that flash when a wrong-way driver is detected, have proven effective in alerting drivers of their mistake. These signs are often integrated with detection systems to provide real-time warnings.
- **Proper Sign Placement:** Ensuring that signs are placed at optimal heights and distances is crucial. Proper placement gives drivers ample time to react and correct their course before entering a highway or ramp in the wrong direction.
- **Clear Lane Markings:** High-visibility, reflective pavement markings help guide drivers, especially at night or during poor weather conditions. Directional arrows painted on the pavement at key decision points can further reinforce the correct travel path.

Geometric Design Improvements

Geometric design flaws are one of the important contributor to WWD incidents. Addressing these issues through targeted design modifications can reduce the likelihood of drivers entering roadways incorrectly.

- **Ramp Configuration:** Redesigning ramps to include clear separation between entry and exit points can minimize confusion. Implementing tighter turning radii on exit ramps discourages wrong-way entry by making it physically difficult for vehicles to turn in the wrong direction.
- **Channelization:** Physical barriers, such as curbs, medians, or raised islands, can effectively separate opposing traffic flows. These barriers prevent drivers from inadvertently entering a roadway in the wrong direction.
- **Dedicated Turn Lanes:** Incorporating dedicated left and right turn lanes at intersections and interchanges can reduce driver confusion and improve traffic flow, thereby lowering the risk of WWD.



Background

Intelligent Transportation Systems (ITS) Technologies
ITS technologies leverage advanced detection and communication systems to identify and respond to WWD incidents in real time. These systems can be integrated with other countermeasures for maximum impact.

- **Dynamic Message Signs (DMS):** These electronic signs can display real-time warnings to wrong-way drivers, alerting them to their error and prompting them to turn around. DMS can also notify other drivers of potential hazards.
- **Detection Systems:** Various types of detectors are used to identify wrong-way vehicles, including Radar Detectors, Infrared Detectors, Inductive Loop Detectors, and Video Detection Systems
- **Connected Vehicle Technology:** This emerging technology enables communication between vehicles and infrastructure. When a wrong-way driver is detected, alerts can be sent directly to the driver's vehicle, providing an immediate warning.

EDUCATION AND ENFORCEMENT
While engineering and technological solutions are critical, addressing human factors through education and enforcement is equally important. These strategies aim to raise awareness about the dangers of WWD and deter risky driving behaviors.

- **Public Awareness Campaigns:** Educational campaigns can inform drivers about the risks of WWD and the importance of paying attention to signage and road markings. These campaigns often target high-risk groups, such as impaired or elderly drivers.
- **Law Enforcement:** Increased police presence in areas with high WWD incidents can deter wrong-way driving. Strict penalties for offenders, such as fines or license suspensions, reinforce the seriousness of the issue.

Countermeasure	Pros	Cons
Enhanced Signage and Pavement Markings	• Provides clear guidance to drivers, reducing confusion. • Cost-effective and easy to implement. • Increases visibility, especially during adverse weather conditions.	• Requires regular maintenance to ensure visibility.
Geometric Design Improvements	• Physically prevents wrong-way entries through design. • Long-term solution with lasting effects. • Reduces reliance on driver compliance.	• High implementation costs due to construction. • May require long time to design and build. • Potential disruption to traffic during construction phases.
ITS	• Provides real-time detection and alerts. • Can notify both wrong-way drivers and right-way drivers. • Allows for data collection to analyze WWD incidents.	• High installation and maintenance costs. • Potential for technical malfunctions or false positives. • Requires integration with existing traffic management systems.
Public Awareness Campaigns	• Educates drivers about the dangers of WWD. • Encourages safer driving behaviors. • Can reach a wide audience through various media channels.	• Effectiveness may diminish over time without ongoing efforts. • Difficult to measure direct impact on WWD incidents. • Relies on drivers retaining and applying the information provided.
Law Enforcement Initiatives	• Deters impaired or reckless driving through increased patrols. • Allows for immediate intervention when WWD is detected. • Reinforces the seriousness of WWD violations.	• Resource-intensive, requiring manpower. • Limited coverage area at any given time. • May not prevent initial wrong-way entry but can respond after detection.

Safety Countermeasures

Florida Department of Transportation

BACKGROUND AND MOTIVATION[1]

Florida Department of Transportation (FDOT) has been actively addressing WWD events as part of its Vision Zero initiative and Vital Few safety priorities. Recognizing WWD as a major safety issue, FDOT launched a systematic approach beginning in 2014 after several high-profile crashes. Since then, FDOT has conducted research and implemented statewide countermeasures for both freeways and arterial roads. The initiative began with two small pilot projects in Tampa Bay and the Panhandle region, which included:

- Red internally illuminated raised pavement markings
- Red rectangular rapid flashing beacons (RRFBs)

These early-stage countermeasures provided data for broader implementation across Florida.

RESEARCH AND DATA-DRIVEN APPROACH[2]

FDOT has conducted a timeline of studies to identify WWD hotspots and evaluate countermeasure effectiveness. Key milestones include:

- Statewide Wrong-Way Crash Study (April 2015): Analyzed WWD crash frequency and severity.
- Human Factors Driving Simulator Studies (November 2015): Conducted by Florida State University (FSU) to evaluate driver responses.
- Comparing Seven WWD Countermeasures (March 2017): Led by the Center for Urban Transportation Research (CUTR).
- Video Detection Systems for Freeway Mainlines (November 2018): Evaluated ITS-based detection technologies.
- Data-Driven Hotspot Analysis (November 2018 - FIU): Used crash data and roadway characteristics to prioritize high-risk locations.
- Countermeasure Implementation Plan (March 2019): A systematic strategy to deploy enhanced signage, ITS solutions, and roadway improvements.
- Arterial and Collector Roadway Countermeasure Guidelines (June 2021 Bulletin, FDM 2022 Update): Expanded WWD prevention beyond freeways.

COUNTERMEASURE IMPLEMENTATION[1&3]

To effectively mitigate WWD incidents, FDOT has implemented a multi-faceted approach that combines enhanced roadway design, advanced detection technologies, and strategic safety countermeasures to proactively prevent and respond to wrong-way entries.

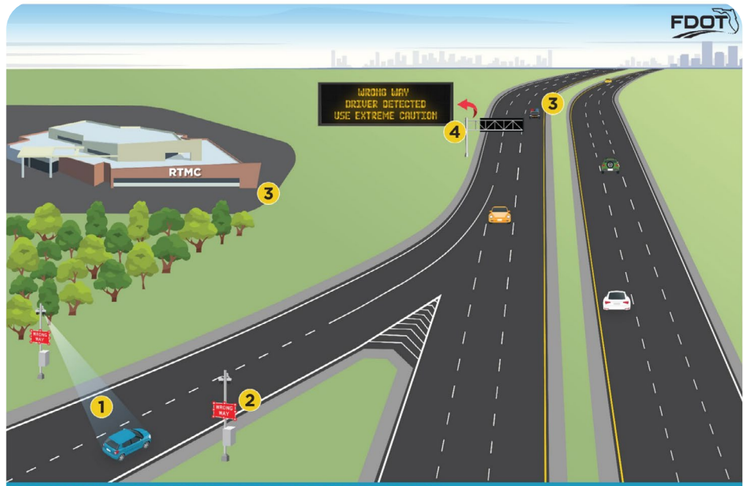
Enhanced Signage and Pavement Markings

- “Do Not Enter” and “Wrong Way” signs strategically placed at key locations.
- Larger and more visible signs installed at lower heights for better driver visibility.
- Directional pavement arrows and pavement shields to guide drivers.
- LED-enhanced “Do Not Enter” and “Wrong Way” signs and blank-out “Wrong Way” signs with flashing beacons that activate upon detection of a wrong-way vehicle.

ITS for Detection and Prevention

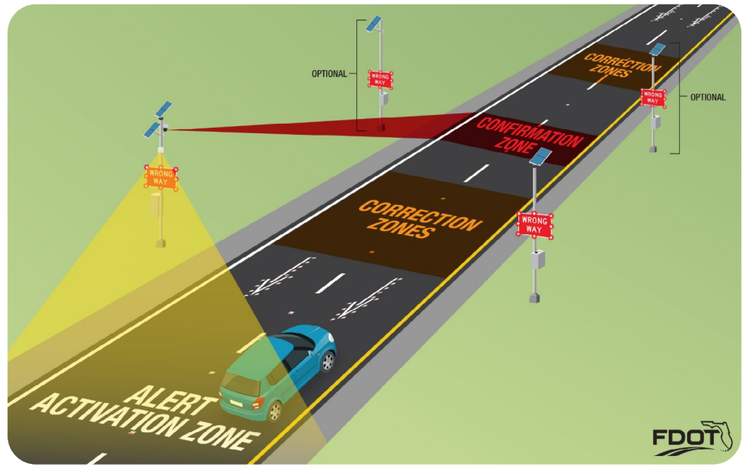
FDOT has developed a Wrong-Way Vehicle Detection System (WWVDS) integrated with Traffic Management Centers (TMCs) for real-time monitoring and intervention. The system includes:

- LED-flashing “Wrong Way” signs that activate when a wrong-way vehicle is detected.
- Video analytics for detecting WWD vehicles.
- DMS to alert right-way traffic.
- Automated alerts to Florida Highway Patrol (FHP) for quick response.
- Multiple detection technologies including radar-based detection systems, thermal and camera-based verification, and delineator embedded with detection sensors.



HOW WRONG-WAY VEHICLE DETECTION SYSTEM WORKS

1. **Detects Vehicle:** Signs located on the exit ramps use system to detect vehicle traveling the wrong way.
2. **Triggers lights:** Flashing lights are turned on along sign border to alert the driver he/she is traveling in the wrong direction.
3. **Notifies officials:** Detection system sends alert immediately to operators at an FDOT Regional Transportation Management Center (RTMC) and law enforcement officials.
4. **Alerts other drivers:** RTMC system broadcasts a wrong-way driver alert on message boards along the freeway.



[1] AASHTO Innovation Initiative (AII) Wrong Way Driver Systemic Approach Webinar, https://aii.transportation.org/Documents/AII%20Wrong%20Way%20Driver%20Systemic%20

[2] Implementation of WrongWay Driving Countermeasures for Arterials and Freeways, https://aii.transportation.org/Documents/2022%20AII%20WWD%20Spring%20Meeting%20FINAL.pdf

[3] FDOT Systemic Approach to Wrong Way Driving Safety: Effective Practices Brief, https://aii.transportation.org/SiteAssets/Pages/Systemic-Approach-to-Wrong-Way-Driver-Safety/AASHTO_AII_WWD_Effective_Practices_Brief_Florida_DOT_v3.pdf Approach%20Presentation.pdf

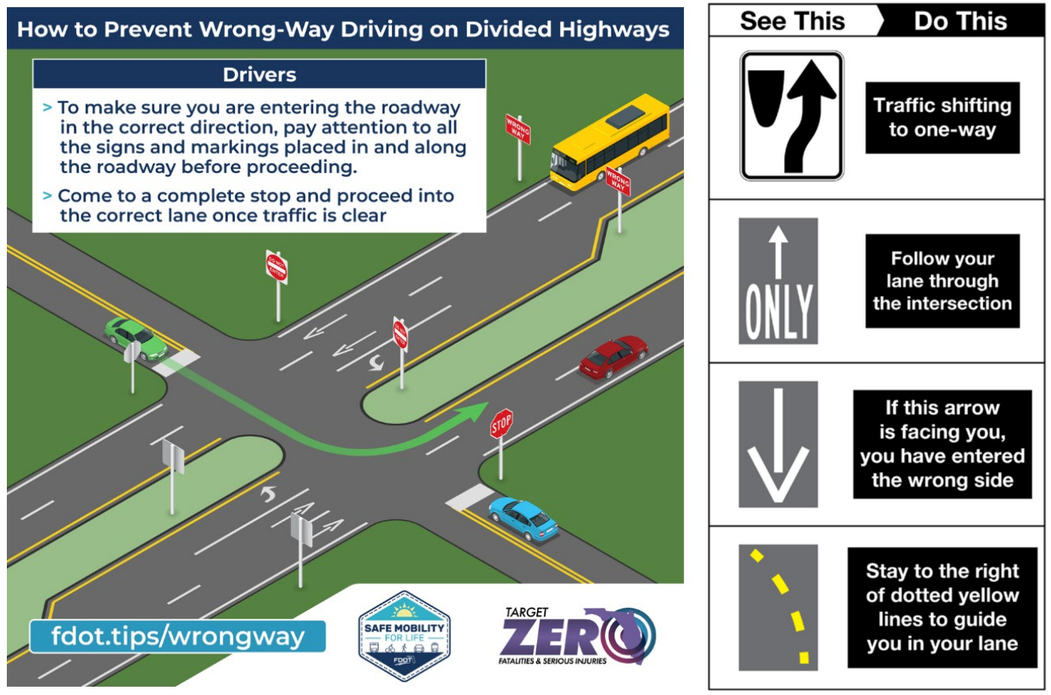
Safety Countermeasures

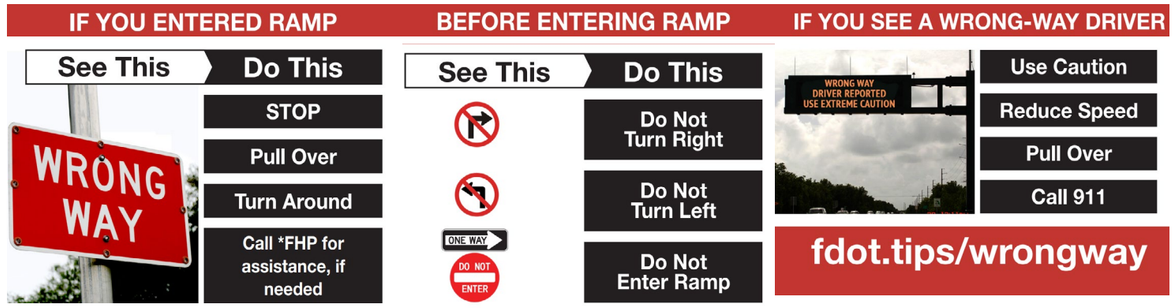
Florida Department of Transportation

WWD DASHBOARD AND REAL-TIME MONITORING SYSTEMS[1&2]

FDOT has developed a GIS-based WWD Safety Countermeasures Dashboard to enhance its efforts in mitigating WWD incidents. This dashboard provides data on both freeway and arterial WWD crashes across the state, encompassing over a decade of processed information. It also tracks the deployment status of various countermeasures, including signage, pavement markings, and ITS solutions.

Additionally, FDOT has implemented the Wrong-Way Driving Alert Viewer, a tool designed to monitor and manage WWD incidents in real-time. This system integrates with detection technologies to provide immediate alerts to TMCs and law enforcement agencies, facilitating rapid response to potential WWD events.





DESIGN MANUAL UPDATES & STANDARDIZATION[3]

FDOT updated FDM Section 230.4 to mandate higher standards than the MUTCD for wrong-way pavement markings, sign placement and specifications (e.g., additional wrong-way signage, red retroreflective strips, enhanced pavement markings for better visibility, etc.), and integration with arterial safety programs. Moreover, the FDOT Approved Product List (APL) now includes pre-certified WWVDS vendors.

EDUCATIONAL INITIATIVES[4]

FDOT places a strong emphasis on education as a pivotal component of its Strategic Highway Safety Plan. By enhancing public awareness and understanding of WWD dangers and preventive measures, FDOT aims to reduce the frequency and severity of these crashes.

FDOT has developed both print and digital resources to educate drivers about WWD countermeasures on the Interstate system. These materials guide drivers on actions to take if they inadvertently enter a ramp incorrectly or encounter a wrong-way driver. Drivers are encouraged to familiarize themselves with these indicators to respond appropriately and enhance roadway safety. Through these educational efforts, FDOT aims to empower drivers with the knowledge and tools necessary to prevent WWD incidents and promote safer travel throughout Florida.

EFFECTIVENESS AND RESULTS[5]

FDOT's multi-tiered approach has reduced WWD incidents across Florida. Key outcomes include:

- 35 Florida Turnpike exit ramps (2014-2021) recorded 159 confirmed wrong-way entries, of which 155 (98%) self-corrected after encountering LED-highlighted signs.
- 88% of freeway ramps in Florida now include enhanced signage and pavement markings.
- Expansion of WWD countermeasures to arterials and collectors, with new guidelines in FDM 230.4.

[1] National Operations Center of Excellence (NOCoE), https://transportationops.org/case-studies/fdots-wrong-way-driving- program
[2] FDOT Sunguide Alert Viewer, https://sav.fdot.gov/login
[3] AASHTO Innovation Initiative (AII) Wrong Way Driver Systemic Approach Webinar, https://aii.transportation.org/Documents/AII%20Wrong%20Way%20Driver%20Systemic%20Approach%20Presentation.pdf
[4] FDOT's Wrong-Way Driving (WWD) Program, https://www.fdot.gov/traffic/teo-divisions.shtm/cmt/Wrong-Way-driving#Research
[5] FDOT Systemic Approach to Wrong Way Driving Safety: Effective Practices Brief, https://aii.transportation.org/SiteAssets/Pages/Systemic-Approach-to-Wrong-Way-Driver-Safety/AASHTO_AII_WWD_Effective_Practices_Brief_Florida_DOT_v3.pdf

Safety Countermeasures

California Department of Transportation

BACKGROUND[1]

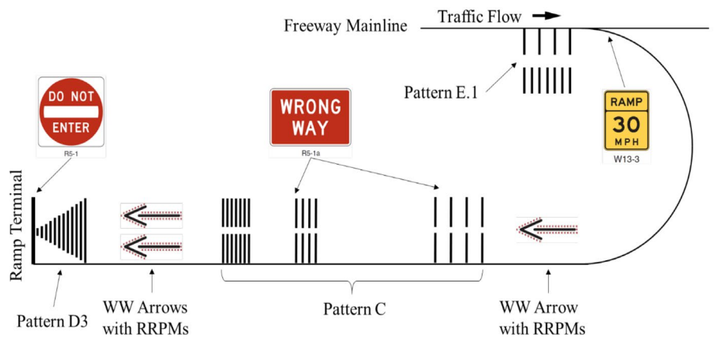
California Department of Transportation (Caltrans) has developed and tested a range of engineering countermeasures to enhance WWD detection, deterrence, and prevention. By combining enhanced conventional treatments with novel technological solutions, Caltrans aims to systematically reduce WWD-related crashes across California.

ENGINEERING COUNTERMEASURES FOR WWD[1,2,3]

Caltrans has employed a combination of enhanced conventional countermeasures and innovative treatments aimed at addressing the root causes of WWD. These efforts focus on making countermeasures more visible and effective for all drivers, particularly intoxicated individuals who are overrepresented in WWD crashes.

Enhanced Pavement Markings and Signage

- Enlarged “DO NOT ENTER” and “WRONG WAY” Signs
  - To improve visibility, Caltrans installed oversized signs, particularly at freeway exit ramps.
  - These larger signs help increase driver awareness, especially under low-visibility conditions.
- LED-Illuminated “DO NOT ENTER” and “WRONG WAY” Signs
  - Flashing LED borders continuously illuminate to catch drivers’ attention as they enter exit ramps incorrectly.
- Two-Way Retroreflective Raised Pavement Markers (RPMs)
  - These markers, implemented at 60 exit ramps provide visual cues to both right-way and wrong-way drivers by reflecting red for wrong-way movements and clear for right-way traffic.
- Bidirectional Pavement Markings
  - Caltrans piloted specialized pavement markings with a biangular profile.
  - These markings produce bidirectional visibility with unidirectional messaging.
  - Additionally, these thermoplastic panels enhance nighttime visibility, even for impaired drivers.
- Directional Rumble Strips
  - Installed at selected locations to generate vibrations that provide haptic feedback to intoxicated or inattentive drivers.

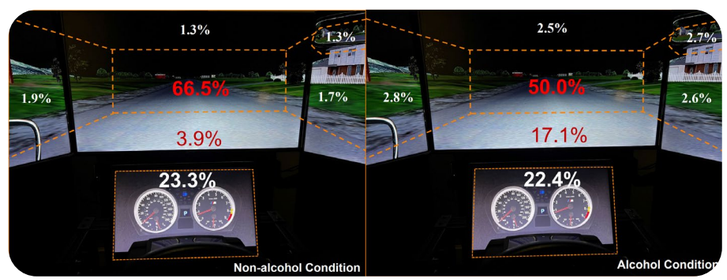


Technology-Based Wrong-Way Driver Detection Systems

- Active Detection and Alert Systems
  - Radar-based WWD detection and notification systems were installed at pilot locations in San Diego and Sacramento.
  - These systems use thermal imaging sensors with infrared illumination to improve detection accuracy.
  - Upon detecting a wrong-way vehicle, the system triggers flashing beacons and sends an immediate notification to Caltrans TMCs and the California Highway Patrol (CHP).
- Video-Based Site Monitoring (VBSM) Systems
  - Caltrans partnered with UC Davis to develop a video-based monitoring system that independently assesses the effectiveness of detection systems. This system helped identify the precise locations and characteristics of WWD events.

RESEARCH & SIMULATION TESTING OF COUNTERMEASURES[1&3]

Caltrans is involved in research to assess the effectiveness of various WWD countermeasures, particularly for intoxicated drivers. In collaboration with Auburn University, Caltrans conducted studies using intoxicated drivers in simulators to evaluate their responses to different countermeasures. **These studies confirmed that flashing LED-bordered signs were highly effective in deterring wrong-way entries. Eye-tracking technology revealed that intoxicated drivers are more likely to focus on the road directly in front of them, emphasizing the importance of in-road warnings like bidirectional pavement markings.**



[1] AASHTO Innovation Initiative (AII) Wrong Way Driver Systemic Approach Webinar, https://aii.transportation.org/Documents/AII%20Wrong%20Way%20Driver%20Systemic%20Approach%20Presentation.pdf
[2] Caltrans Systemic Approach to Wrong Way Driving Safety: Effective Practices Brief, https://aii.transportation.org/SiteAssets/Pages/Systemic-Approach-to-Wrong-Way-Driver-Safety/AASHTO_AII_WWD_Effective_Practices_Brief_Caltrans_FINAL.pdf
[3] Deterrence and Detection of Wrong-Way Drivers on California Highways, https://aii.transportation.org/Documents/Caltrans%20Wrong%20Way%20Driver%20Presentation.pdf

Safety Countermeasures

California Department of Transportation

GPS-BASED WRONG-WAY DRIVER ALERT SYSTEMS[1,2,3]

Caltrans, in partnership with Bosch Mobility Solutions and UC Davis, is testing a GPS-based warning system that detects wrong-way movements using mobile devices. This system sends alerts to wrong-way drivers and nearby motorists, potentially mitigating collisions before they occur.

EDUCATION AND PREVENTION

Caltrans has implemented a Wrong-Way Driver Education and Prevention campaign to address the alarming rise in WWD incidents. The centerpiece of this initiative is the "DON'T MIS TAKE A LIFE" campaign, designed to underscore the severe consequences of wrong-way driving. Key messages include:

- "RED REFLECTORS MEAN WRONG WAY": Educating drivers that encountering red reflectors indicates they are traveling in the wrong direction.
- "IMPAIRED DRIVERS MAKE WRONG WAY DRIVERS": Highlighting the strong correlation between impaired driving and wrong-way incidents.

These messages are disseminated through various channels, including billboards, social media, bus advertisements, print media, and transit shelters, ensuring widespread reach across diverse audiences.

PILOT PROJECT OUTCOMES AND EFFECTIVENESS[3]

- Retroreflective raised pavement markings
  - The installation of retroreflective pavement markers resulted in a 44% reduction in wrong-way driving incidents reported by the CHP in District 11 (San Diego).
- LED-Illuminated Signs
  - Exit ramps equipped with LED-illuminated "DO NOT ENTER" signs saw a 60% reduction in WWD incidents reported by the CHP.
- Active Detection Systems
  - The active detection systems showed a 53% reduction in wrong-way driving events on monitored exit ramps in District 3. However, the systems also recorded some false positives, highlighting the need for continued refinement.

Iowa Department of Transportation

BACKGROUND[1]

Iowa Department of Transportation (DOT) has implemented a systemic approach to wrong-way driver detection and deterrence, emphasizing cost-effective, data-driven strategies to reduce incidents across the state. This initiative, supported by a $1.5 million Highway Safety Improvement Program (HSIP) grant, aimed to deploy low-cost systemic countermeasures while also incorporating technology for targeted interventions at high-risk locations.

NETWORK SCREENING AND RISK ASSESSMENT[1]

Iowa DOT undertook a network screening process to identify priority locations for WWD countermeasures. The screening process considered seven key factors:

- Crash History – Prior WWD crashes and severity levels.
- Traffic Volume – Higher traffic volumes increase the likelihood of multi-vehicle collisions.
- Geometric Design – Certain interchange types, such as parclos, demonstrated higher risk.
- Non-Crash Events – Reports of WWD incidents without collisions.
- Urbanization – Proximity to liquor stores and bars, which correlate with impaired driving.
- Driver Demographics – Acknowledging the role of elderly and impaired drivers.
- Environmental Factors – Lighting conditions and roadway visibility.

Through this analysis, Iowa DOT identified 165 high-risk locations, including both freeway interchanges and at-grade intersections, for implementing systemic safety treatments.

[1] AASHTO Innovation Initiative (AII) Wrong Way Driver Systemic Approach Webinar, https://aii.transportation.org/Documents/AII%20Wrong%20Way%20Driver%20Systemic%20Approach%20Presentation.pdf
[2] Caltrans Systemic Approach to Wrong Way Driving Safety: Effective Practices Brief, https://aii.transportation.org/SiteAssets/Pages/Systemic-Approach-to-Wrong-Way-Driver-Safety/AASHTO_AII_WWD_Effective_Practices_Brief_Caltrans_FINAL.pdf
[3] Deterrence and Detection of Wrong-Way Drivers on California Highways, https://aii.transportation.org/Documents/Caltrans%20Wrong%20Way%20Driver%20Presentation.pdf

Safety Countermeasures

Iowa Department of Transportation

ENGINEERING COUNTERMEASURES[1&2]
Iowa DOT implemented low-cost, high-impact countermeasures that align with a systemic approach:

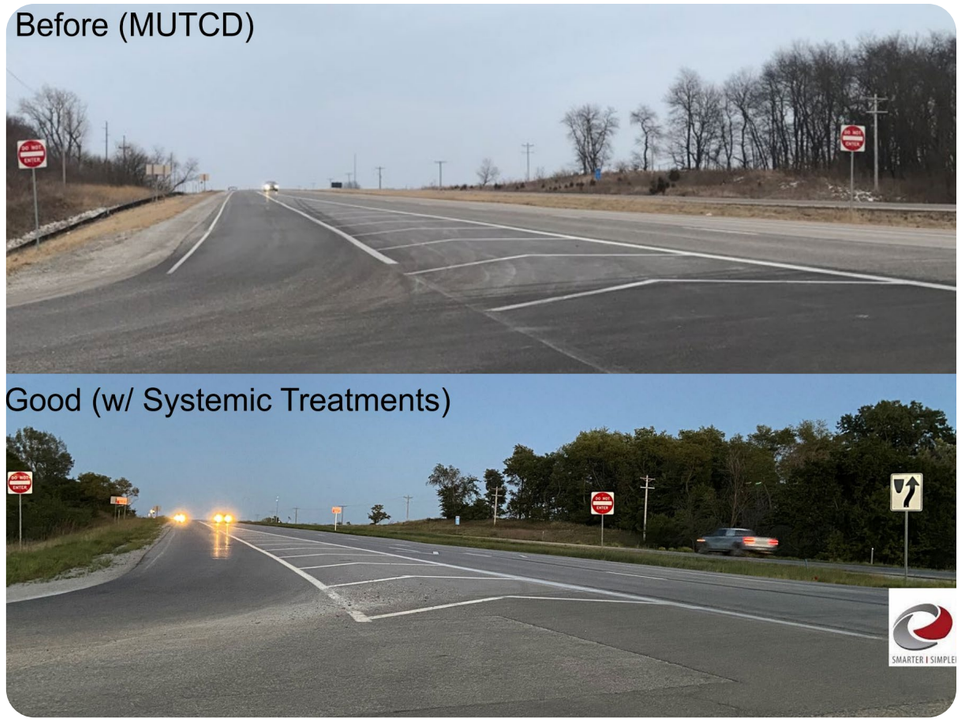
Enhanced Signage & Pavement Markings
- Increased the size of “Do Not Enter” and “Wrong Way” signs from the standard 36x36 inches to 48x48 inches, improving visibility.
- Strategically positioned signs where wrong-way drivers are most likely to look, such as at eye level and near the stop bar.
- Placed signs on both the left and right sides of the roadway for maximum effectiveness.
- Enhanced pavement markings with wrong-way arrows, supplemented by additional “Do Not Enter” messages on the roadway.
- Addition of “RAMP” plaques under DO NOT ENTER signs, which proved highly effective in discouraging intentional wrong-way entries.
- Adjustments to left-turn lane configurations to reduce potential wrong-way movements.
- Implemented acceleration lanes at select at-grade intersections,

ITS-Based Wrong-Way Driver Detection
- Iowa DOT deployed 62 camera-based detection systems equipped with video analytics to identify WWD incidents in real-time.
- These systems send alerts to TMCs, enabling quick law enforcement response.

RESULTS AND EFFECTIVENESS[2]
Preliminary results from Iowa DOT’s 2021–2023 evaluation show the following improvements:

- 94% reduction in WWD incidents at partial cloverleaf interchanges with enhanced signage & pavement markings.
- 91% reduction in WWD incidents at ramp terminals with added “RAMP” plaques.
- 76% reduction in WWD incidents after changing left-turn lane arrows near exits.
- 62% decrease in WWD incidents after implementing MUTCD Treatment 2B-19 at ramp terminals.
- 55% reduction in nighttime WWD incidents by disconnecting power to certain luminaires at divided highway intersections.
- 71% reduction in WWD incidents at 4-lane divided highway intersections after adding acceleration lanes.


“Gateway” for Folded Diamonds



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[2] Iowa Systemic Approach to Wrong Way Driving Safety: Effective Practices Brief, https://aii.transportation.org/SiteAssets/Pages/Systemic-Approach-to-Wrong-Way-Driver-Safety/AASHTO_AII_WWD_Effective_Practices_Brief_Iowa_FINAL.pdf

Safety Countermeasures

Michigan Department of Transportation

BACKGROUND[1]

Michigan Department of Transportation (MDOT) conducted an study to address WWD events. The initiative stemmed from concerns raised by engineers within MDOT, despite a lack of public outcry or upper management directives. The goal was to systematically analyze WWD crashes and implement low-cost, systemic countermeasures.

ANALYSIS OF WWD CRASHES IN MICHIGAN[1&2]

MDOT analyzed crash data from 2005 to 2009, identifying 110 WWD crashes on Michigan's freeway system. The findings revealed:

- 32% resulted in a fatality or serious injury.
- 6% of fatal crashes occurred on ramps, while 42% occurred on the mainline.
- Only 35 known entry points were identified, meaning the majority of crashes occurred after vehicles had traveled a significant distance in the wrong direction.
- 57% of crashes occurred between 11 PM and 6 AM, highlighting the link between nighttime driving and WWD incidents.
- The study found that 60% of known WWD entry points were at partial cloverleaf interchanges, despite these accounting for only 24% of all interchanges in Michigan.

ENGINEERING COUNTERMEASURES[1]

MDOT focused on low-cost, systemic improvements to address WWD across 161 identified high-risk interchanges. The following interventions were implemented:

Improved Signage and Pavement Markings

- Lowering the height of "Do Not Enter" and "Wrong Way" signs to 4 feet for improved driver visibility, especially at night.
- Adding reflective strips on signposts to enhance nighttime visibility.
- Placing wrong-way pavement markings and delineators at critical entry points.
- Using corrugated island treatments to better delineate correct travel paths.
- Implementing painted islands between exit and entrance ramps to reinforce proper directional flow.

Enhancing Interchange Design

- Increasing the angle of entrance ramps from 8 degrees to 11 degrees, making it clearer which ramps lead to highways.
- Moving the corrugated median island closer to the roadway (from 30 feet to 20 feet) to improve visibility for drivers on cross streets.
- Improving lighting conditions at identified high-risk interchanges to mitigate night-time wrong-way entries.

ITS Detection System

MDOT piloted active detection and notification systems at high-risk locations, such as I-94 at Sargent Road. These systems included:

- Radar-based detection of wrong-way vehicles.
- Flashing LED signs that activate when a wrong-way driver is detected.
- Immediate alerts sent to Traffic Operations Centers and law enforcement.

IMPACT AND FUTURE INITIATIVES[1&2]

The results of MDOT's systemic approach showed a significant reduction in WWD incidents

- Zero recorded WWD crashes at high-risk locations after treatment.

Looking ahead, MDOT is working to:

- Evaluate the effectiveness of different countermeasures.
- Develop a cost-benefit analysis for future implementations.

[1] AASHTO Innovation Initiative (AII) Wrong Way Driver Systemic Approach Webinar, https://aii.transportation.org/Documents/AII%20Wrong%20Way%20Driver%20Systemic%20Approach%20Presentation.pdf

[2] Michigan Systemic Approach to Wrong Way Driving Safety: Effective Practices Brief, https://aii.transportation.org/SiteAssets/Pages/Systemic-Approach-to-Wrong-Way-Driver-Safety/AASHTO_AII_WWD_Effective_Practices_Brief_Michigan_FINAL.pdf

Safety Countermeasures

Texas Department of Transportation

BACKGROUND[1]

TXDOT's focus on WWD began nearly a decade ago with pilot programs in some of the state's largest cities which included installing a variety of countermeasures on corridors identified as having the most wrong-way drivers. Understanding that many wrong-way drivers are impaired and tend to focus on the pavement directly in front of their vehicles, TxDOT developed countermeasures tailored to this behavior. Additionally, regional agencies like the North Central Texas Council of Governments (NCTCOG) and city-specific programs (e.g., San Antonio's TransGuide) play an important roles in implementing and expanding WWD mitigation efforts.

ENGINEERING COUNTERMEASURES[1]

Improved Signage and Pavement Markings

- Reflective Pavement Arrows: Installed to guide drivers correctly, especially at night when visibility is reduced.
- LED-Enhanced "Wrong Way" Signs: Equipped with flashing LED lights to capture the attention of drivers entering ramps incorrectly.
- Lowered and Reflective Tape-Enhanced Signs: Positioning signs lower to align with the typical line of sight of impaired drivers and adding reflective tape to increase visibility.

ITS Detection Systems

- Radar Detection Modules: Deployed to identify vehicles entering ramps in the wrong direction, triggering alerts to TMCs.
- Thermal Sensors with Artificial Intelligence: Utilized to detect wrong-way vehicles accurately and reduce false alarms.
- Integration with TMCs: Systems like San Antonio's TransGuide receive real-time alerts from detection devices, enabling swift responses to WWD events.

NCTCOG'S WWD MITIGATION PILOT PROGRAM[2]

NCTCOG, in partnership with TxDOT's Dallas and Fort Worth Districts, launched the Wrong-Way Driving Mitigation Pilot Program to tackle WWD incidents in Dallas, Collin, Denton, and Tarrant Counties. This program was divided into two phases:

Phase I: Dallas County (2014)

Improvements were made to 350 diamond interchanges across nine cities, including:

- Removing conflicting pavement markings and lane assignment signs.
- Installing straight arrow pavement markings for directional guidance.
- Enhancing signage placement and LED wrong-way warning systems.
- Expanded to Collin and Denton Counties, reaching Allen, McKinney, Plano, Carrollton (Denton County), and Lewisville.

Phase II: Tarrant County (2015)

This phase focused on 54.2 miles of high-risk freeway corridors. As part of this phase, wrong-way pavement markings, improved signage, and active WWD detection technology were added and installed at the corridors.

SAN ANTONIO'S WWD MITIGATION PROGRAM[3&4]

In 2011, a fatal wrong-way crash killed a San Antonio police officer, prompting action. TxDOT San Antonio District formed a Wrong-Way Driver Task Force with law enforcement, city officials, and researchers. Task force analyzed TransGuide traffic management logs and 911 call records. They found a 15-mile segment of U.S. Highway 281 to be a WWD hotspot, especially at night. Based on these findings, TxDOT implemented several countermeasures:

- "Wrong Way" and "Do Not Enter" signs with red reflective tape on them
- Enlarged "One Way" Signs
- LED-Enhanced Wrong-Way Signs
- Radar-Based Wrong-Way Detection Systems

EFFECTIVENESS[1,3,4]

- In the Fort Worth area, over 90% of wrong-way drivers self-corrected before entering the highway.
- The use of LED-enhanced signs in San Antonio resulted in a 30% decrease in WWD incidents.

[1] Helping to prevent wrong-way drivers, https://www.txdot.gov/about/newsroom/stories/2024/helping-to-prevent-wrong-way-drivers.html
[2] Wrong Way Driving, https://www.nctcog.org/trans/quality/safety/transportation-safety/wrong-way-driving
[3] TxDOT Significantly Curbs Wrong-Way Driving in San Antonio, https://ewscripps.brightspotcdn.com/11/97/2ff9cbbe4fc88d9c0f9c07ef754e/1023-00004-san-antonio-wrong-way-case-study-2021-updated.pdf
[4] Do Not Enter! You're Driving the Wrong Way, https://tti.tamu.edu/researcher/do-not-enter-youre-driving-the-wrong-way/

Safety Countermeasures

Arizona Department of Transportation

BACKGROUND[1]

Arizona Department of Transportation (ADOT) has addressed WWD through a multifaceted program that integrates advanced technology, infrastructure enhancements, public awareness campaigns, and strategic partnerships. This approach aims to detect, deter, and respond to WWD incidents, thereby enhancing road safety across the state.

ENGINEERING COUNTERMEASURES[1&2]

ADOT has undertaken different measures to improve roadway safety and prevent wrong-way entries:

Improved Signage and Pavement Markings

- Enhanced Signage: Installation of larger and lower-mounted “Wrong Way” and “Do Not Enter” signs at hundreds of freeway ramps and overpasses in Phoenix and on rural state highways to increase visibility.
- Pavement Markings: Application of large, white directional arrows on off-ramps, supplemented with reflectors that glow red when approached from the wrong direction, providing an additional visual cue to deter wrong-way driving.

ITS Detection Systems

In January 2018, ADOT launched a wrong-way vehicle detection and warning system along a 15-mile stretch of I-17 in Phoenix. This first-of-its-kind system employs the followings:

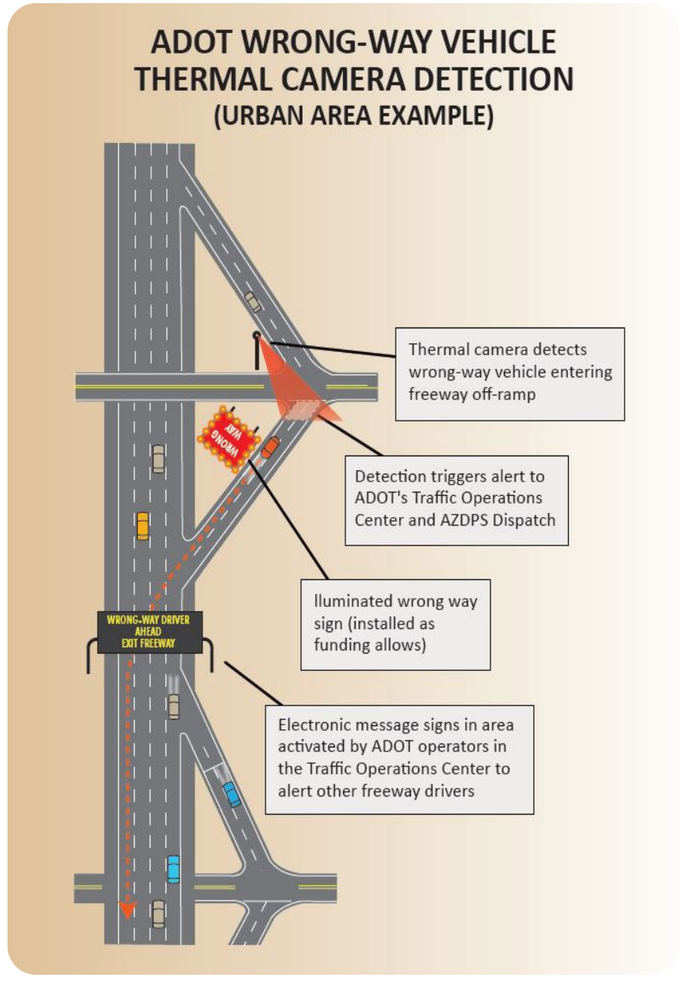
- 90 thermal cameras: Strategically positioned to detect vehicles entering off-ramps or traveling in the wrong direction on the freeway.
- Illuminated Warning Signs: Internally lit “Wrong Way” signs with flashing red lights activate to alert the errant driver.
- Alerts to Authorities: Immediate notifications are sent to ADOT’s Traffic Operations Center and the Arizona Department of Public Safety (DPS), enabling rapid law enforcement response.
- Driver Advisories: DMS inform right-way drivers of the potential danger ahead, advising them to exercise caution or exit the freeway.

EFFECTIVENESS[1&2]

The detection system has proven effective; between its inception and July 2020, it detected over 100 wrong-way vehicles, with more than 85% of drivers self-correcting by turning around on exit ramps before entering the main freeway lanes.

PUBLIC AWARENESS AND EDUCATION[1,2,3]

Recognizing that engineering solutions alone cannot eradicate wrong-way driving, ADOT launched the “Drive Aware, Get There” safety campaign. This initiative educates motorists on how to respond if they encounter a wrong-way vehicle and emphasizes the importance of preventing impaired individuals from driving.



DRIVE AWARE
GET THERE

[1] A big step forward for ADOT’s wrong-way detection and warning system, https://azdot.gov/blog-article/big-step-forward-adots-wrong-way-detection-and-warning-system
[2] Wrong-Way Drivers, https://azdot.gov/about/transportation-safety/wrong-way-drivers
[3] Wrong-Way Drivers: ‘Drive Aware, Get There’ safety campaign, https://focusondriving.com/wrong-way-drivers

Safety Countermeasures

Rhode Island Department of Transportation

BACKGROUND[1]

Rhode Island has addressed WWD through a program initiated by the Rhode Island Department of Transportation (RIDOT). This initiative integrates advanced detection technology and infrastructure enhancements to mitigate the risks associated with WWD and enhance roadway safety across the state.

ENGINEERING COUNTERMEASURES[1&2]

Infrastructure Enhancements

- Signage and Striping Upgrades: Enhancements were made at 145 locations, encompassing over 200 ramps, to improve the visibility and clarity of “Do Not Enter” and “Wrong Way” signs. Pavement markings were also updated to provide clearer guidance to drivers.
- Ramp Redesigns: Certain ramps were reconfigured to make it more challenging for drivers to enter them incorrectly, thereby reducing the likelihood of wrong-way incidents.

ITS Detection Systems

In 2015, RIDOT launched a $2 million project to combat WWD by installing detection systems at 24 high-risk locations throughout the state. The system operates as follows:

- Radar and Camera Detection: Detect vehicles entering highway off-ramps in the wrong direction. The system also captures real-time images and videos of the violating vehicle for monitoring and incident analysis.
- Automated Warning System for Drivers: Activate flashing “Wrong Way” LED signs immediately when a wrong-way vehicle is detected.
- Integration with TMCs: Send real-time notifications to RIDOT’s TMC and the Rhode Island State Police. Operators at the TMC monitor footage and coordinate with law enforcement for immediate response.
- DMS for Other Drivers: Display alerts to warn right-way drivers on highway about an active wrong-way vehicle.

EFFECTIVENESS[2]

The implementation of these measures has yielded positive results. Between May 2015 and November 2022, ramps equipped with detection systems experienced only one wrong-way crash and zero fatalities. In contrast, during the seven years prior to the installation (January 2010 to May 2015), there were 34 crashes and 13 fatalities attributed to WWD.

Ohio Department of Transportation

ITS DETECTION SYSTEMS[3,4,5]

In 2024, Ohio Department of Transportation (ODOT) introduced Ohio’s first “wrong-way detection corridor” in Cuyahoga County, encompassing 25 exit ramps along I-71 and I-90 between West 154th Street and East 140th Street. This $3.2 million project employs advanced technology to detect and alert wrong-way drivers:

- Detection Mechanism: Sensors installed at exit ramps identify vehicles entering in the wrong direction.
- Driver Alerts: Upon detection, flashing “Wrong Way” signs with lighted borders are activated to warn the driver of their error.
- Real-Time Notifications: The system sends immediate alerts to ODOT’s TMC in Columbus, providing video clips to confirm the presence of a wrong-way driver. Local law enforcement is then promptly notified to respond to the situation.

[1] Wrong Way Crash Avoidance, https://www.dot.ri.gov/safety/wrong_way_safety.php
[2] Rhode Islands Wrong-Way Detection Systems Are Working, https://www.roadsbridges.com/road-traffic-safety/news/21545525/rhode-islands-wrong-way-detection-systems-are-working
[3] Ohio DOT Installing New Wrong Way Detection System, https://aashtojournal.transportation.org/ohio-dot-installing-new-wrong-way-detection-system/
[4] ODOT working to prevent wrong-way crashes in the state, https://www.youtube.com/watch?v=za1IBx_xfpw
[5] Ohio’s first ‘wrong way detection corridor’ installed at 25 Northeast Ohio highway exits , https://www.youtube.com/watch?v=V63lW8k-prs&t=11s

Safety Countermeasures

Ohio Department of Transportation

ITS DETECTION SYSTEMS[1]

This corridor for the detection system was selected based on a statewide analysis of wrong-way crashes from 2016 to 2019, considering factors such as the proximity of bars and restaurants to highway ramps and the frequency of alcohol-related incidents.

In addition to the initial implementation, ODOT has expanded wrong-way detection systems to other high-risk areas in Cincinnati, Dayton, and Columbus.

EFFECTIVENESS[1]

Collectively, the systems in Cincinnati, Dayton, and Columbus have detected nearly 300 wrong-way drivers, demonstrating the effectiveness of technology in enhancing roadway safety.

Nevada Department of Transportation

ITS DETECTION SYSTEMS[2&3]

Nevada Department of Transportation (NDOT) has installed 37 wrong-way driver detection systems across Nevada, including on U.S. 395 in the North Valleys. The system operates as follows:

- Radar sensors & cameras: Detect wrong-way vehicles at off-ramps. Live footage helps confirm incidents for quick response.
- Flashing “Wrong Way” signs: Activate instantly and lower-mounted signage (4 ft) targets impaired drivers.
- Integration with TMCs: Send instant alerts to NDOT’s Traffic Center with live feeds. Nevada Highway Patrol (NHP) notified for immediate interception.
- DMS for Other Drivers: Display alerts to warn right-way drivers about an active wrong-way vehicle.

EXPANSION OF DETECTION SYSTEMS[4&5]

In response to ongoing concerns, NDOT has continued to enhance its wrong-way driver detection infrastructure:

- Southern Nevada Installations: In August 2024, NDOT announced the installation of four wrong-way driver detection systems on interchanges in Southern Nevada, including I-15 at the Starr Avenue ramp and U.S. 95 at the Kyle Canyon, Skye Canyon, and Durango ramps.
- Additional Deployments: Following a fatal wrong-way crash in December 2024, NDOT committed to installing 12 new wrong-way warning systems to further mitigate such incidents.

[1]Governor DeWine, ODOT Announce New Technology to Warn Drivers of Dangerous Traffic Congestion, https://governor.ohio.gov/media/news-and-media/governor-dewine-odot-announce-new-technology-to-warn-drivers-of-dangerous-traffic-congestion
[2] NDOT Completes Installation of Wrong Way Driver Detection Systems on I-580 Carson City Freeway, https://www.dot.nv.gov/Home/Components/News/News/7928/395
[3] Wrong Way Driver System, https://nvtim.com/
[4] Dangers of Wrong Way Drivers & the Proposed Plan to Prevent it In Southern Nevada, https://www.bensonbingham.com/dangers-of-wrong-way-drivers-the-proposed-plan-to-prevent-it-in-southern-nevada/
[5] NDOT putting up 12 new wrong-way warning systems after latest deadly crash, https://www.fox5vegas.com/2024/12/13/ndot-putting-up-12-new-wrong-way-warning-systems-after-latest-deadly-crash/

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