Wrong-Way Driving (WWD) Analysis

NCTCOG Regional Safety Advisory Committee

July 25, 2025

Meeting Agenda

Parisa Hosseini, PhD
ITS Engineering Specialist
Mobility Technology, COE

- Why This Matters
- Background
- WSDOT WWD Project
- Conclusions

STV
Market Sectors

Transportation

Airports

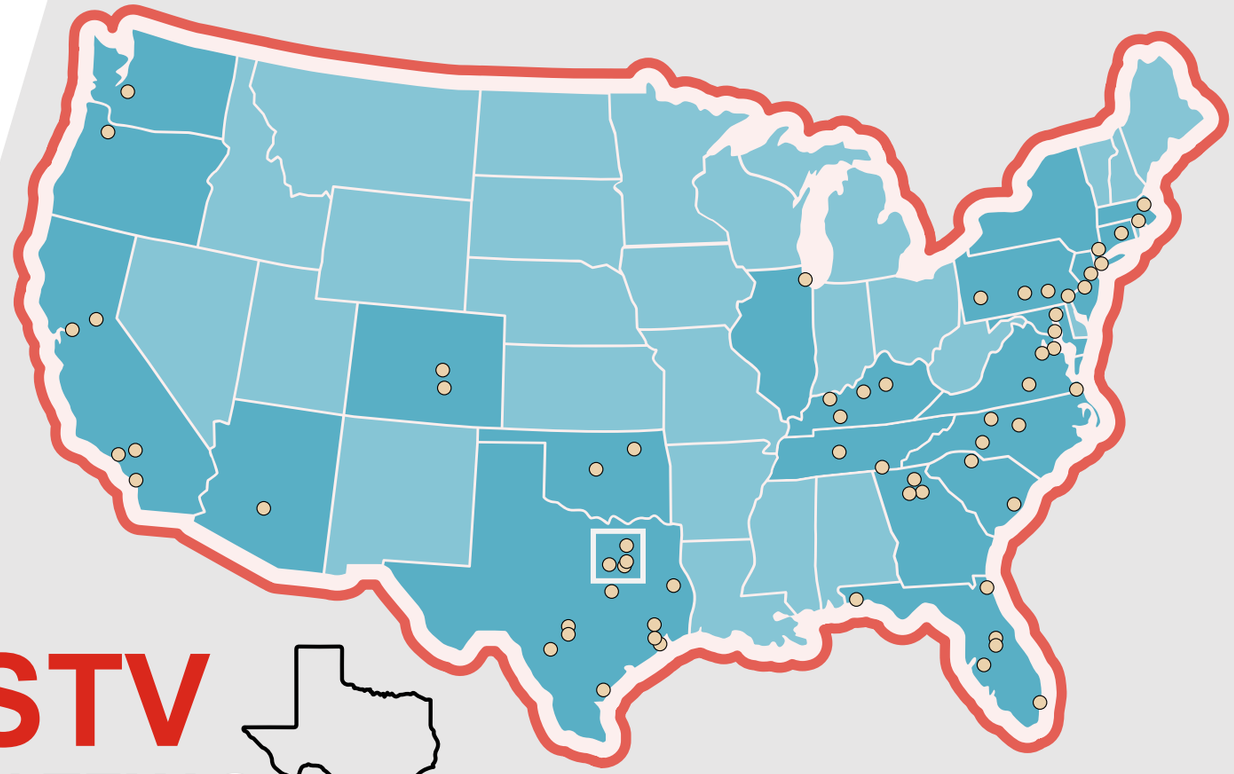
Transit and Rail

Buildings
Corporate, Commercial, State and Municipal

Federal Programs

Water

The STV Centers of Excellence are national practices that partner with our Operating Groups.



STV
IN TEXAS

- Established in Dallas **since 1980**
- SAME Member **since 1968**
- 400 employees in Texas/Oklahoma

Background

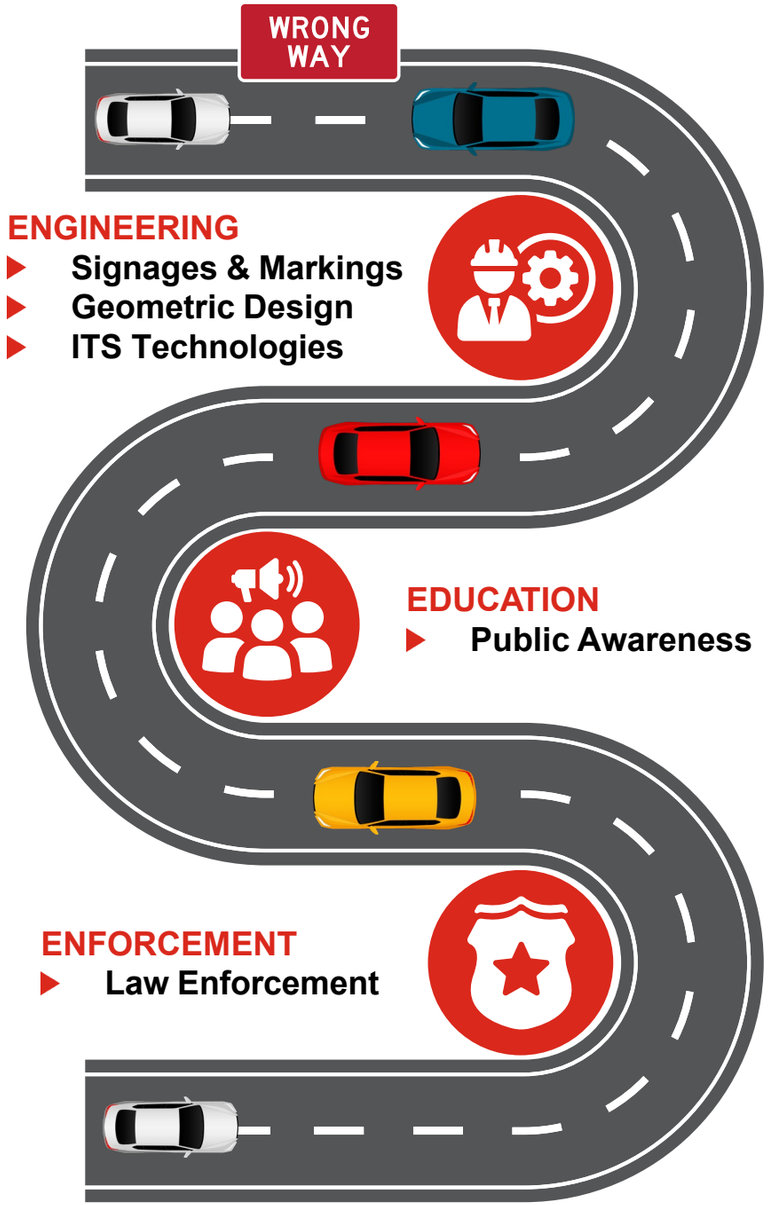
- WWD is the act of traveling against the traffic flow on physically divided highways
- A rate of 1.34 fatalities per WWD fatal crash, while a rate of 1.10 fatalities per fatal crash for other crash types
- Around 460 fatalities per year, an increase from the 360 fatalities per year from 2004 to 2009 reported by NTSB

4,140

WWD Fatalities

3,029

Fatal WWD Crashes from 2012 to 2020 in the US



How We Do It

Data Collection

- Crashes & incidents
- Crash reports
- Google Maps
- Site visit
- Other data sources

Data Analysis

- Network screening
- Potential hotspots
- Potential entry points
- Crash characteristics
- Location characteristics

WWD Score & Countermeasures

- WWD crash score for location ranking (NCHRP Report)
- Safety countermeasures recommendations

WSDOT WWD Project

Objective

To identify and analyze locations across the state with potential for WWD incidents and to develop appropriate draft recommendations to enhance safety on Washington's highway system.

WWD Project Tasks

QAQC

TASK 1: PROJECT MANAGEMENT

- Project Management and Coordination

TASK 2: DATA ANALYSIS

- Region Support
- Location Identifications
- Site Survey

TASK 3: DEVELOP MITIGATION

- Research Best Practice
- Develop Mitigation Measures

TASK 4: FINAL REPORT

- Develop Report to WSDOT
- Assist with Final Report to the Legislature

TASK 2: DATA COLLECTION & ANALYSIS

- 2.1 Assist Region Offices
- 2.2 Identify Locations or Corridors for Countermeasures
- 2.3 Conduct Site Surveys

TASK 2 | Assist Region Offices

Southwest Region (SWR)

- **Plan:** Develop a list of locations for implementing safety measures
- **Data:** Five years of WSDOT State Patrol log of WWD incident data and WWD crashes
- **STV Support:** Discussed their data and location selection, provided answers to their queries, and offered best practices for data analysis

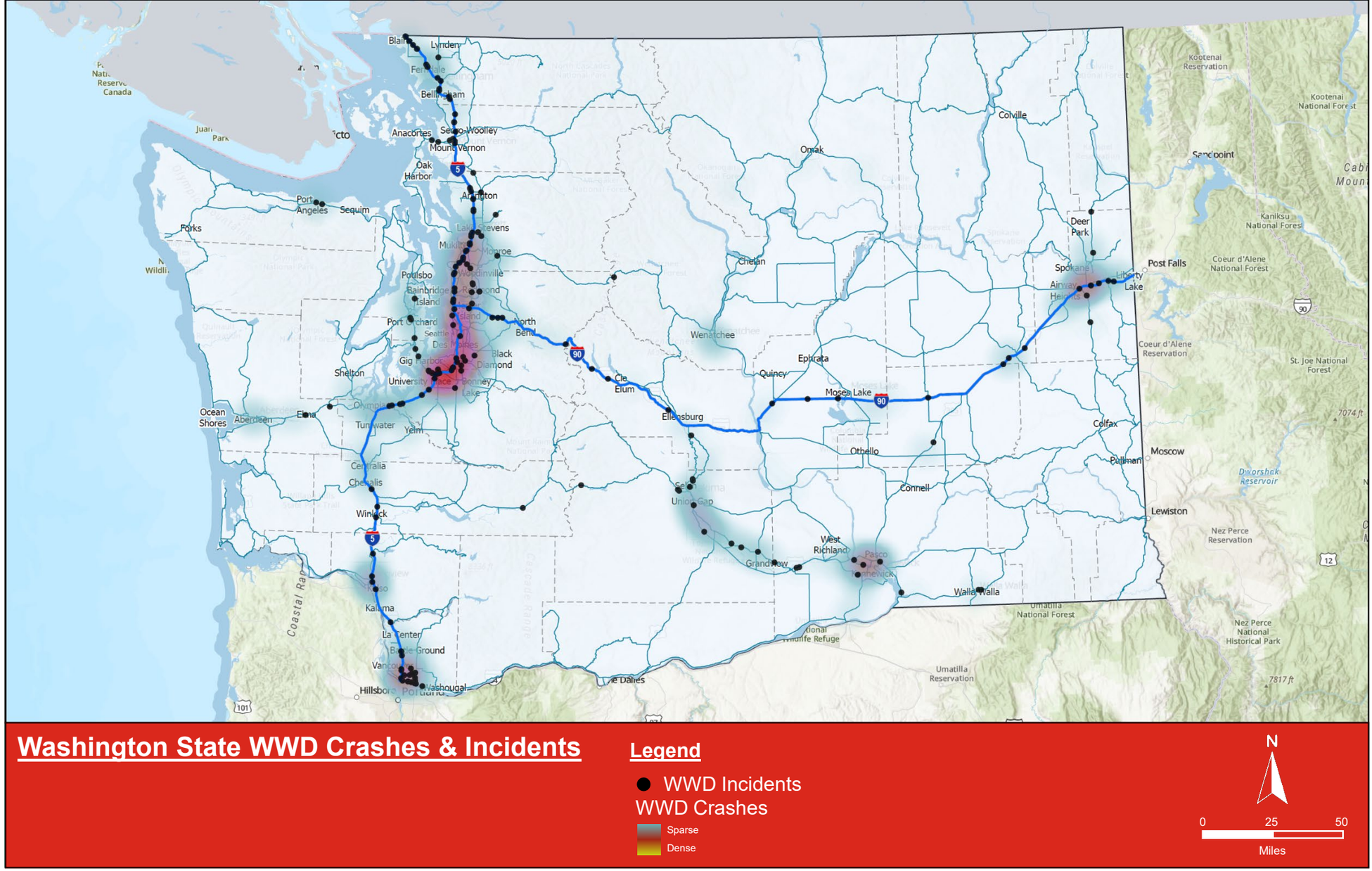
North Central Region (NCR)

- **Plan:** Selected 23 locations for safety measures, including: signage (WWD, OW, DNE, & LED), and striping
- **STV's Support:** Discussed their proposed improvements, suggested additional safety measures, and provided sources for the effectiveness of WWD LED signs

South Central Region (SCR)

- **Plan:** Selected 7 Locations for safety measures, including: signage (WWD, OW, & DNE) and striping
- **STV's Support:** Discussed their proposed improvements and suggested additional safety measures

TASK 2
Data Analysis



TASK 2
Data Analysis

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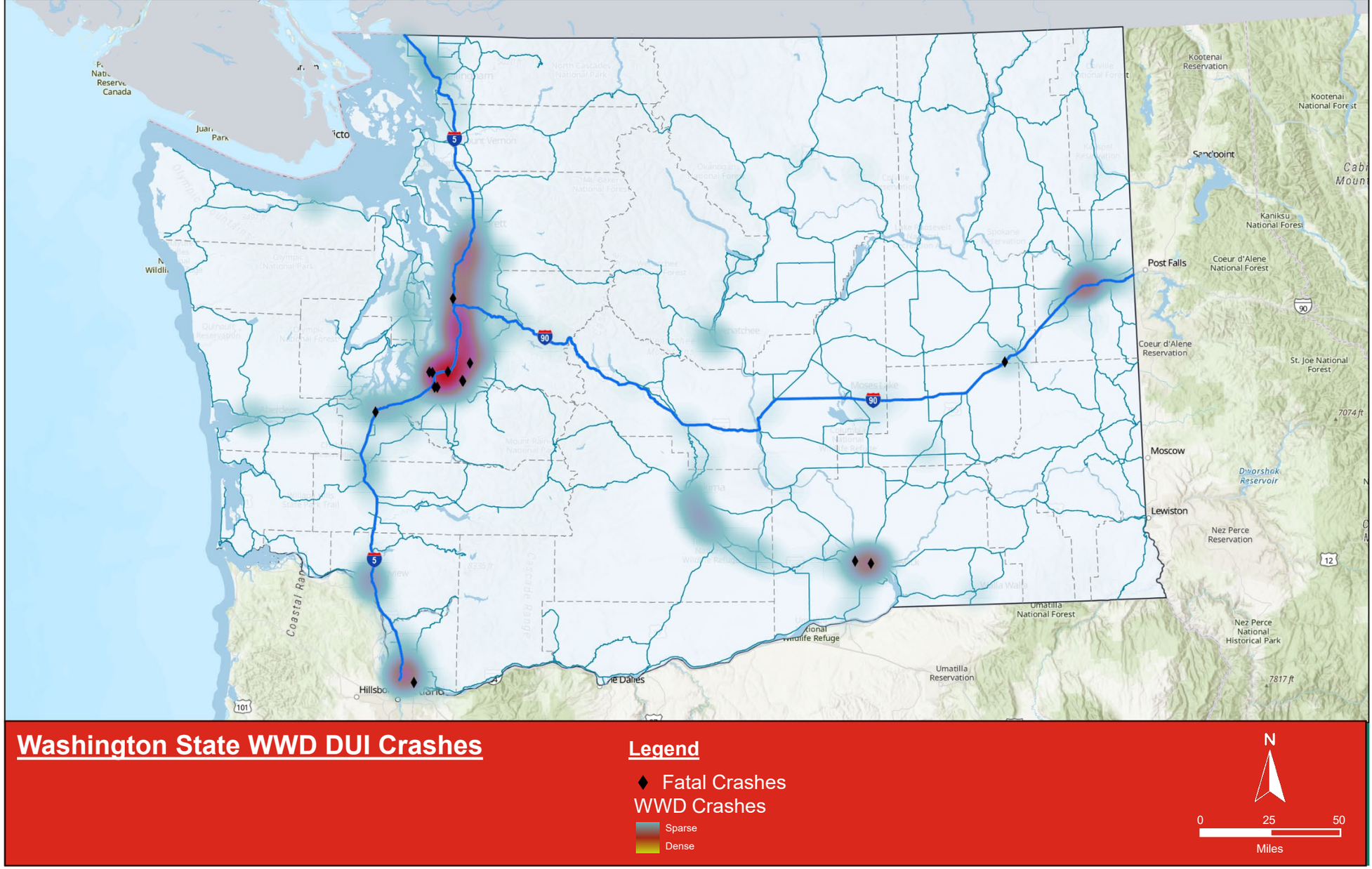
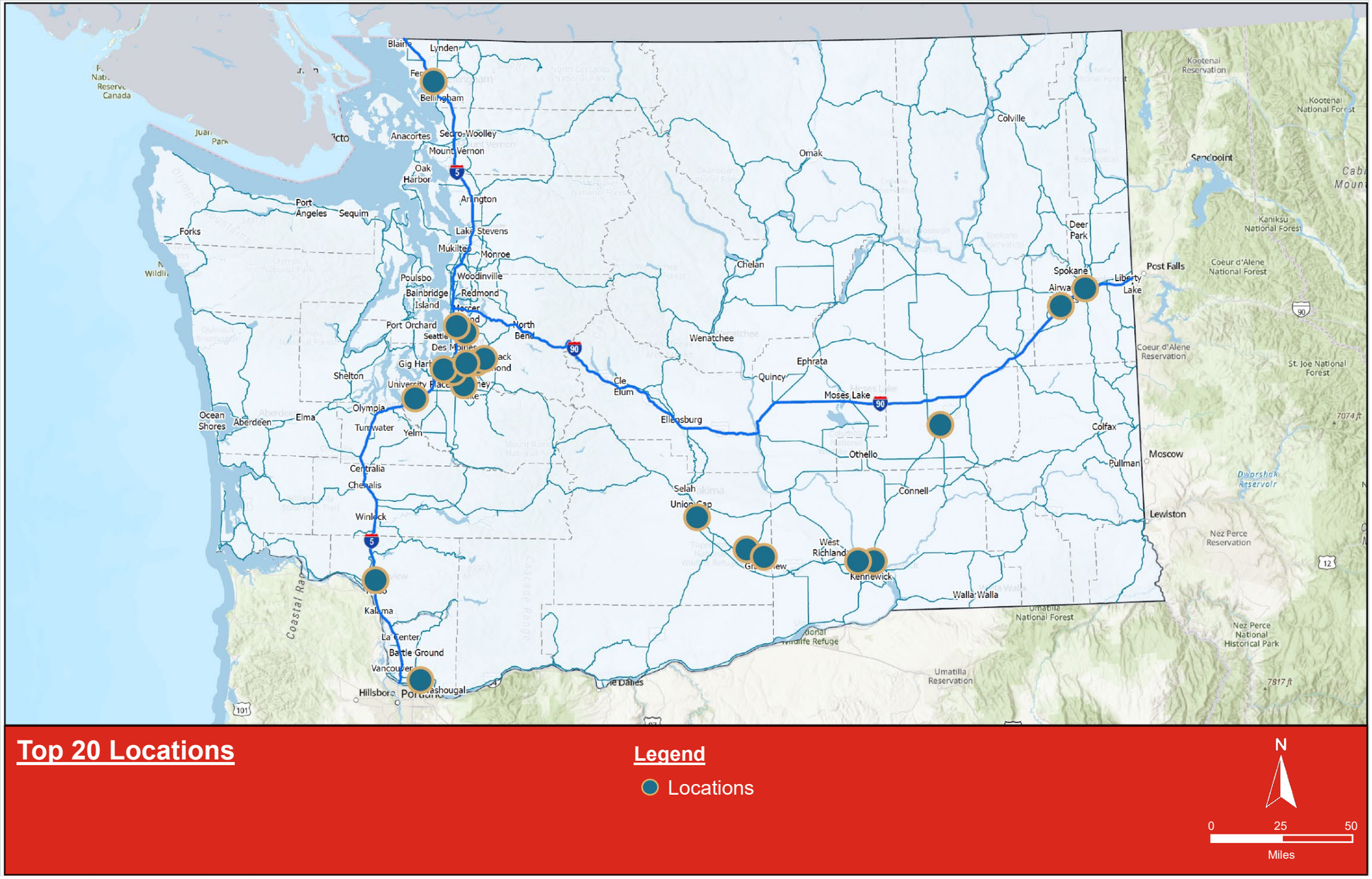
Data Analysis



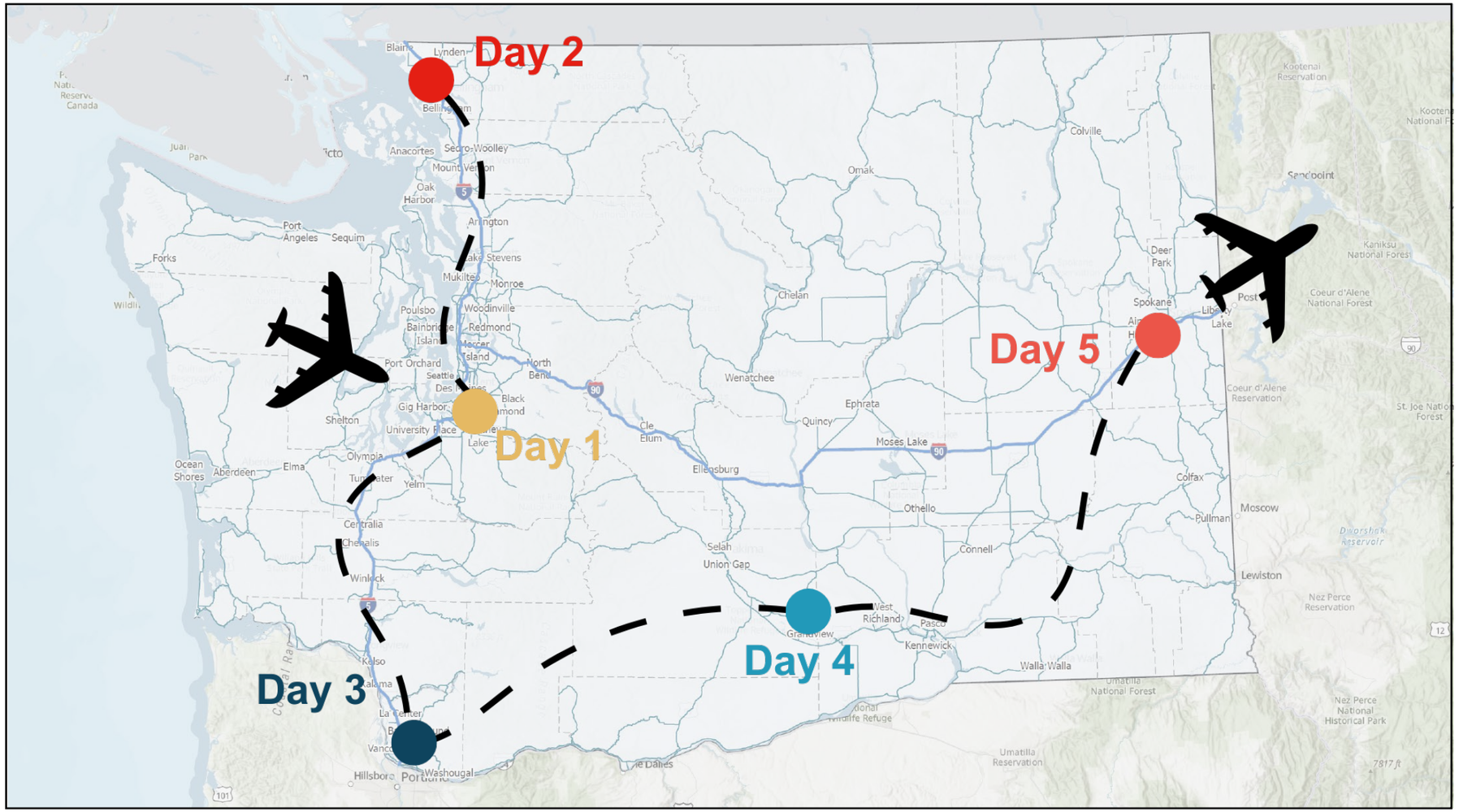
TASK 2
Data Analysis

Category	Criteria/Threshold	Points	Category	Criteria/Threshold	Points
WWD Crash History	No WWD crashes	0	Interchange Geometry Complexity	Standard Diamond	0
	0.1–<0.25 WWD crashes/yr	5		Moderate Complexity (e.g., Folded Diamond)	15
	0.25–<0.5 WWD crashes/yr	10		High Complexity (Unconventional Designs)	30
	0.5–<1.0 WWD crashes/yr	15	Traffic Volumes (Mainline & Ramp AADT)	Determine percentile rank among all locations	
	1.0–<1.5 WWD crashes/yr	20		≤10th percentile	1
	>=1.5 WWD crashes/yr	25		≤20th percentile	2
	Fatal WWD Crash (per crash)	+50		≤30th percentile	3
Non-Crash WWD Incidents	Each documented incident	+5 each (up to 50 max)		≤40th percentile	4
DUI-Related Crashes	1–2 DUI-related WWD crashes	10		≤50th percentile	5
	3–5 DUI-related WWD crashes	20		≤60th percentile	6
	>5 DUI-related WWD crashes	30		≤70th percentile	7
Older Driver Involvement	1–2 older-driver WWD crashes	10		≤80th percentile	8
	>2 older-driver WWD crashes	20		≤90th percentile	9
Proximity to Liquor Establishments	Within 0.7 mi	10		>90th percentile	10
	0.7–<2.0 mi	5	High-Volume Bonus	Both Mainline & Ramp >70th percentile	+5
	>=2.0 mi	0	Visibility & Signage Factors	Poor/Obstructed Visibility of WWD Signs	+10
Confusing Median/ Midblock U-Turns	Present	+10		Enhanced Mitigation (LED signs, detection)	-5 (subtract)

TASK 2
Data Analysis

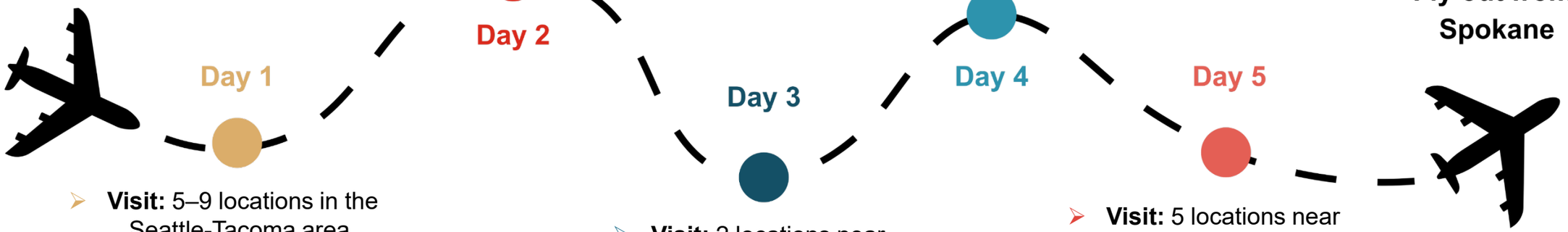


TASK 2 | Site Visit Plan



TASK 2 | Site Visit Itinerary

Fly in to Seattle



Day 1

- **Visit:** 5–9 locations in the Seattle-Tacoma area.
- **Travel:** Fly into Seattle-Tacoma International Airport (SEA).
- **Stay:** Overnight in Seattle or Tacoma.

Day 2

- **Visit:** Remaining Day 1 locations (if any) + Northern Washington.
- **Travel:** Drive north from Seattle.
- **Stay:** Overnight in Seattle or Tacoma.

Day 3

- **Visit:** 2 locations near Vancouver.
- **Travel:** Drive south from Seattle to the Vancouver area.
- **Stay:** Overnight in Yakima or nearby.

Day 4

- **Visit:** 5 central locations.
- **Travel:** Drive from Yakima and head toward Spokane.
- **Stay:** Overnight in Spokane or nearby.

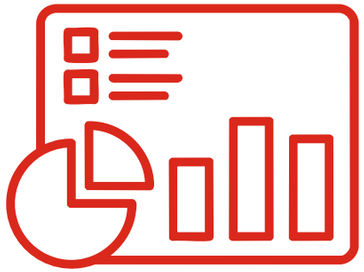
Day 5

- **Visit:** 5 locations near Spokane.
- **Travel:** Complete visits and fly out from Spokane International Airport (GEG).

Fly out from Spokane

TASK 2
Data Analysis

Loc ID	Interchange Type	# of Crashes	# of Incidents	# of Fatal Crashes	AADT ML	AADT R	# of DUI Crashes	# of Crashes with Older Driver	Poor visibility?	Presence of Confusion?	Enhanced Mitigation?	Liquor Store Distance	WWD Score	Rank
1	Parclo	2	0	2	59000	4600	1	1	Yes	No	No	1.8	170	1
2	Parclo	3	3	1	52000	5800	2	2	Yes	No	No	0.3	145	2
3	Modified Diamond	4	0	1	73000	49000	2	0	No	Yes	No	0.3	142	3
4	Parclo	2	1	1	74000	14000	1	0	Yes	No	No	3.3	122	4
5	Half Diamond	2	1	1	213000	4600	2	0	Yes	No	Yes	0.5	120	5
6	Diamond	3	0	1	63000	6400	3	0	Yes	No	No	0.3	118	6
7	Half Diamond	5	0	0	207000	9600	3	1	Yes	Yes	No	0.7	114	7
8	Parclo	3	0	1	25000	3000	2	0	Yes	No	Yes	0.4	109	8
9	Parclo	2	0	1	29000	3700	2	0	Yes	No	No	0.7	106	9
10	Diamond	2	0	1	62000	3700	2	1	Yes	No	No	1.2	105	10
11	Diamond	2	1	1	79000	15000	1	0	No	No	No	1	103	11
12	Parclo	2	0	1	56000	920	0	0	Yes	No	No	2.4	92	12
13	Diamond	2	2	1	126000	400	1	0	No	No	No	2.5	90	13
14	Diamond	2	1	1	9200	140	2	0	Yes	No	No	15	87	14
15	Diamond	3	0	1	30000	1200	2	0	No	Yes	Yes	2.7	84	15
16	Diamond	4	0	0	63000	8200	3	0	Yes	Yes	No	1.1	73	16
17	Parclo	3	0	0	40000	8500	3	0	No	No	No	0.3	71	17
18	Diamond	3	0	0	53000	3900	1	1	No	Yes	No	1.2	59	18
19	Diamond	3	0	0	102000	8800	1	1	No	No	Yes	0.8	57	19



TASK 3: Mitigation Strategies Development

- 3.1 Research Best Practices
- 3.2 Develop Mitigation Measures

TASK 3
Develop Mitigation

Safety Countermeasures

California Department of Transportation

BACKGROUND[1]

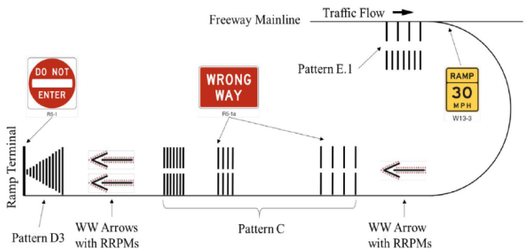
California Department of Transportation (Caltrans) has developed and tested a range of engineering countermeasures to enhance WWD detection, deterrence, and prevention. By combining enhanced conventional treatments with novel technological solutions, Caltrans aims to systematically reduce WWD-related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

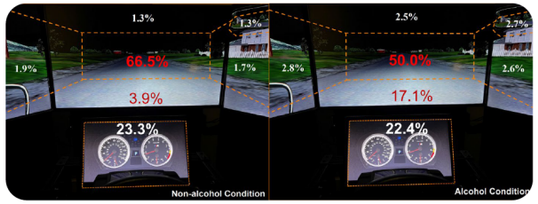


Technology-Based Wrong-Way Driver Detection Systems

- 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

TASK 3
Develop Mitigation

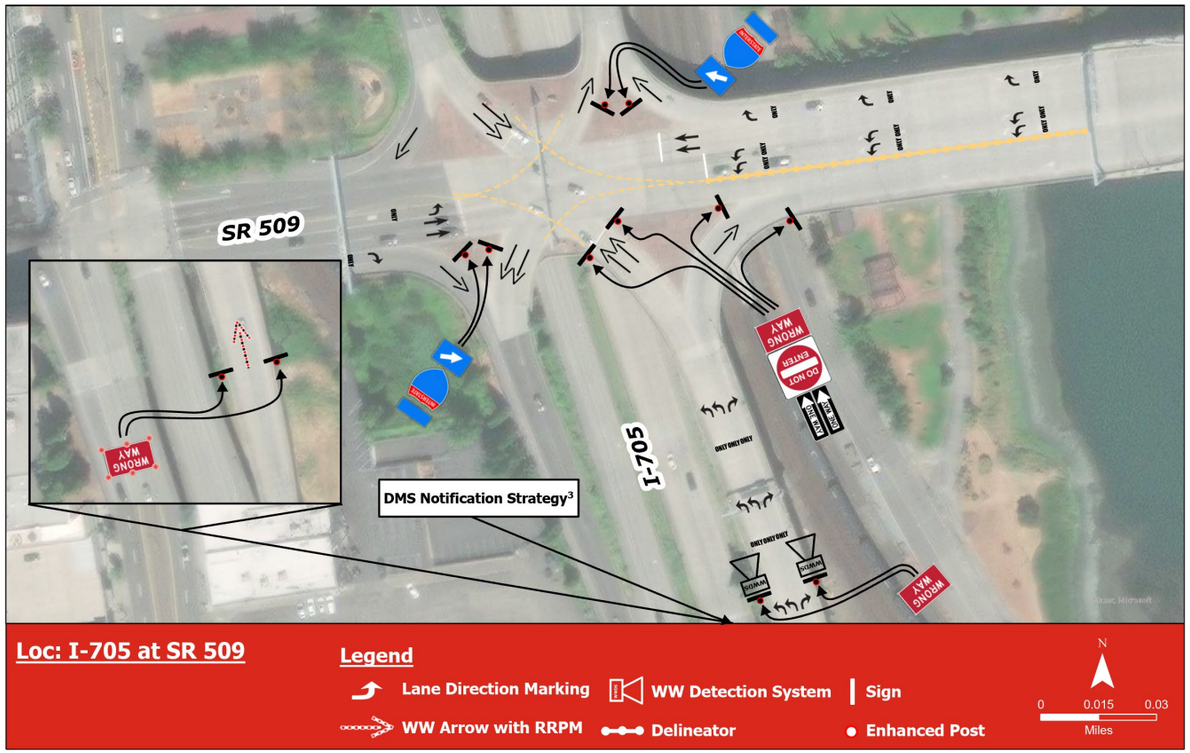
Loc ID	ITS Detection System & DMS Notification[1]	Low-Mounted Wrong Way" & "Do Not Enter" Signs	"Wrong Way" Sign	"One Way" Sign	LED-Enhanced "Wrong Way" Sign	"No Left/Right Turn" Signs	Interstate/ Route Guide Signs	Reflective Sheeting on Signposts	Lane Direction & Pavement Markings	Wrong-Way Arrows with RRPMs	Median Extension / Delineators
1	✓	✓	✓		✓		✓	✓	✓	✓	✓
2	✓	✓	✓		✓		✓	✓	✓	✓	
3	✓	✓	✓	✓	✓		✓	✓	✓	✓	
4	✓	✓			✓	✓		✓	✓	✓	
5	✓	✓			✓	✓		✓	✓	✓	
6	✓	✓			✓	✓	✓	✓	✓	✓	
7	✓	✓		✓	✓	✓	✓	✓	✓	✓	
8		✓		✓	✓		✓	✓	✓	✓	✓
9		✓	✓	✓			✓	✓	✓	✓	✓
10		✓	✓			✓	✓	✓	✓	✓	
11		✓	✓				✓	✓	✓	✓	
12		✓	✓	✓			✓	✓	✓	✓	
13		✓	✓			✓	✓	✓	✓	✓	
14		✓	✓			✓	✓	✓	✓	✓	
15			✓			✓	✓	✓	✓	✓	✓
16		✓	✓			✓	✓	✓	✓	✓	✓
17		✓	✓	✓		✓		✓	✓	✓	
18		✓	✓			✓	✓	✓	✓	✓	✓
19								✓	✓	✓	
20		✓	✓	✓				✓	✓	✓	

[1]Locations 1-7 prioritized for ITS Detection and WW System due to the ranked WWD potential score evaluation performed as part of this assessment.

TASK 3 | Develop Mitigation

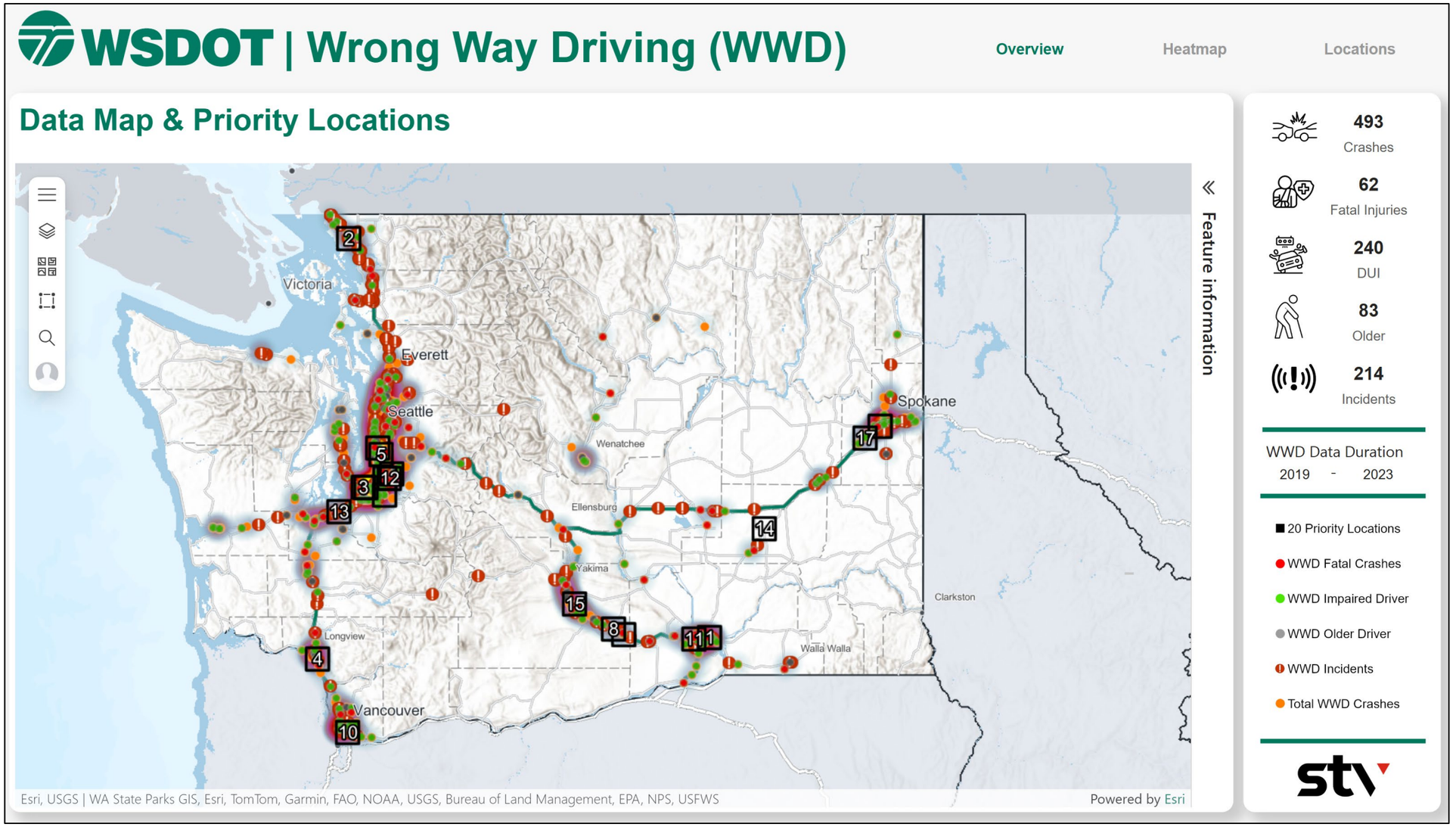
WWD Final Report: Identified Location in Ferndale, WA

WWD Final Report: Recommended Mitigation Measure



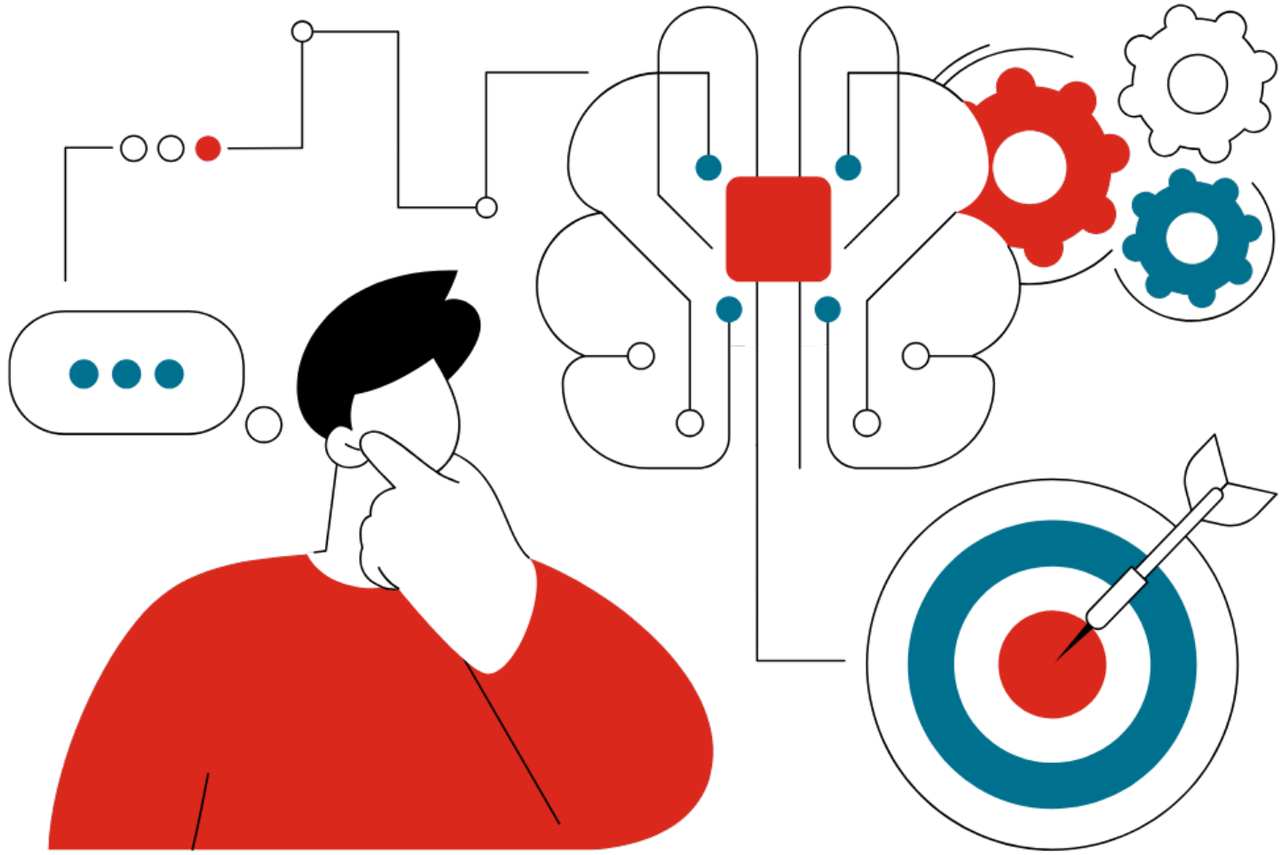
TASK 3
Develop Mitigation

WWD Power BI Dashboard with GIS Maps integrated



CONCLUSIONS

- WWD remains a critical and addressable safety challenge across jurisdictions
- Data-driven approaches enable early identification of potential locations
- Tiered mitigation strategies help tailor cost-effective solutions
- Interactive dashboards and real-time third-party data integrations offer scalable tools for monitoring, prioritization, and tracking over time



THANK YOU!

Questions?

Contact Information:

Parisa Hosseini, Ph.D.

ITS Engineering Specialist

Mobility Technology

(d) 267-535-5718 | (c) 856-818-8080

parisa.hosseini@stvinc.com | stvinc.com