



WRONG-WAY DRIVER WARNING SYSTEMS

Presented by Frederick (Rick) Tydeman, P.E.

- BACKGROUND
- MITIGATION
- EXPERIMENTATION
- NDOT EVALUATION



According to the FHWA...

- Wrong-way driver (WWD) crashes are a significant traffic safety issue
- In the United States, WWD crashes result in 300 – 500 fatalities per year
- Non-fatal crashes typically involve severe injuries

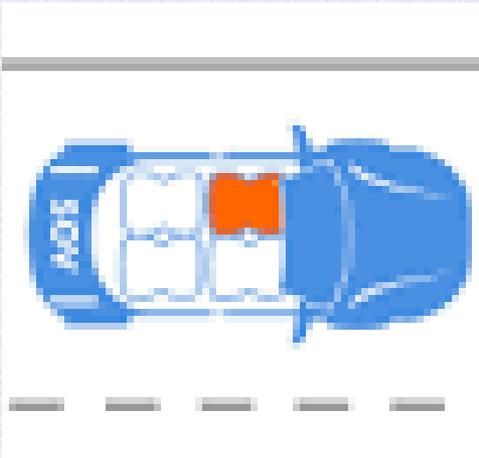


BACKGROUND



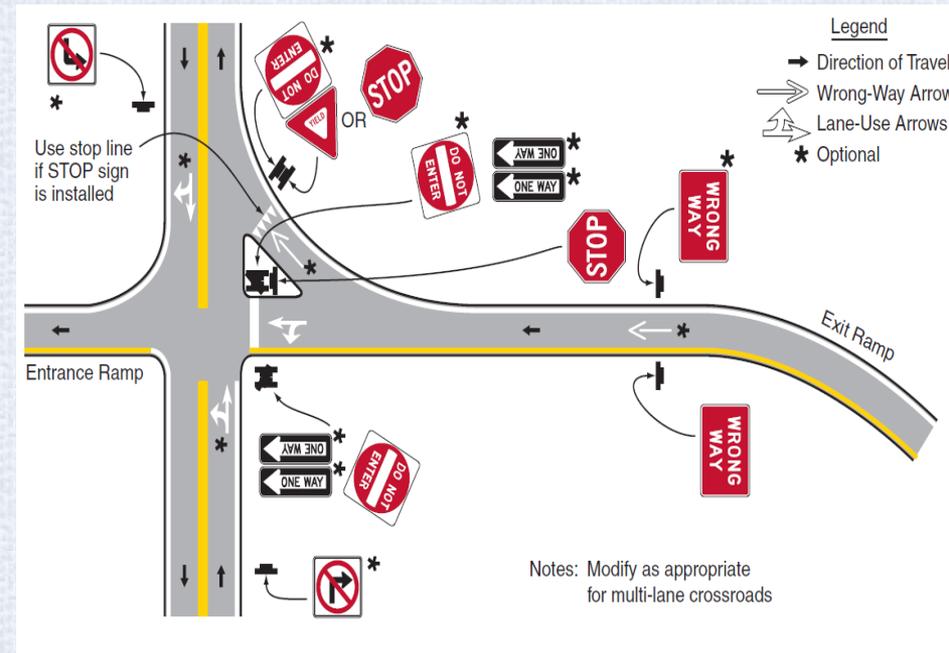
- ELDERLY DRIVERS

- IMPAIRED DRIVERS



- SOLO DRIVERS

- Basic MUTCD measures
 - DO NOT ENTER signs
 - WRONG WAY signs
- Increased measures
 - Wrong way arrow markings
 - Red reflectors on back side of guide posts
- Advanced measures
 - WWD warning systems



- Detect vehicles travelling the wrong way on freeway exit ramps
 - Activate stop beacons
 - Document the event
 - Notify TMC



MUTCD COMPLIANCE

- STOP BEACON
- LED BORDER



EXPERIMENTATION



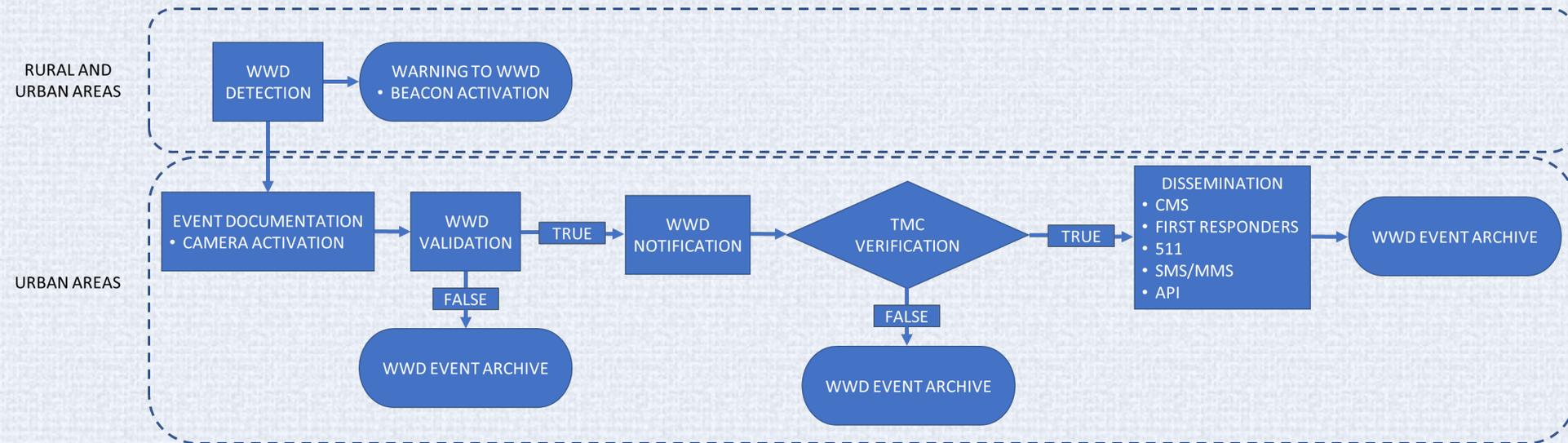
- Rectangular Rapid Flashing Beacon
- Sign Height



NDOT/UNR STUDY



SYSTEM FLOWCHART



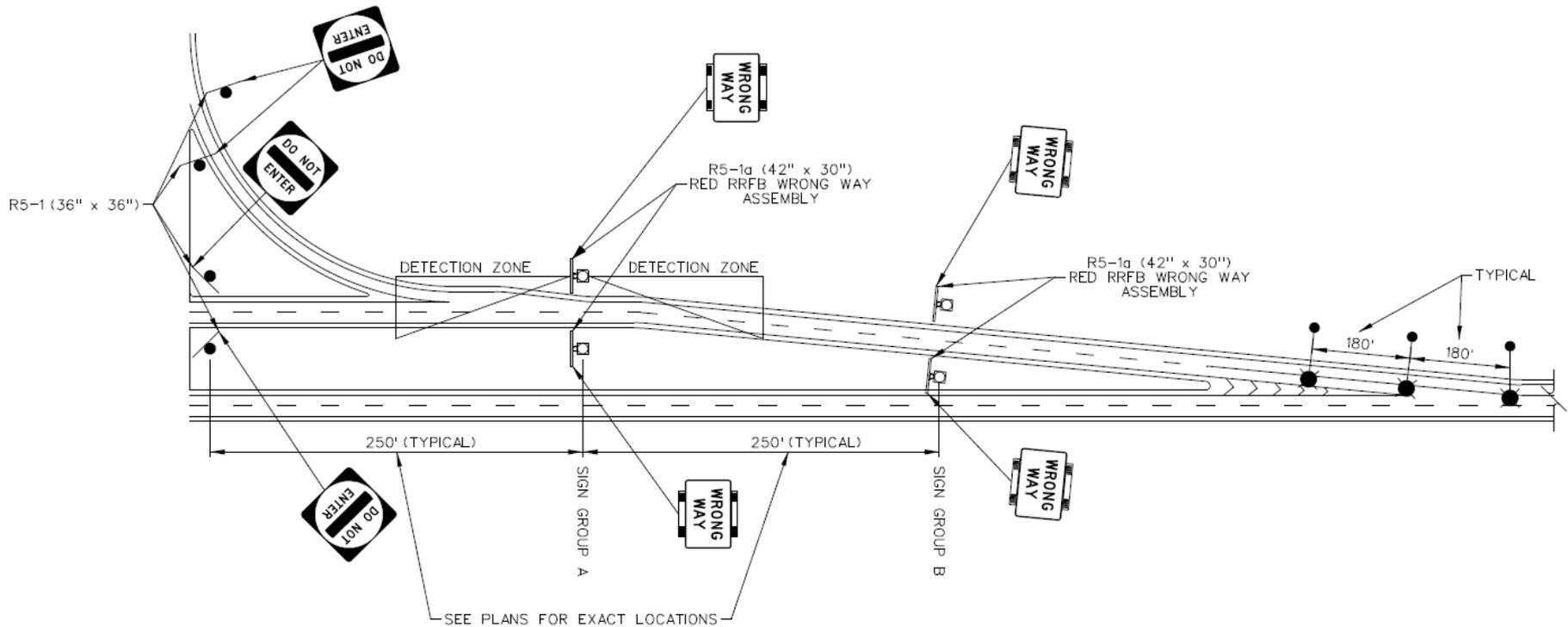
- Detect wrong-way driver
- Activate flashing beacons
- Document event
- Validate wrong-way driver
- Notify TMC

- Detection
 - Radar
 - CCTV Camera
- Activation
 - Red RRFB
- Documentation
 - CCTV Camera
 - Still images
 - Video
- Validation
 - Radar
 - CCTV Camera
- Notification
 - Email
 - Software

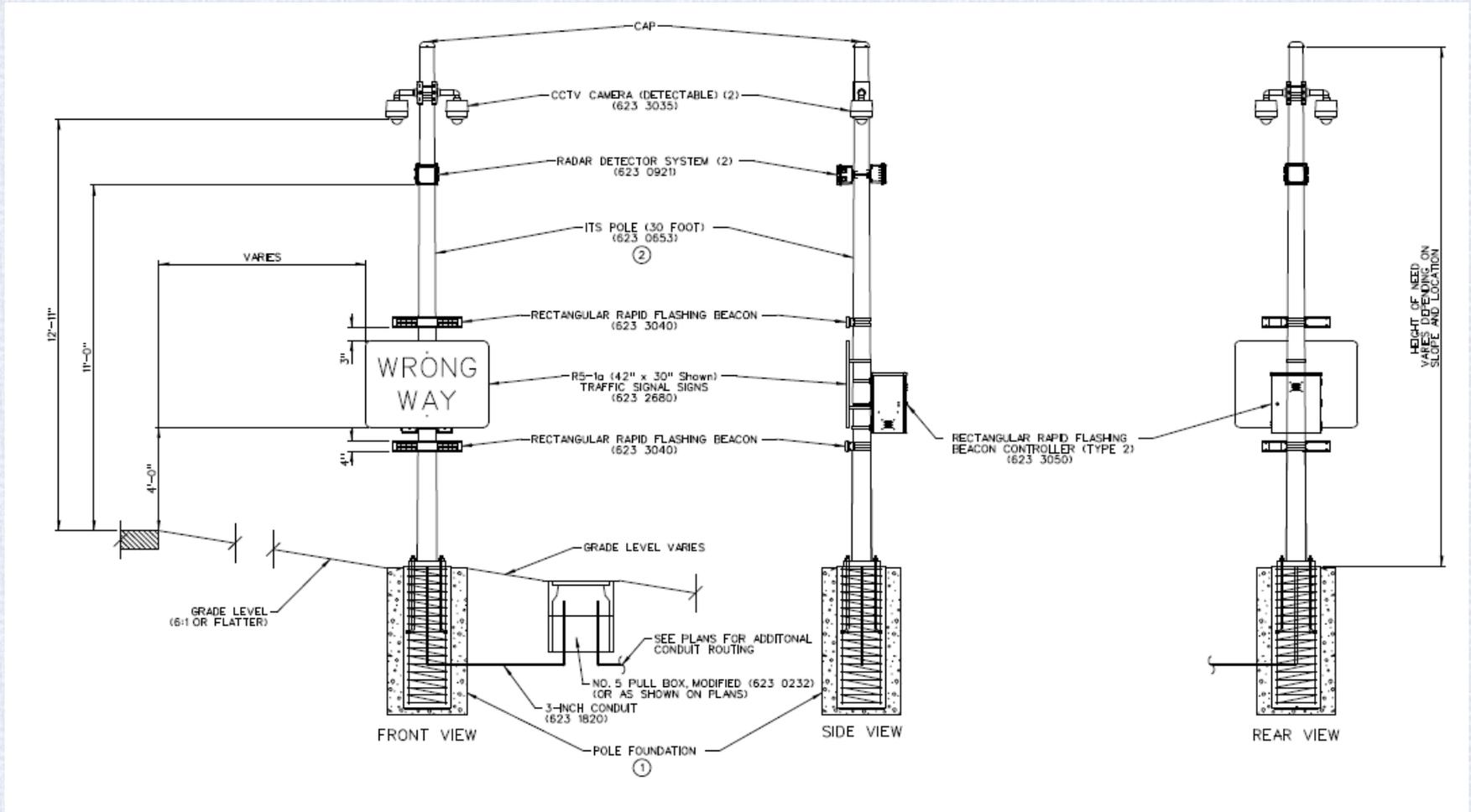
Equipment

- Wrong-way Driver System Controller
- CCTV Camera (Detectable)
- Radar Detector System
- Red RRFB
- Permanent Traffic Signs
- Poles
- Pull Boxes
- Conduit
- Wiring

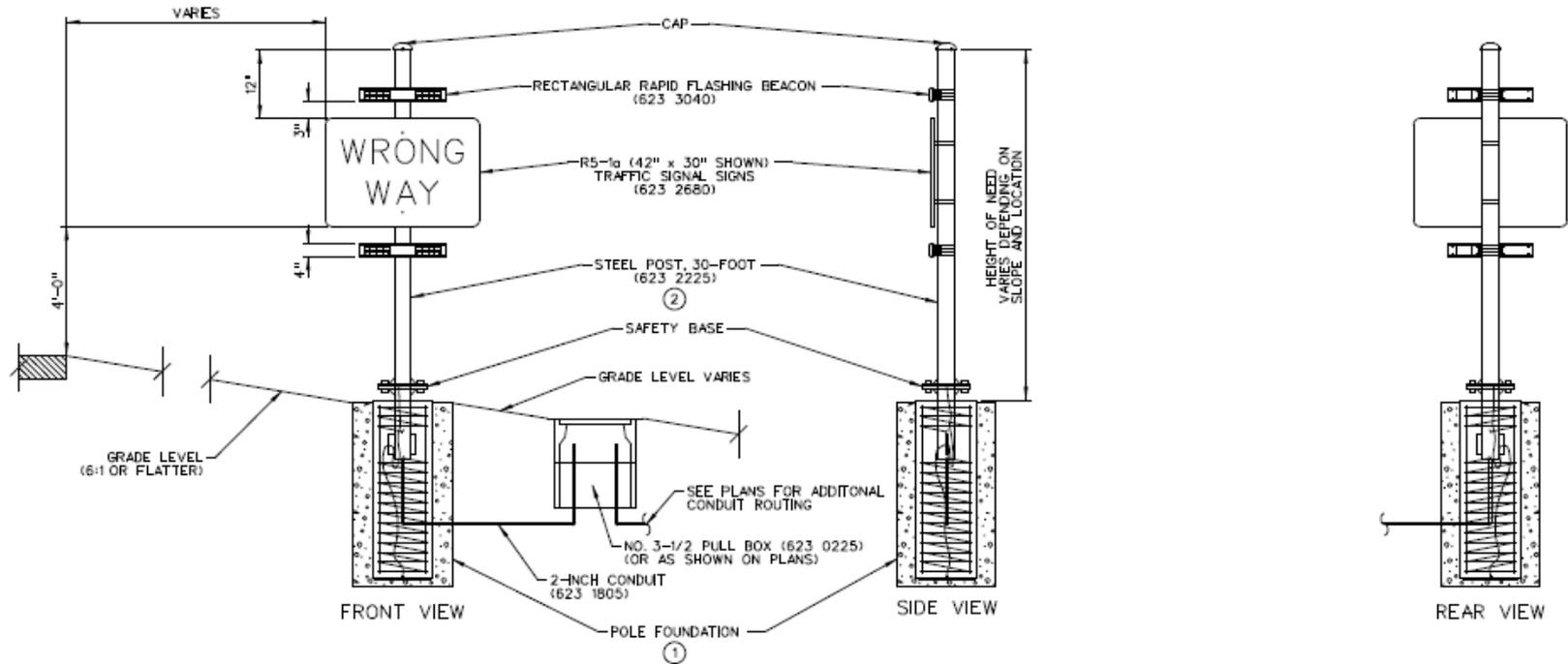
Typical Ramp Layout



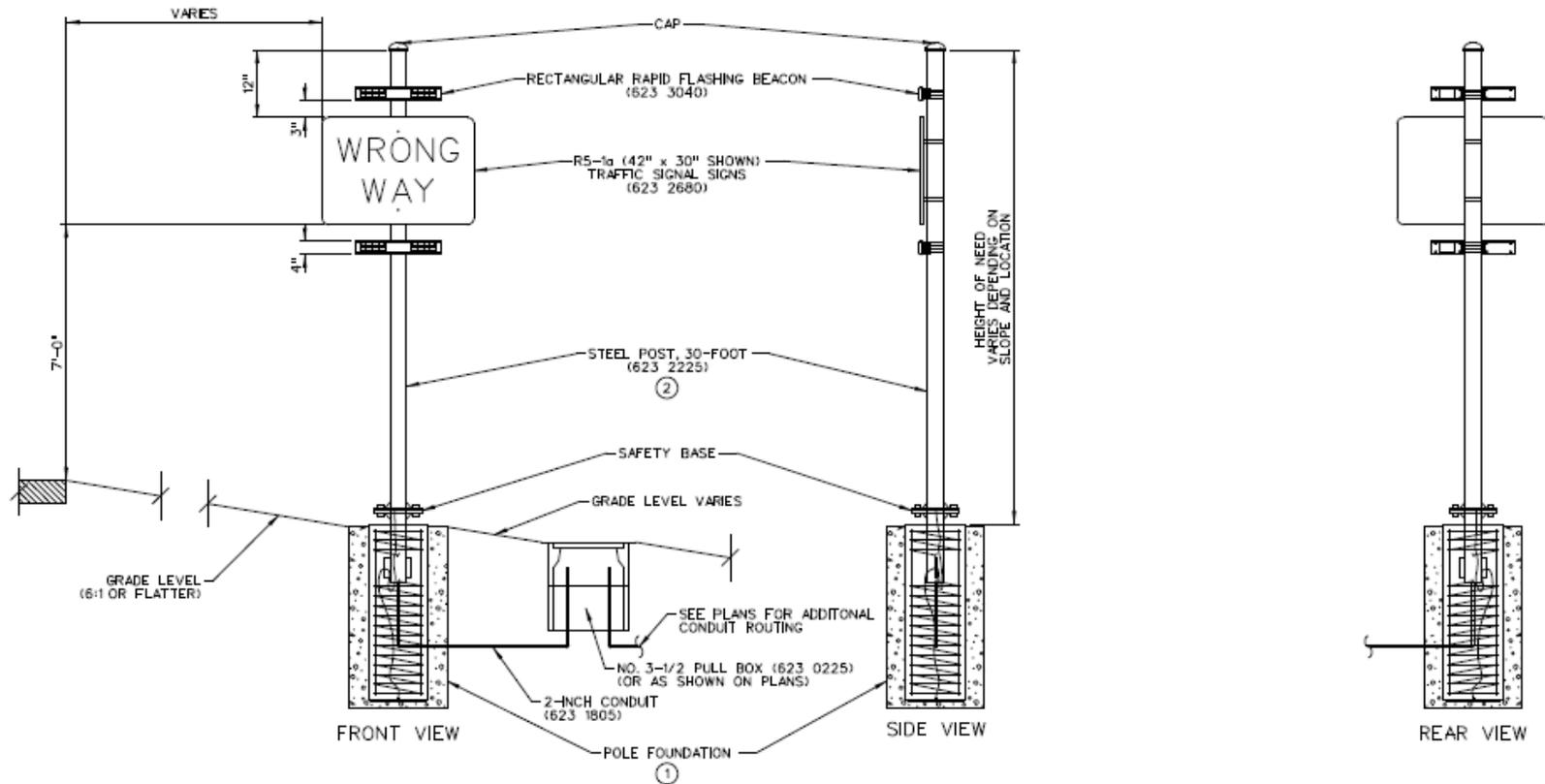
Sign Group A With Actuation



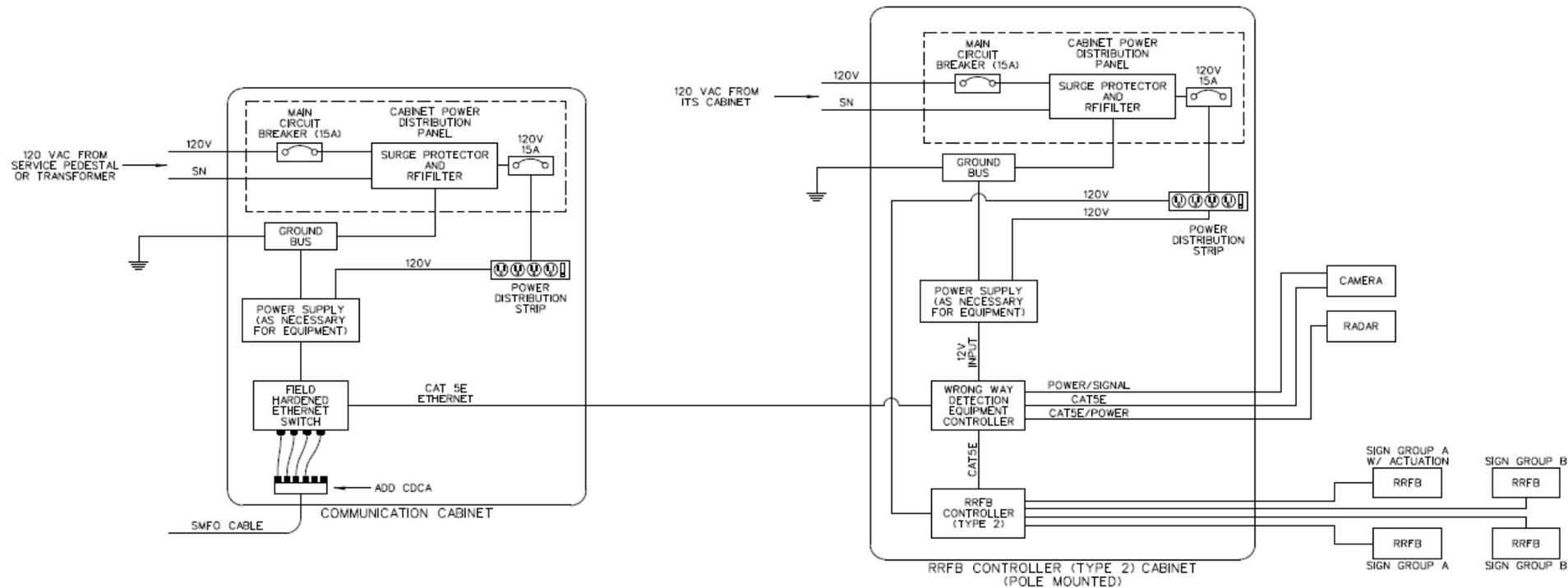
Sign Group A Without Actuation



Sign Group B



WWD System Block Diagram



Testing Procedures

- Stand Alone Test (SALT)
 - System Operation Via Field Connection
- Subsystem Test (SST)
 - System Operation Via Network Connection

Testing Procedures



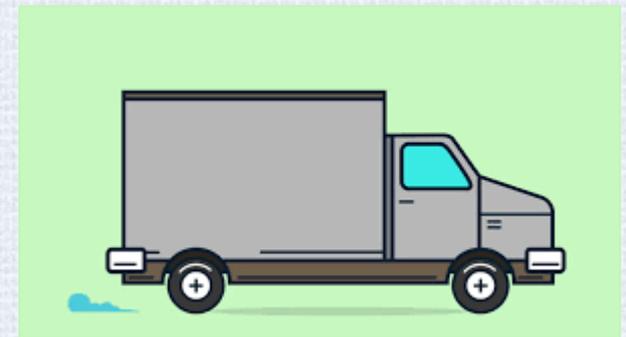
Motorcycle



Small



Medium



Large

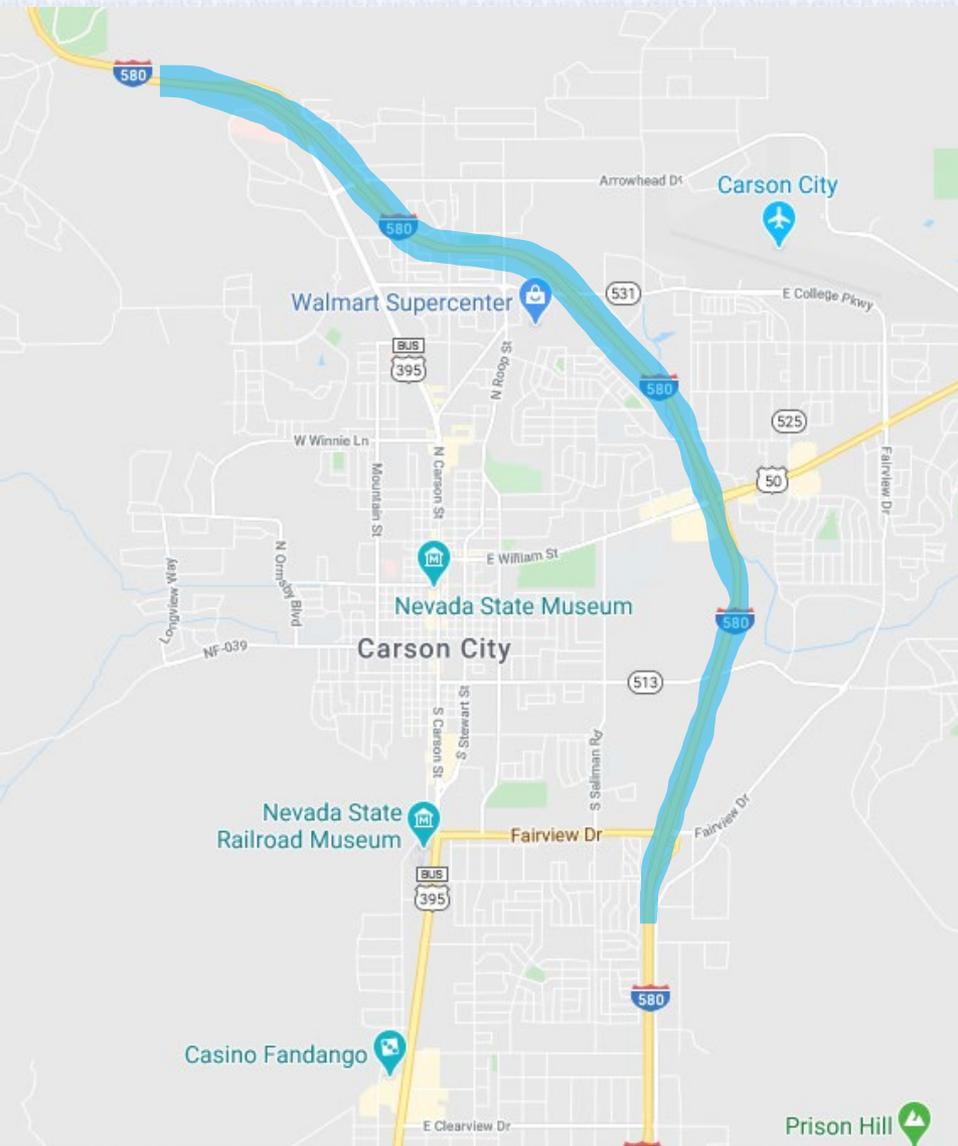
Testing Procedures

- 5 mph
- 25 mph
- 45 mph

CURRENT SYSTEMS



Reno, NV

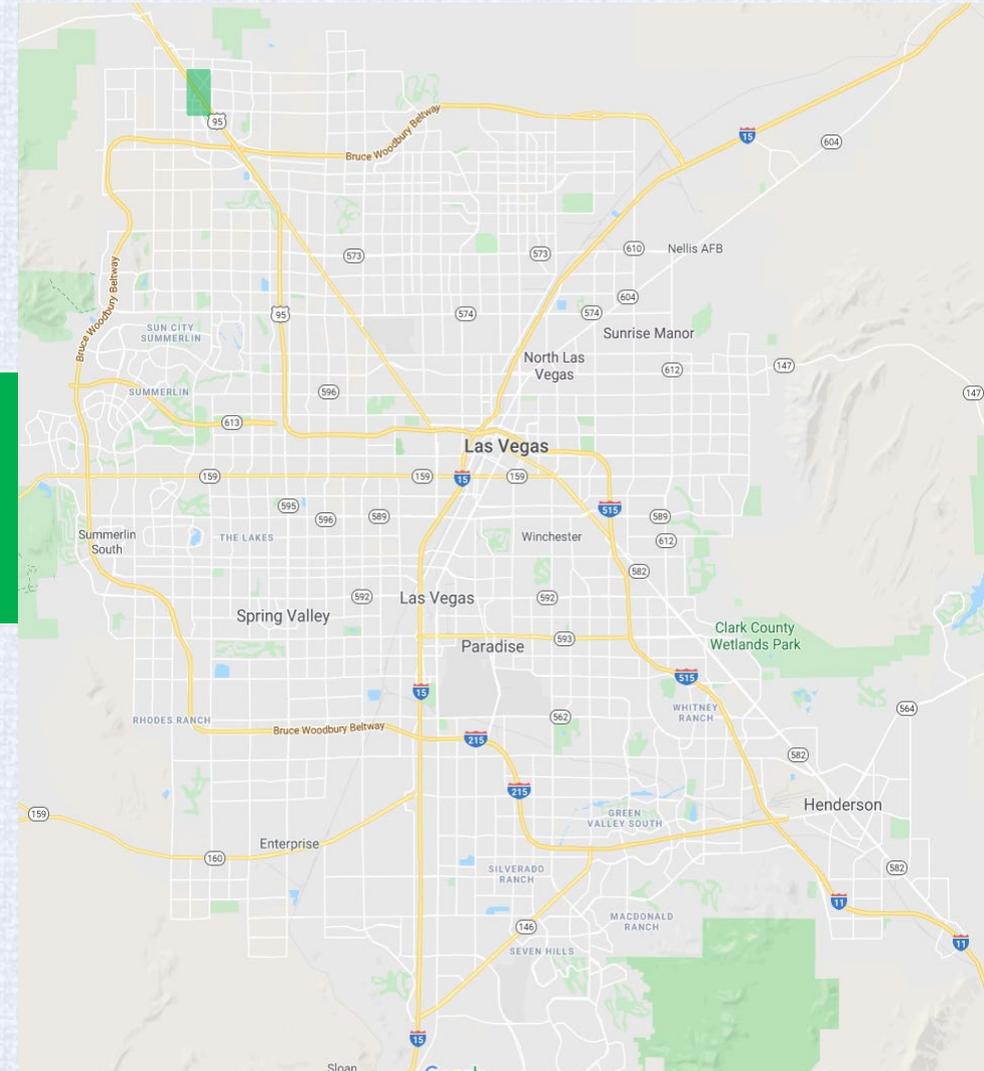


Carson City, NV

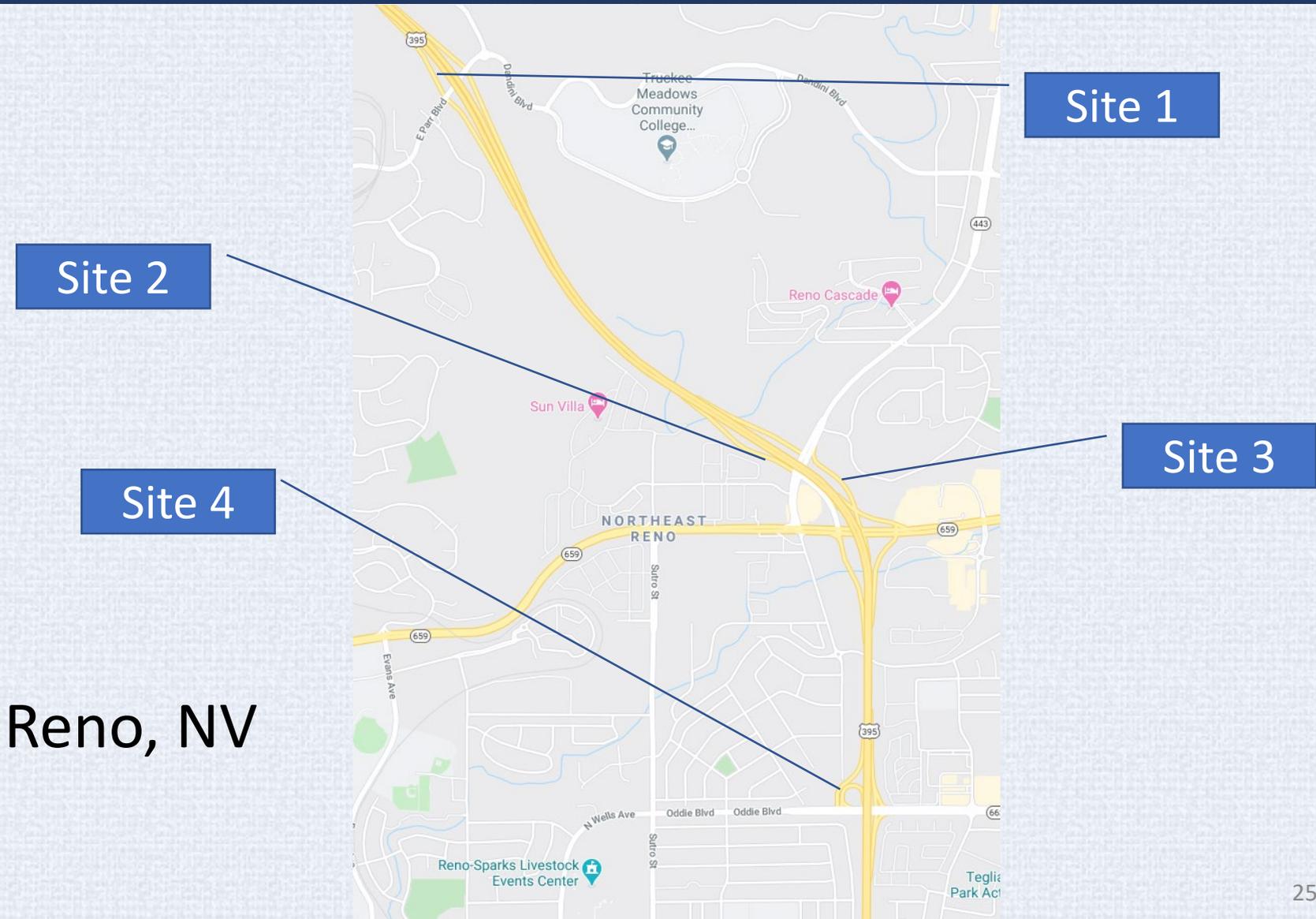
- I-580: Fairview Dr. to N. Carson St.
- Installed 2019
- Infrastructure only

Las Vegas, NV

- US-95: N. Durango Dr.
- Installed 2019
- Infrastructure only



EVALUATION LOCATIONS

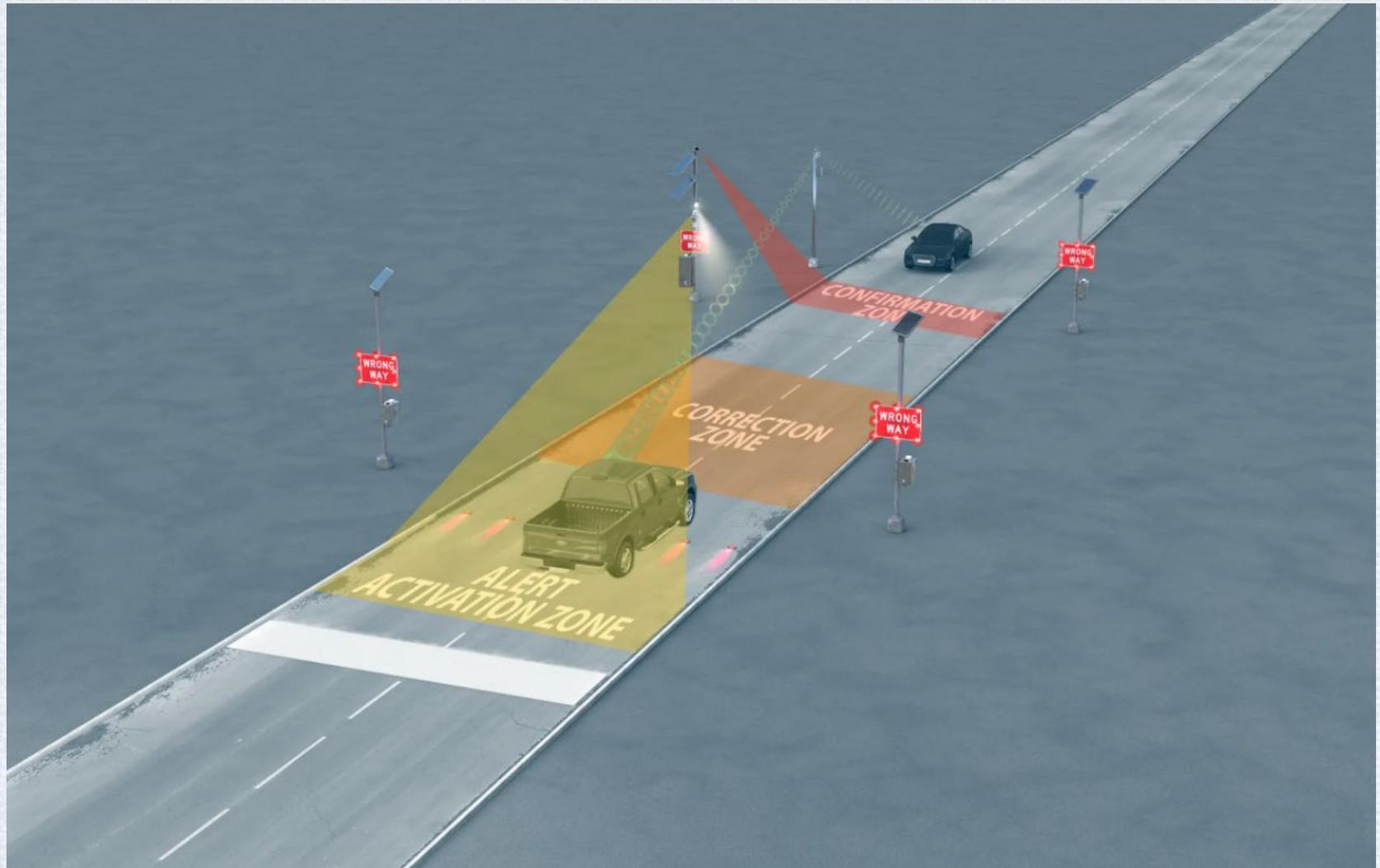




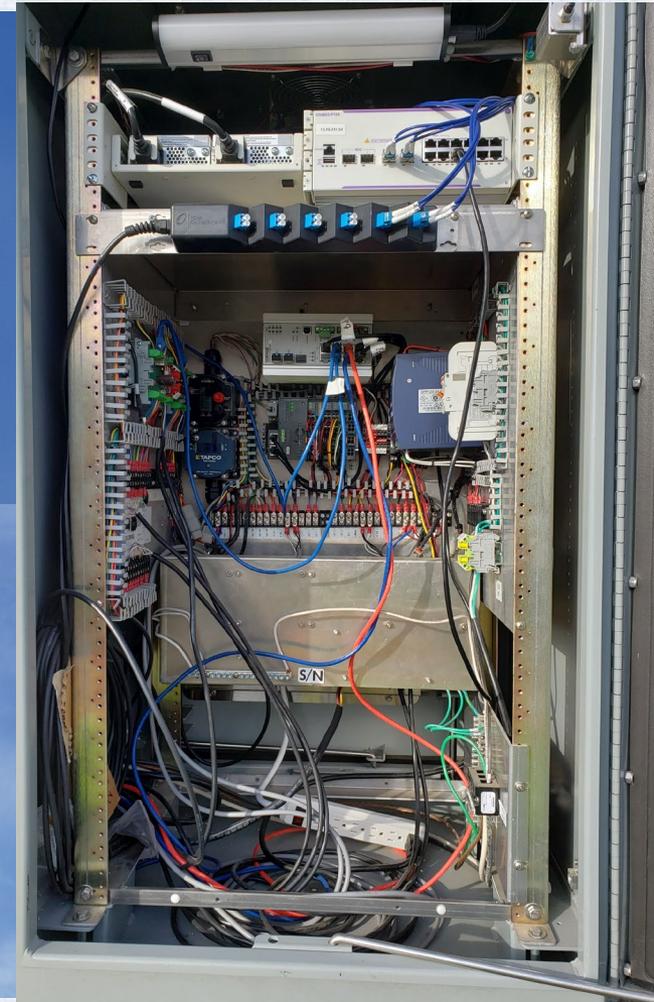
LEGEND

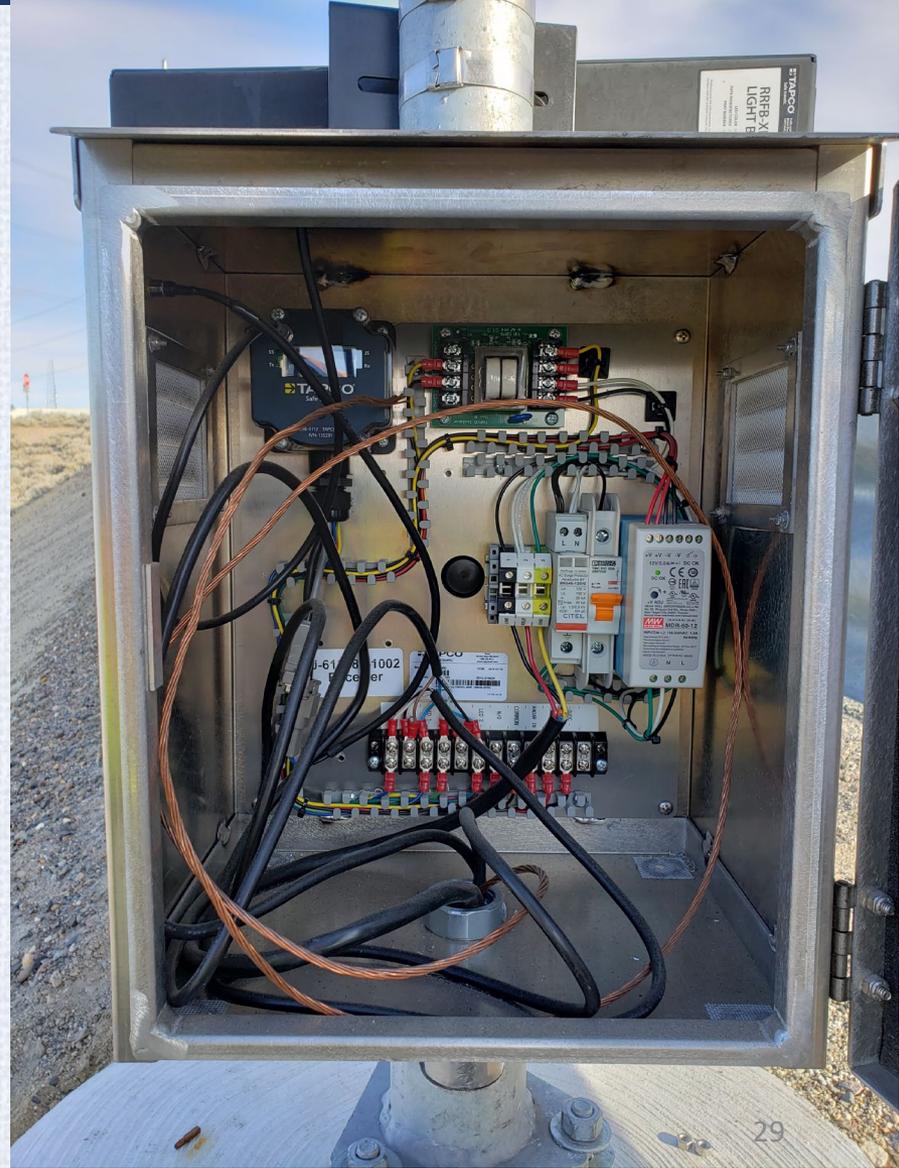
-  - COMMUNICATIONS CABINET
-  - EQUIPMENT STANDARD
-  - WRONG WAY SIGN WITH STOP BEACONS

SITE 1 – SB US 395 @ Parr Blvd



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SITE 1 – SB US 395 @ Parr Blvd























LEGEND

-  - COMMUNICATIONS CABINET
-  - EQUIPMENT STANDARD
-  - WRONG WAY SIGN WITH STOP BEACONS



- Intersection Facing
- Large Vehicle



- Mainline Facing
- Large Vehicle



Facing Intersection

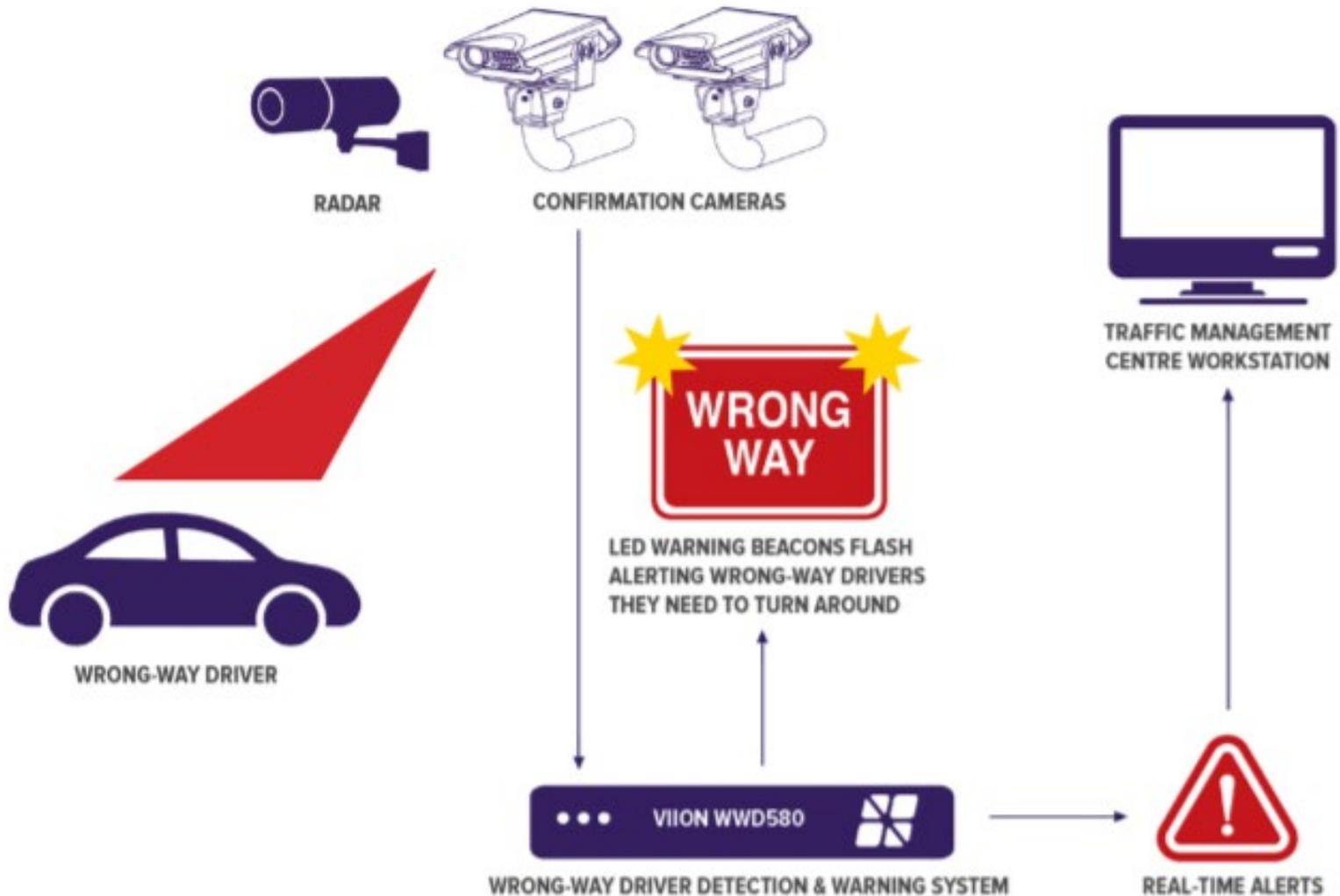


Facing Mainline

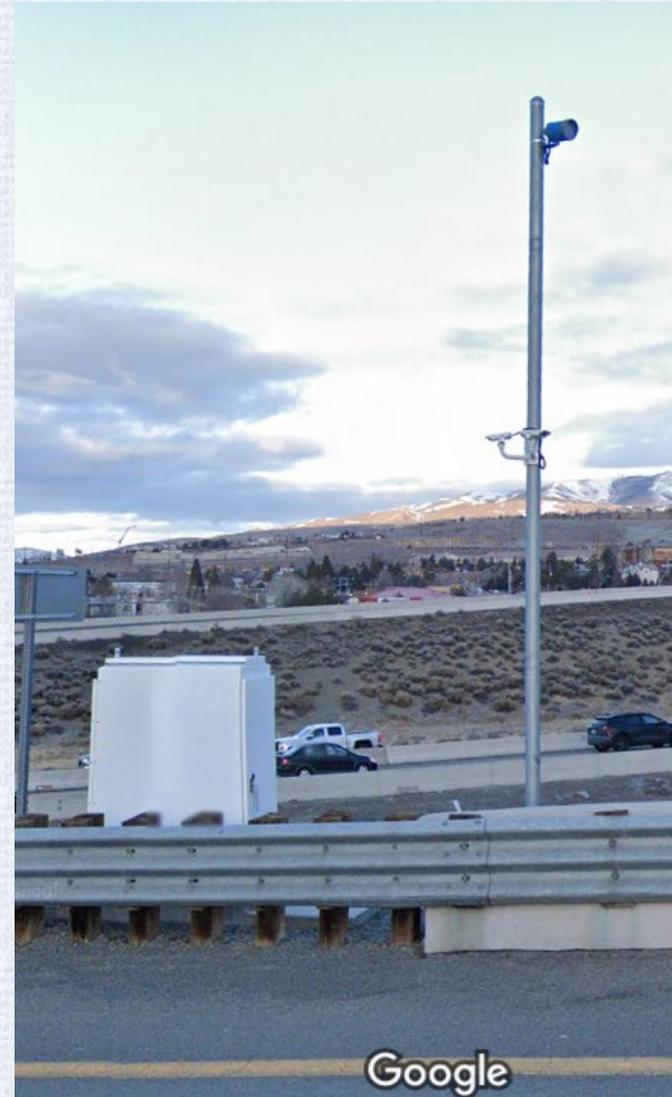


LEGEND

-  - COMMUNICATIONS CABINET
-  - EQUIPMENT STANDARD
-  - WRONG WAY SIGN WITH STOP BEACONS



SITE 3 – NB US395 @ N. McCarran Blvd











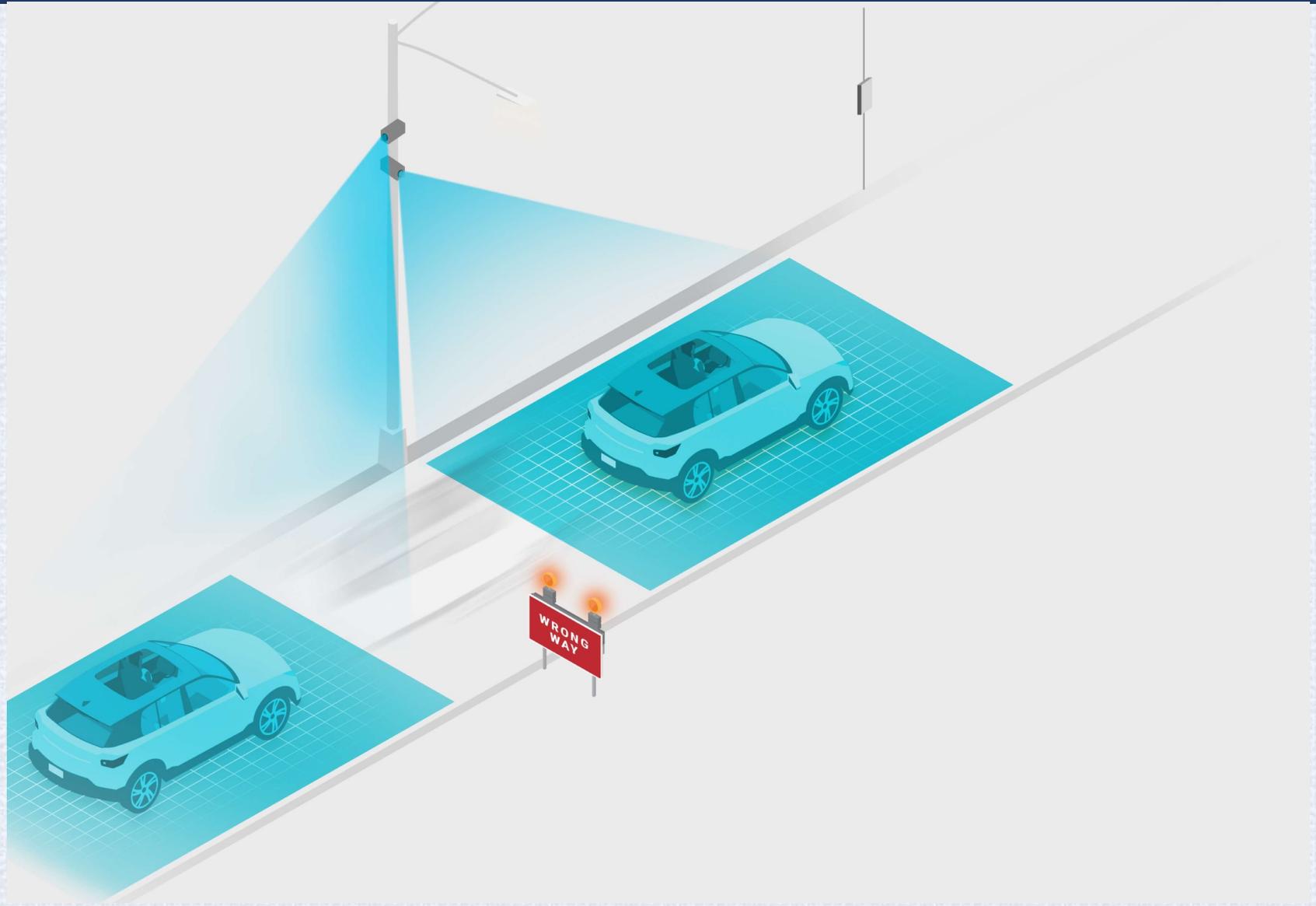




LEGEND

-  - COMMUNICATIONS CABINET
-  - EQUIPMENT STANDARD
-  - WRONG WAY SIGN WITH STOP BEACONS

SITE 4 – SB US395 @ Oddie Blvd



SITE 4 – SB US395 @ Oddie Blvd



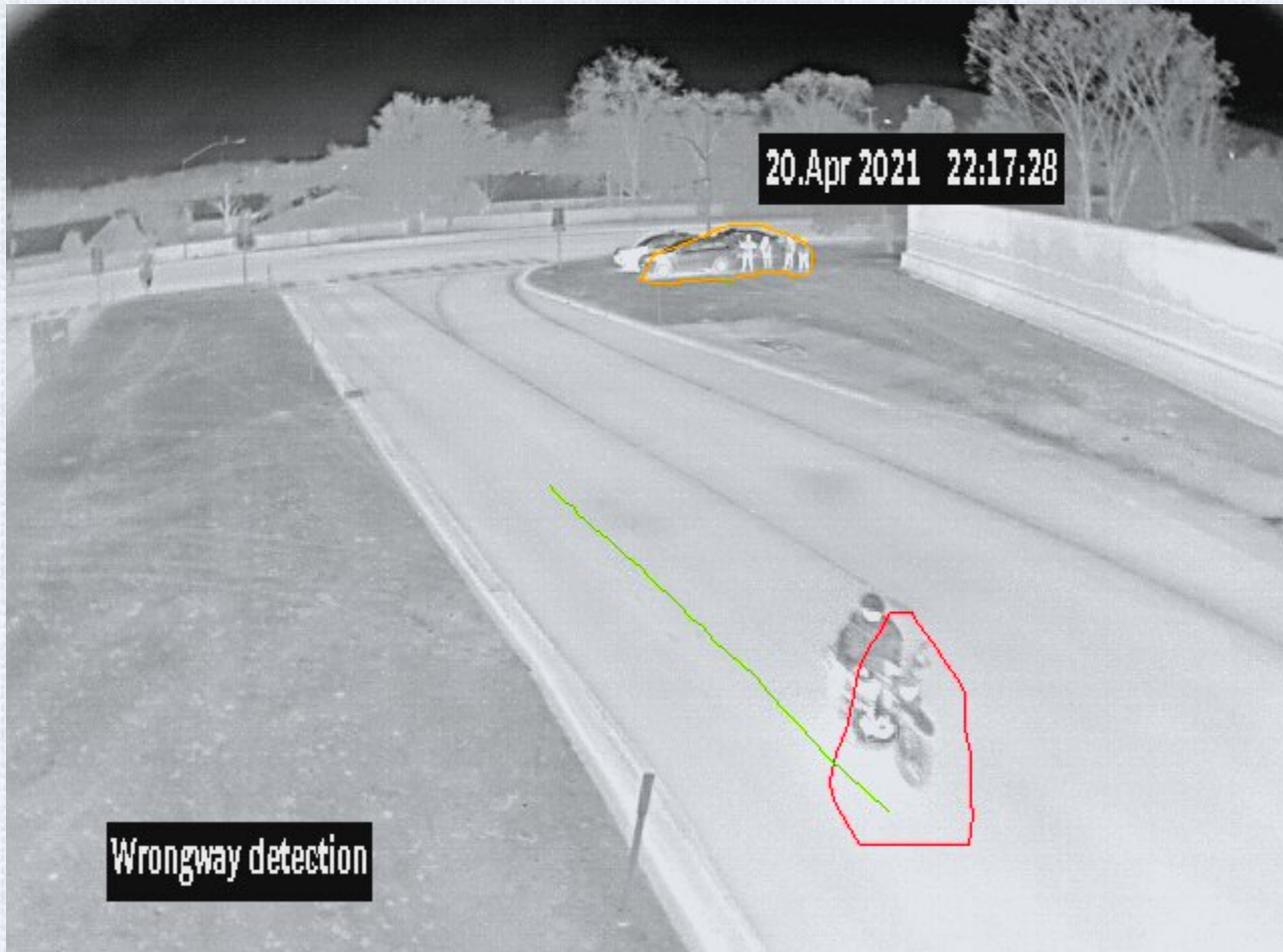
SITE 4 – SB US395 @ Oddie Blvd



SITE 4 – SB US395 @ Oddie Blvd



SITE 4 – SB US395 @ Oddie Blvd



WRONG-WAY DRIVER WARNING SYSTEM EVALUATION PROJECT

- Four systems
- Two months
- Criteria
 - Detection
 - Activation
 - Validation
 - Notification
 - Other
- Methods
 - Real-World Testing
 - NDOT Testing

DETECTION

- Wrong Way Driver Event Detection Accuracy
 - Qty. of events
 - #
 - ~~• Qty. of false events~~
 - ~~• #~~
- Detection Zone Accuracy
 - System settings vs field results
 - PASS/FAIL
- Camera Documentation
 - Still images captured
 - PASS/FAIL
 - Video captures driver behavior
 - PASS/FAIL

ACTIVATION

- Flasher Activation Accuracy
 - Qty. of activations
 - #
 - ~~• Qty. of false activations~~
 - ~~• #~~

VALIDATION

- Wrong Way Driver Event Validation Accuracy
 - Qty. of events
 - #
 - ~~Qty. of false events~~
 - ~~#~~
- Validation Zone Accuracy
 - System settings vs field results
 - PASS/FAIL
- Camera Documentation
 - Still images captured
 - PASS/FAIL
 - Video captures driver behavior
 - PASS/FAIL

NOTIFICATION

- Notification Transmission Accuracy
 - Qty. of notifications
 - #
 - ~~• Qty. of false notifications~~
 - ~~• #~~
- Still Image quality
 - Daytime
 - Image clarity
 - GOOD/POOR
 - Color accuracy
 - PASS/FAIL
 - Vehicle identification capability (e.g. sedan, truck, van, tractor-trailer)
 - PASS/FAIL

NOTIFICATION

- Still Image Quality
 - Nighttime
 - Image clarity
 - GOOD/POOR
 - Color accuracy
 - PASS/FAIL
 - Vehicle identification capability (e.g. sedan, truck, van, tractor-trailer)
 - PASS/FAIL

NOTIFICATION

- Video Image Quality
 - Daytime
 - Video clarity
 - GOOD/POOR
 - Color accuracy
 - PASS/FAIL
 - Vehicle identification capability (e.g. sedan, truck, van, tractor-trailer)
 - PASS/FAIL
 - Quality vs. Mainline CCTV Camera (PTZ)
 - LESSER/EQUIVALENT/GREATER

NOTIFICATION

- Video Image Quality
 - Nighttime
 - Video clarity
 - GOOD/POOR
 - Color accuracy
 - PASS/FAIL
 - Vehicle identification capability (e.g. sedan, truck, van, tractor-trailer)
 - PASS/FAIL
 - Quality vs. Mainline CCTV Camera (PTZ)
 - LESSER/EQUIVALENT/GREATER

NOTIFICATION

- Includes Application Programming Interface (API)
 - TRUE/FALSE
- Data management/storage
 - Client server
 - TRUE/FALSE
 - Cloud hosted
 - TRUE/FALSE
 - Redundant servers
 - TRUE/FALSE
 - Meets Traffic Management Data Dictionary (TMDD) information standard
 - TRUE/FALSE
 - Bandwidth requirement ≤ 10 Mbps
 - TRUE/FALSE

NOTIFICATION

- Notification ease of use (email/SMS/etc.)
 - Location identification
 - TRUE/FALSE
 - Travel direction identification
 - TRUE/FALSE
 - Result determination (driver behavior)
 - TRUE/FALSE
- Graphical User Interface (GUI) ease of use
 - Location identification
 - TRUE/FALSE
 - Travel direction identification
 - TRUE/FALSE
 - Result determination (driver behavior)
 - TRUE/FALSE

NOTIFICATION

- Graphical User Interface (GUI) ease of use
 - System parameter manipulation
 - TRUE/FALSE
 - Remote Accessibility
 - TRUE/FALSE
 - Video timeframe
 - TRUE/FALSE
 - Qty. of images captured
 - TRUE/FALSE
 - Beacon flash duration
 - TRUE/FALSE
 - Detection and validation zones
 - TRUE/FALSE

NOTIFICATION

- Graphical User Interface (GUI) ease of use
 - Video Accessibility
 - READILY AVAILABLE/UPON REQUEST/NOT AVAILABLE
 - Ease of video retrieval from specific event/s
 - GOOD/POOR
 - Location Naming (ability to change)
 - TRUE/FASLSE
 - Live video viewing capability
 - TRUE/FALSE

NOTIFICATION

- Notification delay
 - Shortest
 - # [time]
 - Longest
 - # [time]
 - Average
 - # [time]

OTHER

- Field maintenance
 - Qty. of devices that require maintenance
 - #
 - Recommended maintenance schedule
 - # [time]
 - Ability to save **all** Individual component configurations (e.g., camera, controller, radar)
 - TRUE/FALSE
 - Vendor Provided Preventative Maintenance Procedure
 - TRUE/FALSE
 - All system components are included
 - TRUE/FALSE

OTHER

- Reporting
 - Event categories
 - TRUE/FALSE
 - Automated reporting functionality
 - TRUE/FALSE
- Absence of camera coverage dead zone
 - TRUE/FALSE
 - Overlap
 - TRUE/FALSE
- Equipment diagnostic functionality
 - Remote
 - TRUE/FALSE

OTHER

- Equipment diagnostic functionality
 - Remote
 - TRUE/FALSE
- Availability of a 3 Year Warranty period (complete system)
 - TRUE/FALSE
- Warranty coverage
 - Hardware
 - TRUE/FALSE
 - USA sourced replacement parts
 - TRUE/FALSE
 - Software Upgrades Included
 - TRUE/FALSE

OTHER

- Support
 - US based
 - TRUE/FALSE
 - 24/7
 - TRUE/FALSE
 - Method
 - Phone
 - TRUE/FALSE
 - Email
 - TRUE/FALSE

- NDOT Selected WWD Warning System For Statewide Deployment
 - WWD Controller
 - Detection Method
 - Documentation Needs
 - Notifications

- Detection
 - ~~Radar~~
 - **Thermal Detection** CCTV Camera
- Activation
 - ~~Red RRFB~~
 - **Red 1W1C Signal Head**
- Documentation
 - CCTV Camera
 - Still images
 - Video
- Validation
 - ~~Radar~~
 - **Thermal Detection** CCTV Camera
- Notification
 - Email
 - Software
 - **ATMS**

CONCLUSIONS

- Known Issues
 - False Detections
 - Image/Video Quality
 - Knock Downs
 - Provide Protection (e.g., Guard Rail)
 - Camera “Dead Zone”
 - One size does not fit all
- Determine Best System/s For Agency
 - Detection Type
 - Documentation Needs
 - Still Images and/or Video
 - System Notifications
 - Email
 - Software
 - ATMS

CLOSING REMARKS



- BACKGROUND
- MITIGATION
- EXPERIMENTATION
- NDOT EVALUATION



WRONG-WAY DRIVER WARNING SYSTEMS

Presented by Frederick (Rick) Tydeman, P.E.

QUESTIONS?



www.nevadadot.com

