

# I-95

## Variable Speed Limit System

### Commonwealth Transportation Board Meeting

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October 26, 2022

Kimley»Horn

**VDOT** Virginia Department  
of Transportation



# I-95 VSL Project Presentation Overview

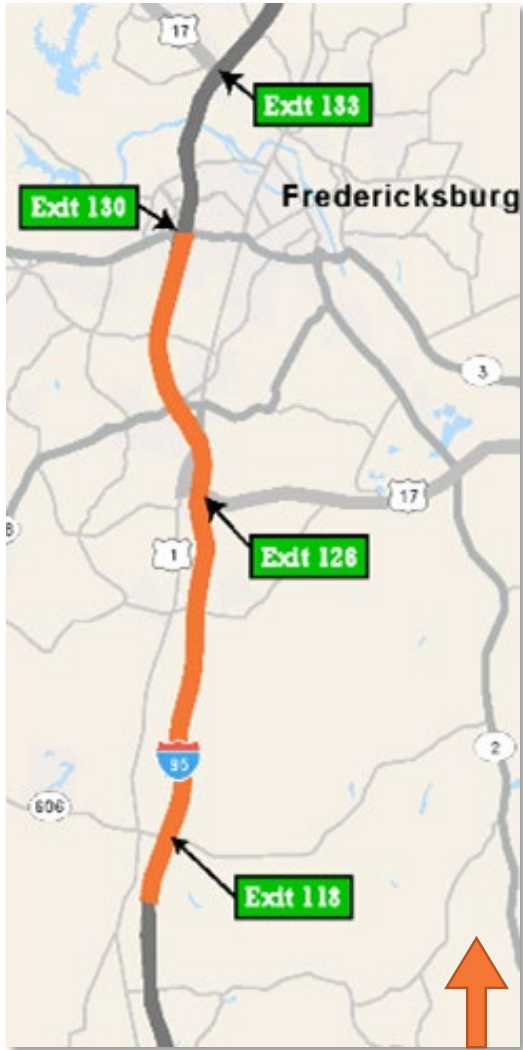


- Overview of Project
  - Corridor Selection
  - Project Approach & Expected Benefits
  - How the System Works
- Project Evaluation
  - Considerations
  - Driver Behavior
  - Safety
- Conclusions

**JUNE 22, 2022 FULLY OPERATIONAL!!**

The screenshot shows the VDOT website page for the I-95 Northbound Variable Speed Limits project. The page features a blue header with the VDOT logo and navigation links. Below the header is a navigation bar with links to Home, Projects, Fredericksburg Projects, and I-95 Northbound Variable Speed Limits. A search bar is located on the right side of the page. The main content area includes a large image of a bridge at night, a section titled "Coming Soon: I-95 Northbound Variable Speed Limits" with a "Cost and schedule" button, and a photograph of a highway with cars. Text below the photograph explains that VDOT will install variable speed limits (VSL) to enhance safety in the Interstate 95 northbound corridor between mile markers 115 and 130 in Caroline and Spotsylvania counties. It also notes that crashes have occurred when northbound vehicles traveling at speed unexpectedly encounter stopped or slowing traffic flow due to congestion or lane closures for incidents and highway work zones. Finally, it mentions that new signs displaying variable speed limits between 35 mph and 65-70 mph will be paired with dynamic message boards in this section of I-95 northbound.

# VSL Pilot Project Corridor



## Corridor Selection

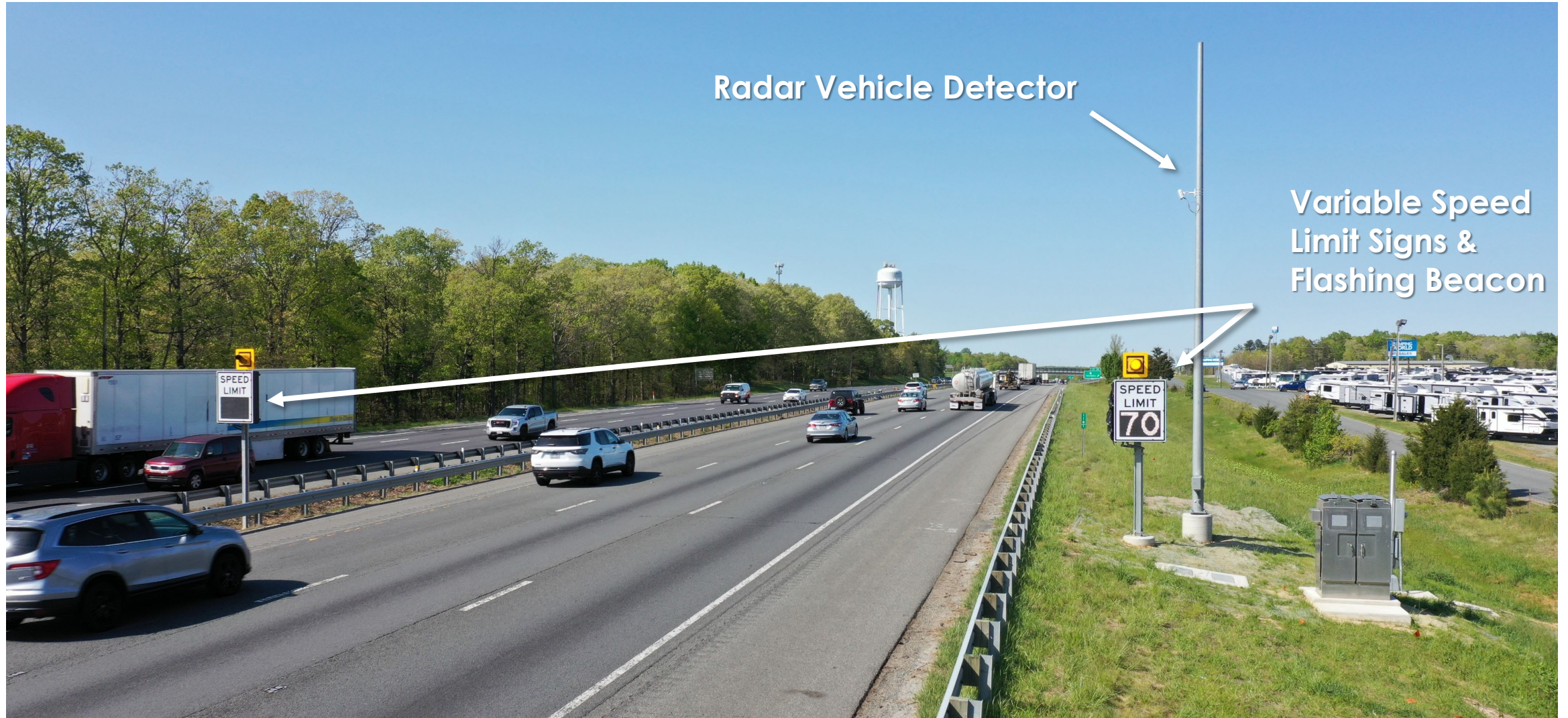
- Regular and incident-related congestion
- Hot spots with stop-and-go conditions
- High crash rates & incident delay

Project approach is to use VSL to **harmonize** traffic flow resulting in:

- Reduced crashes
- Reduced stop-and-go conditions
- Improved travel time & reliability

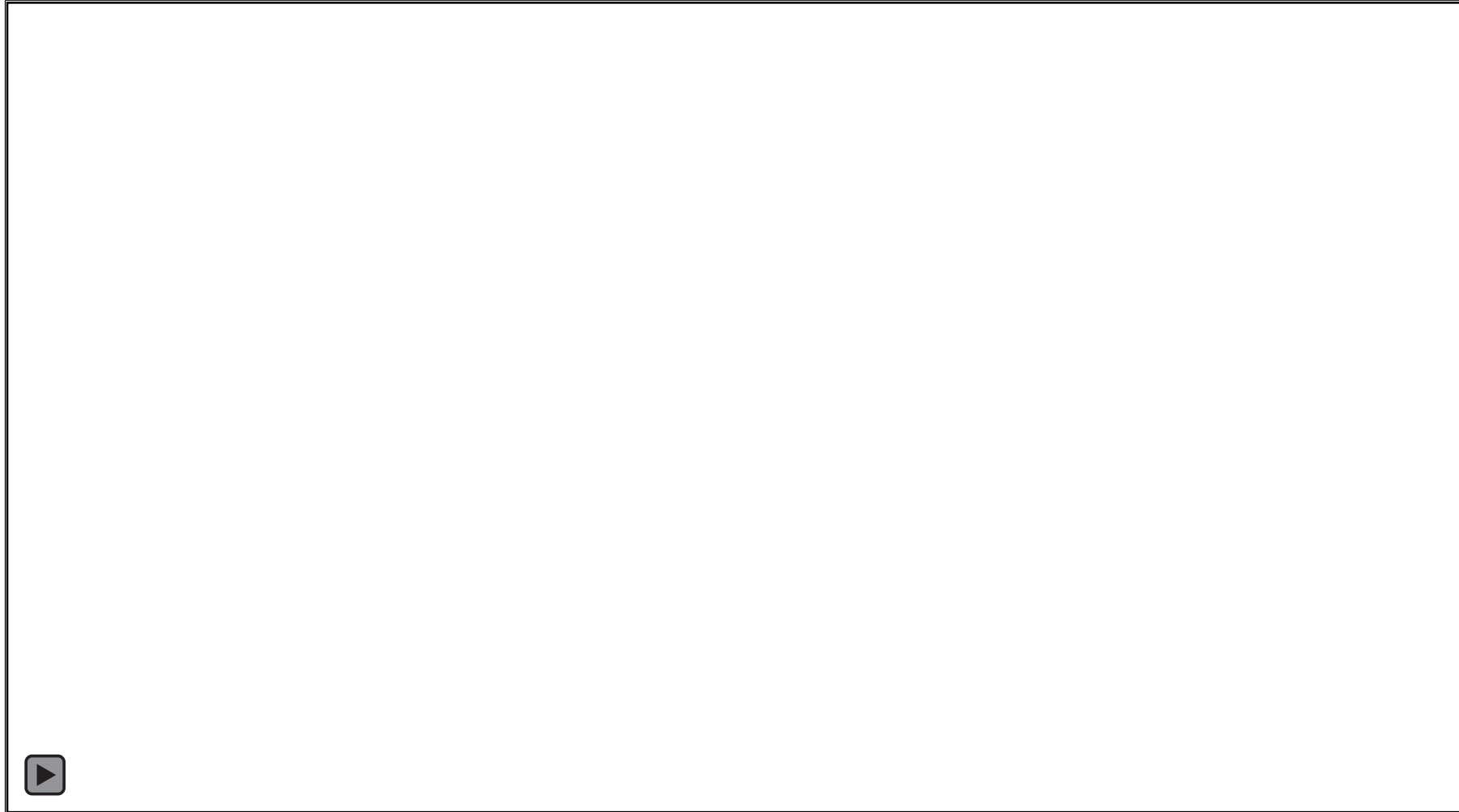


# I-95 VSL Field Elements





# Corridor Video



# Public Outreach

## Signs

- Safety rest area signs, indoor and outdoor
- I-95 northbound billboard at mile marker 98 (Doswell)



## Social Media

- Waze & Facebook ads
- Digital, geofenced display ads
- 900,000+ impressions (June 15-July 15)

## Website


- [virginiadot.org/variablespeedlimits](http://virginiadot.org/variablespeedlimits)

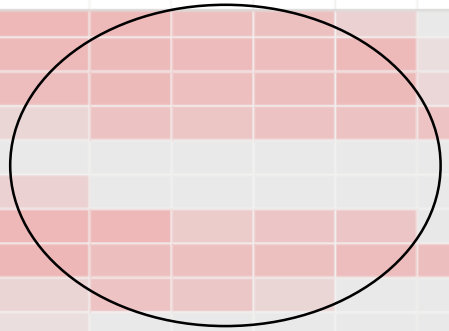
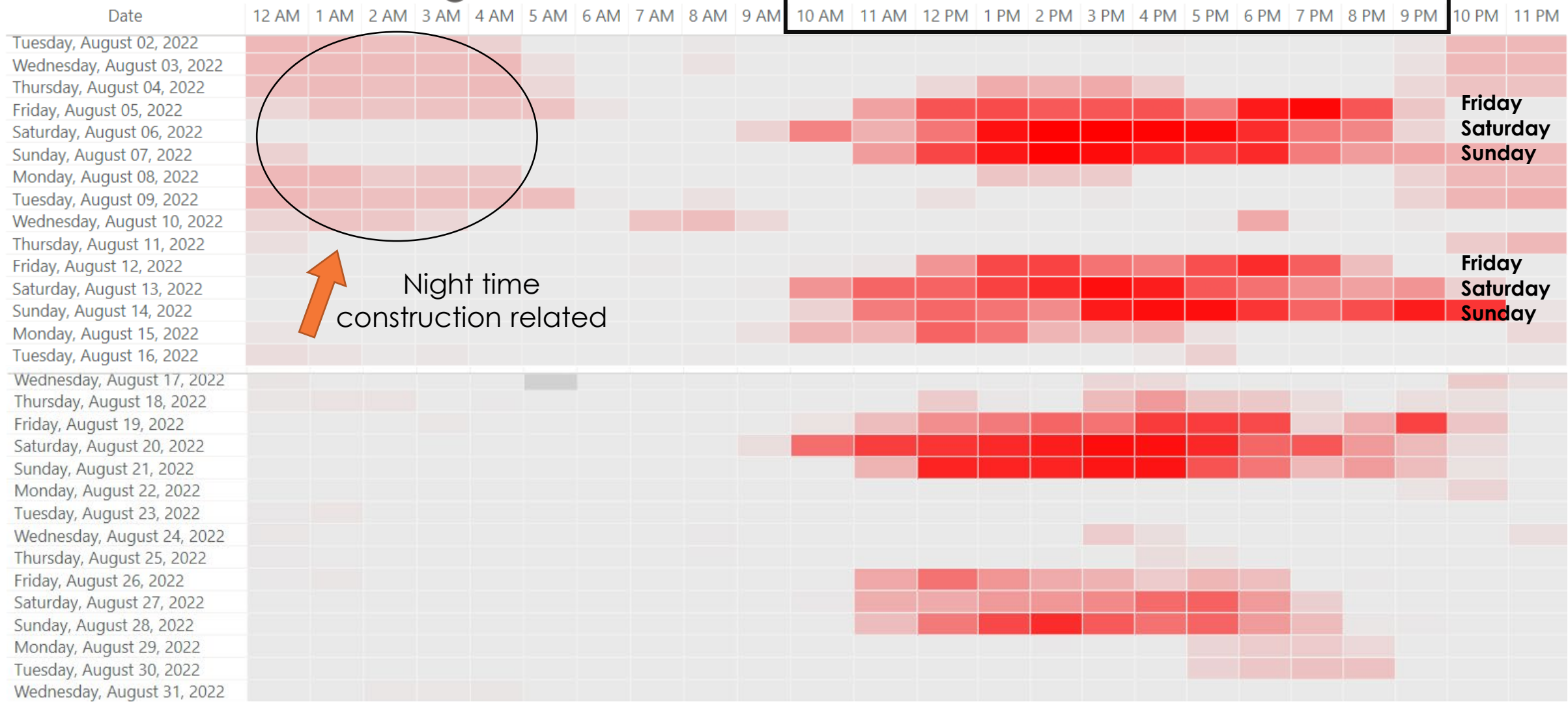




# August System Activation Patterns

Intensity of **RED** corresponds to a lower speed limit displayed for a longer time

Posted Speed Reductions throughout the Day 

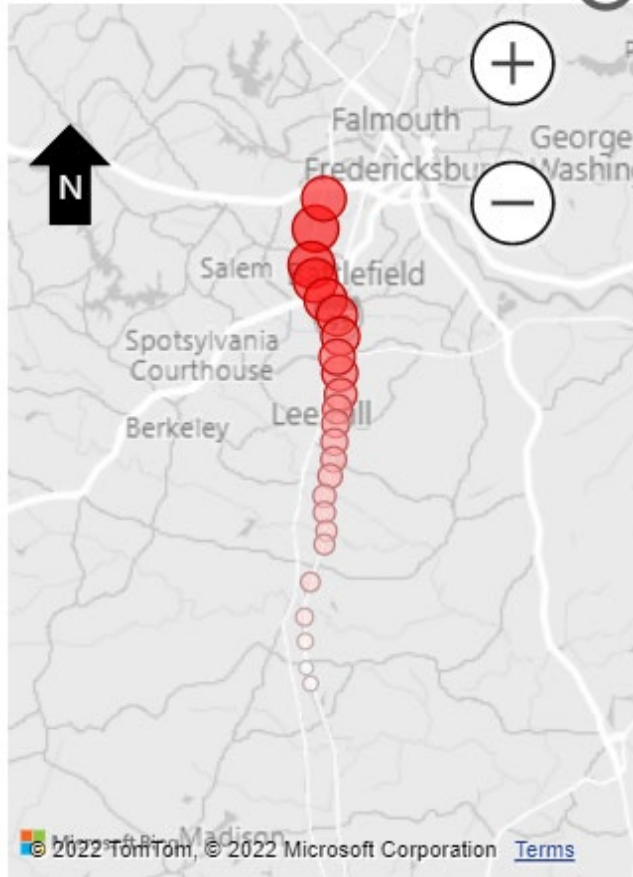


Night time construction related

# System Activation by Location

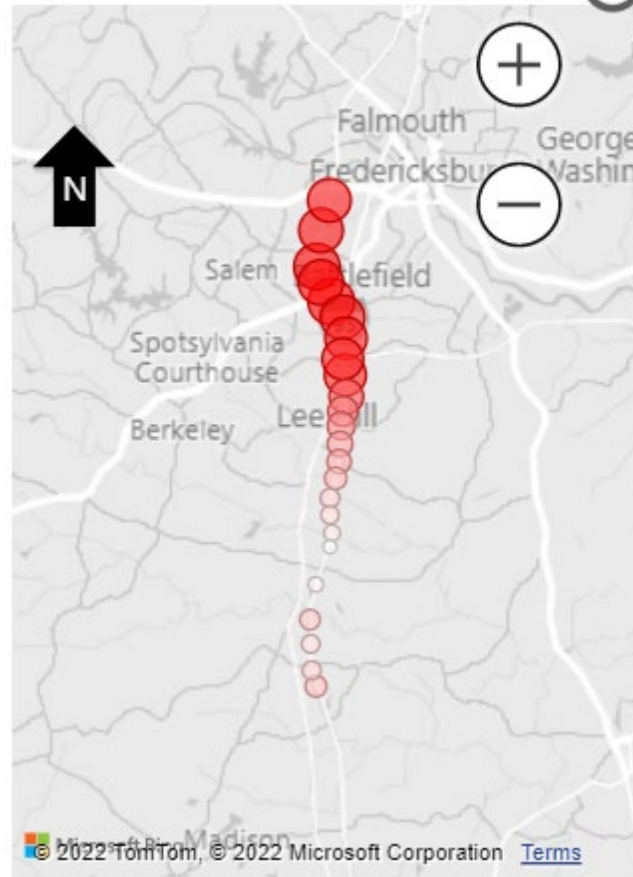
June 2022

Frequency of Speed Reductions  
by Gantry



July 2022

Frequency of Speed Reductions  
by Gantry



August 2022

Frequency of Speed Reductions  
by Gantry



Intensity of **RED** corresponds to a lower speed limit; size of circle corresponds to more frequent activation



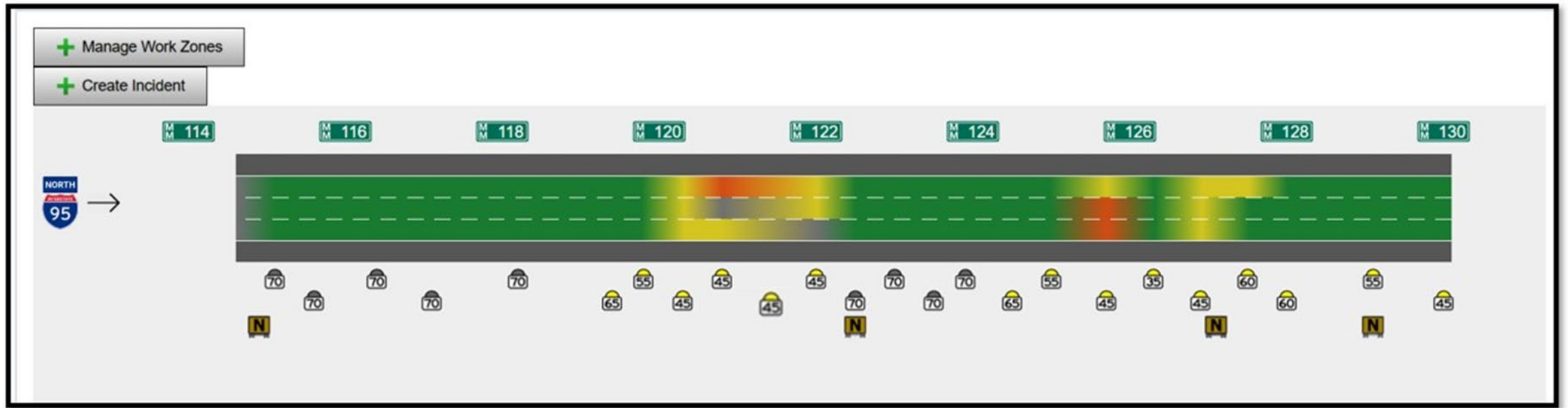
# System Management

- Detailed Algorithm Performance Review



# System Management

- Real-time System Monitoring at TOC
  - Monitoring hardware and communication status
  - Monitoring active congestion and algorithm speed recommendations



*Image captured on June 9, 2022 prior to go-live*



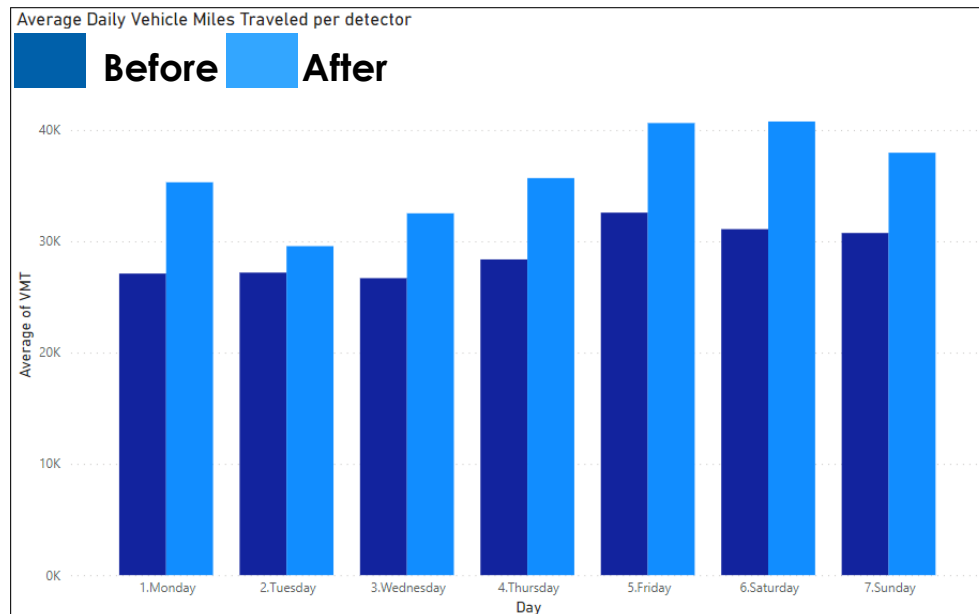
# System Evaluation Considerations



- A before/after evaluation was conducted in the corridor.  
**Before:** 1/1/22 – 3/26/22    **After:** 6/22/22 – 8/31/22
- Volume and event types changed significantly between the periods.
- The analysis attempts to address this to the extent possible.

## Traffic Volume

(Daily Vehicle Miles of Travel by Day of Week)



## Event Types

(Traffic Impacting Events)

| Event Type       | Average Hours/Day |       |
|------------------|-------------------|-------|
|                  | Before            | After |
| Crash            | 0.65              | 0.26  |
| Weather          | 0.72              | 0.07  |
| Work Zone        | 0.18              | 2.51  |
| Disabled Vehicle | 0.04              | 0.09  |

# System Evaluation - Driver Behavior



- Drivers are responding to new posted speed limits.
- Speeds were 3-4 mph slower during transitional periods (55 or 45 mph speed limits).
- Pre-activation data was processed using the VSL algorithm to determine what would have been posted in the “before” period if the system had been active.

| VSL Algorithm Recommended Speed (mph) | Before<br>(Static Speed Signs, Algorithm On) |                  |                           | After<br>(VSLs Active) |                  |                           |
|---------------------------------------|--|------------------|---------------------------|------------------------|------------------|---------------------------|
|                                       | % of Posted Speeds                           | Avg. Speed (mph) | Difference from VSL (mph) | % of Posted Speeds     | Avg. Speed (mph) | Difference from VSL (mph) |
| 65, 70                                | 96.5%  | 72               | +7                        | 89.7%                  | 71               | +6                        |
| 60                                    | 0.0%   | 63               | +3                        | 0.1%                   | 62               | +2                        |
| <b>55</b>                             | <b>0.8%</b>                                  | <b>62</b>        | <b>+7</b>                 | <b>1.5%</b>            | <b>59</b>        | <b>+4</b>                 |
| <b>45</b>                             | <b>0.6%</b>                                  | <b>52</b>        | <b>+7</b>                 | <b>1.4%</b>            | <b>48</b>        | <b>+3</b>                 |
| 35                                    | 2.1%   | 28               | -7                        | 7.3%                   | 29               | -6                        |

**Transitional Speeds**

# System Evaluation – Driver Behavior



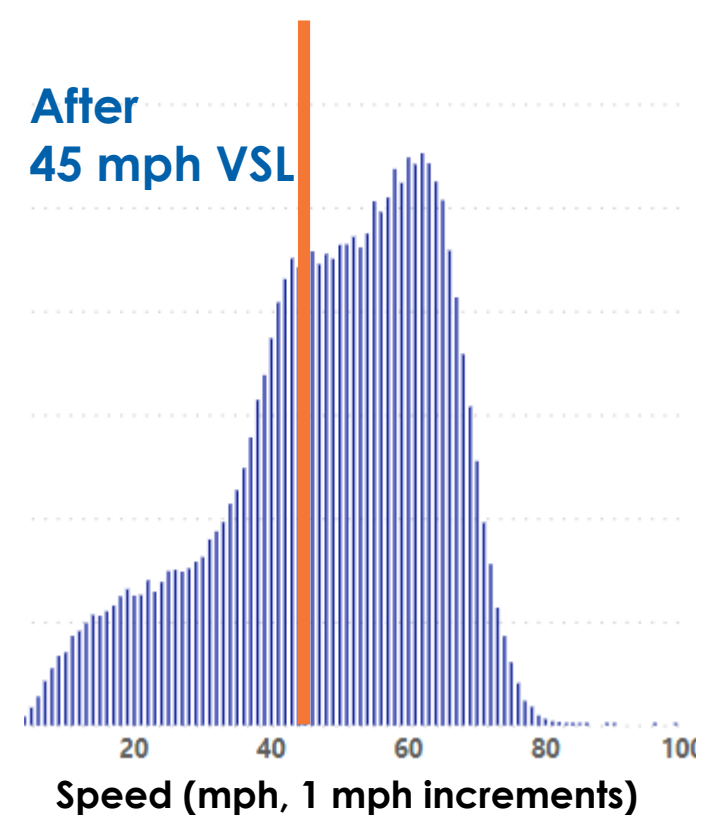
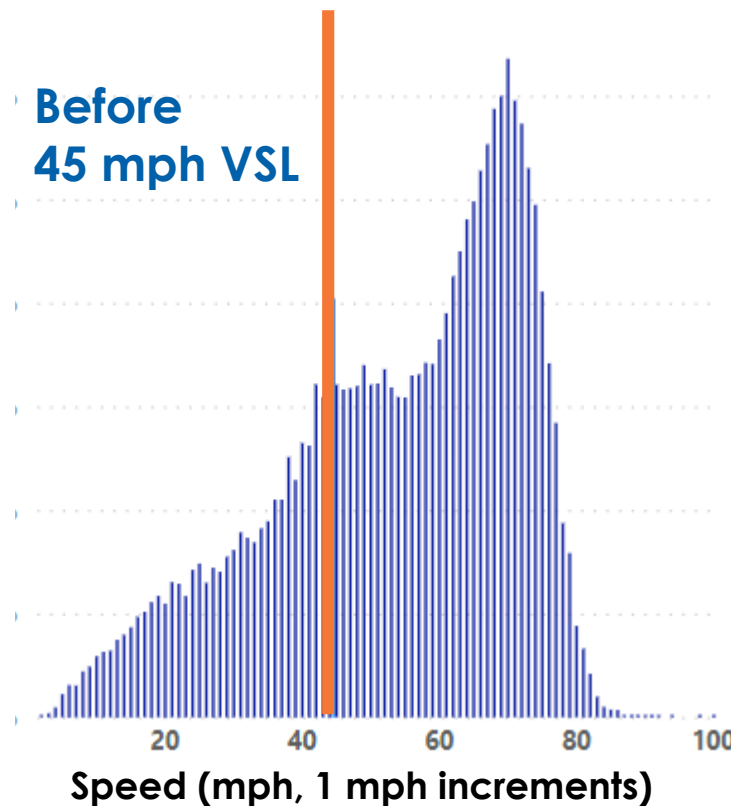
- Drivers did respond to the VSLs during transitional flow, indicating that the VSL was providing benefits in smoothing flow into congestion.
- Further improvements in driver compliance with VSLs could be beneficial.

| VSL Algorithm Recommended Speed (mph) | Before<br>(Static Speed Signs, Algorithm On) |                    |                     | After<br>(VSLs Active) |                    |                     |
|---------------------------------------|--|--------------------|---------------------|------------------------|--------------------|---------------------|
|                                       | > VSL Speed                                  | > VSL Speed +5 mph | > VSL Speed +10 mph | > VSL Speed            | > VSL Speed +5 mph | > VSL Speed +10 mph |
| 65,70                                 | 65%  | 29%                | 5%                  | 60%                    | 24%                | 4%                  |
| 60                                    | 74%  | 52%                | 25%                 | 66%                    | 35%                | 8%                  |
| <b>55</b>                             | <b>81%</b>                                   | <b>74%</b>         | <b>62%</b>          | <b>78%</b>             | <b>65%</b>         | <b>44%</b>          |
| <b>45</b>                             | <b>69%</b>                                   | <b>61%</b>         | <b>53%</b>          | <b>62%</b>             | <b>51%</b>         | <b>39%</b>          |
| 35                                    | 29%  | 21%                | 14%                 | 32%                    | 21%                | 12%                 |

# System Evaluation – Driver Behavior



- Drivers reacted to VSLs by traveling closer to the recommended speed

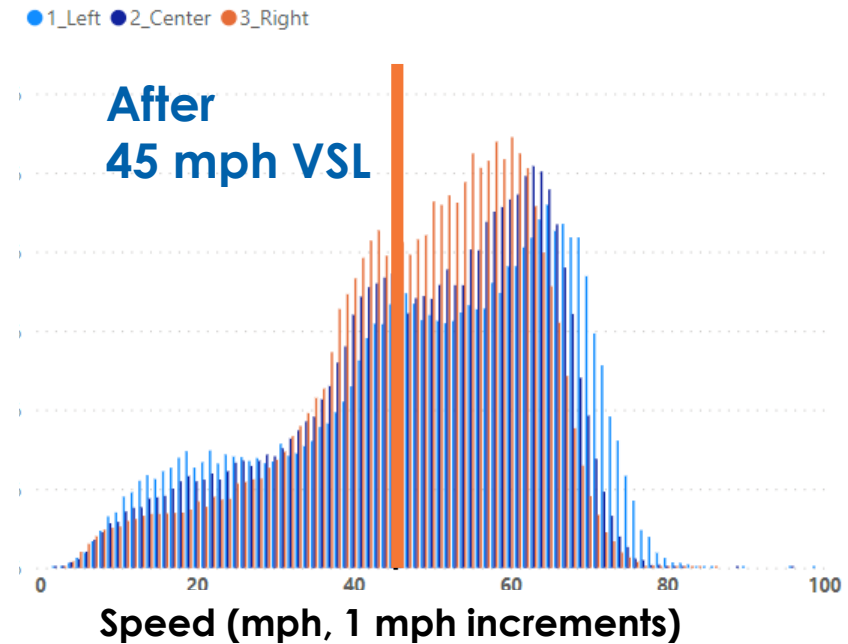
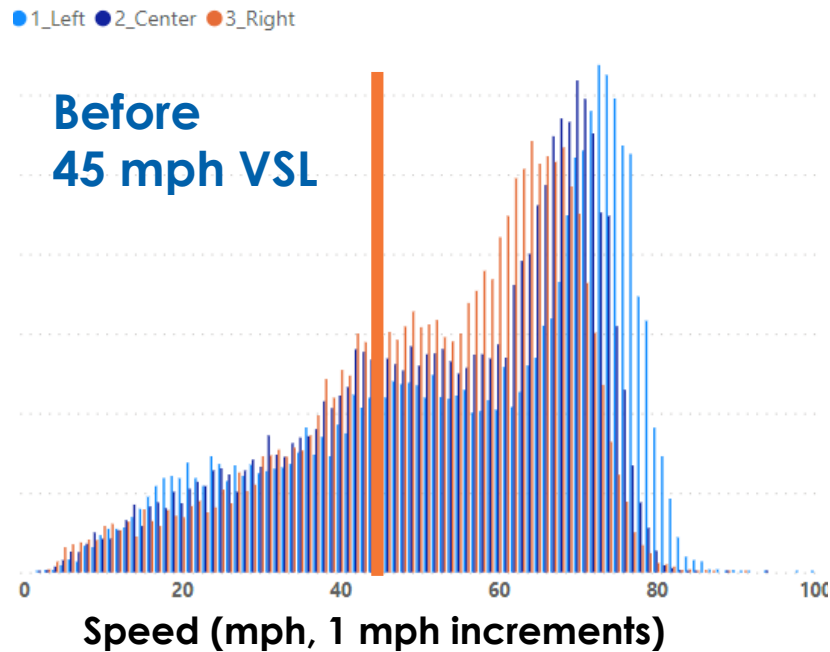




# Speed Harmonization Improvement



- Speed differentials between lanes have decreased since VSL activation



| Period | Speed Differential (mph) |              |
|--------|--------------------------|--------------|
|        | Left-Center              | Center-Right |
| Before | 2.4                      | 1.4          |
| After  | 1.0                      | 0.3          |

# System Evaluation – Safety



- Crashes were compared between milepost 115 and 130 from system activation through July 31 (most recent finalized data).
- **Crashes are rare and random events. Trends from 5 weeks of VSL activation data are a small sample and should be viewed with caution.**

| Year        | Crash Counts                               |                             |                   |                             |
|-------------|--|-----------------------------|-------------------|-----------------------------|
|             | January 1 - June 21                        | % Change from Previous Year | June 22 - July 31 | % Change from Previous Year |
| 2019        | 78   | -21%                        | 34                | -29%                        |
| 2020        | Omitted due to pandemic effects on traffic |                             |                   |                             |
| 2021        | 99   | +27%                        | 42                | +24%                        |
| <b>2022</b> | <b>137</b>                                 | <b>+38%</b>                 | <b>35</b>         | <b>-17%</b>                 |

# Conclusions

- Based on initial results, the system is working as designed.
- Drivers are reacting to the VSLs.
  - Average speeds have decreased 3-4 mph when the transitional 45 and 55 mph speed limits are posted.
  - Speed differentials have declined between lanes. Speed harmonization is occurring.
  - Early crash results show positive trends.
- Safety and operational results will continue to be monitored. Updated results will be reported to the Board at a future meeting.