



Utah's Smart Work Zone System Implementation

Kimley»Horn

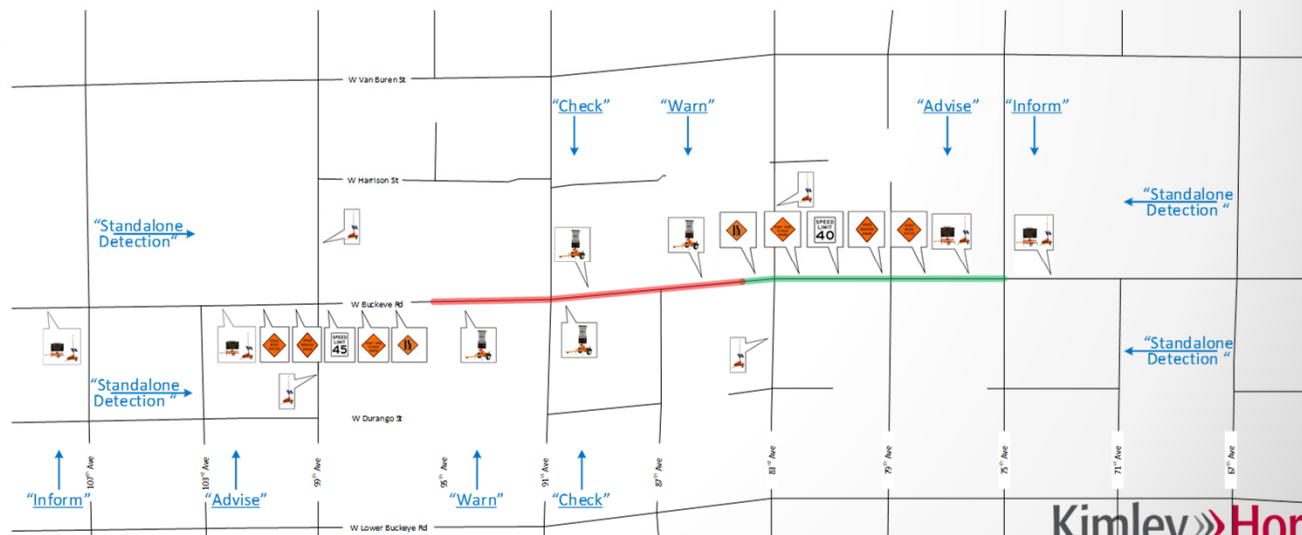
Expect More. Experience Better.



SWZ Concepts – Lots of Options!

Table 3 – SWZ Core Components and Applications Summary

		LENGTH OF WORK ZONE			
		< 1 MILE	1-2 MILES	> 2 MILES (WITHOUT INTERSECTION IN WORK ZONE)	> 2 MILES (WITH INTERSECTION IN WORK ZONE)
DISTANCE BETWEEN INFORM LOCATION AND WORK ZONE	> 2 MILES	INFORM - message sign, detector ADVISE (multiple locations may be necessary) - message sign, detector WARN - CCTV, speed assignment, detector CHECK (may not be needed) - speed feedback, detector	ADDITIONAL INFORM (may not be needed) - message sign INFORM - message sign, detector ADVISE (multiple locations may be necessary) - message sign, detector WARN - CCTV, speed assignment, detector CHECK - CCTV, speed feedback, detector	ADDITIONAL INFORM (may not be needed) - message sign INFORM - message sign, detector ADVISE (multiple locations may be necessary) - message sign, detector WARN - CCTV, speed assignment, detector CHECK (one per mile will be necessary) - CCTV, speed feedback, detector	ADDITIONAL INFORM (may not be needed) - message sign INFORM - message sign, detector ADVISE (multiple locations may be necessary) - message sign, detector WARN - CCTV, speed assignment, detector CHECK (one per mile between intersections within work zone will be necessary) - message sign, CCTV, speed assignment and/or speed feedback, detector
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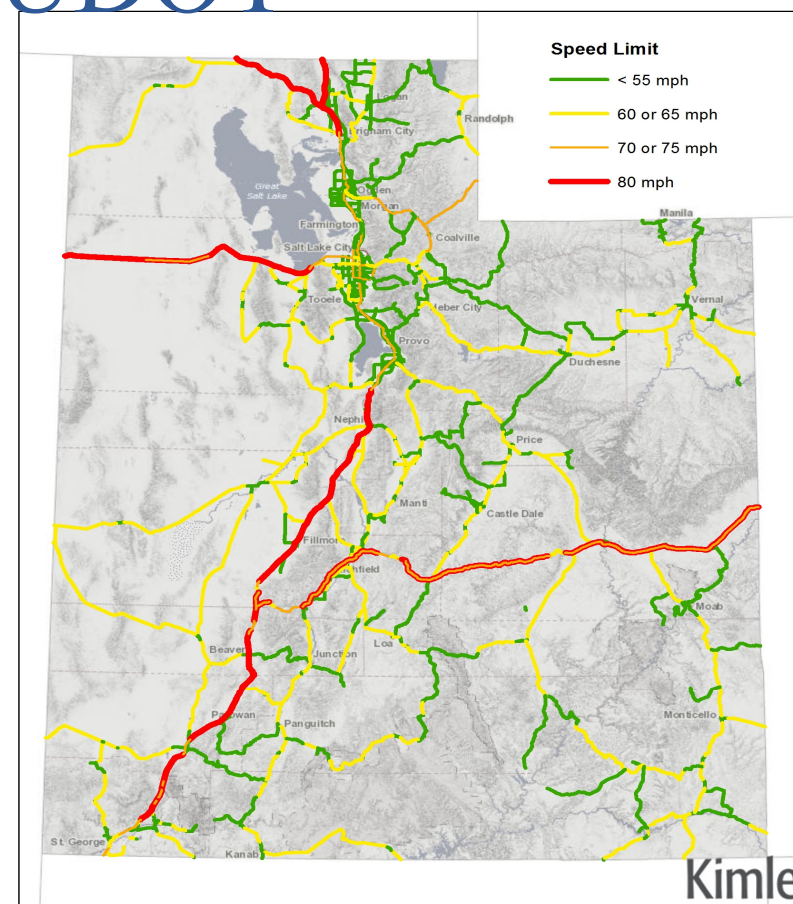
Overview of UDOT

➤ Centerline Miles by Type

- 935 miles of Interstate
- 2,945 miles of Level 1 (AADT>1,000)
- 1,985 miles of Level 2 (AADT<1,000)
- 5,865 miles total

➤ Speed Limits

- 13% @ 80 mph
- 35% @ 70mph or higher
- 60% @ 60mph or higher
- 82% @ 50mph or higher





Portable Variable Speed Limit (PVSL) System

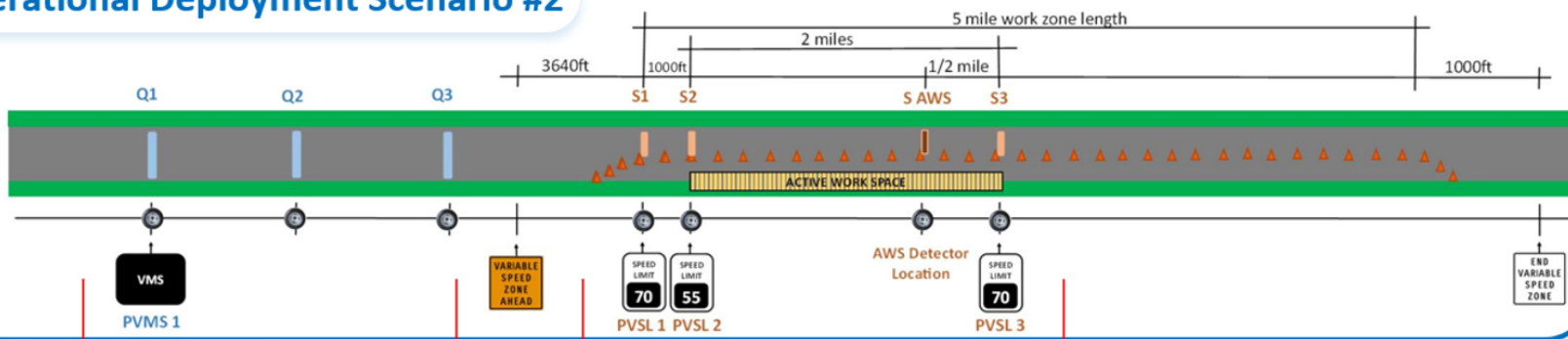
Project Goal

Goal: Improve safety within construction work zones through significant reduction in traveler speed within the boundary of Active Work Space.

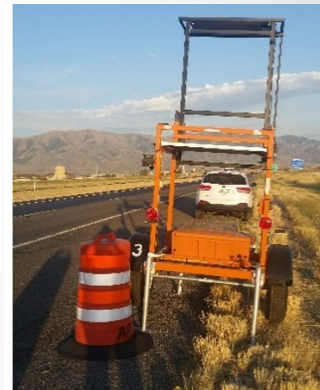


PVSL System - Overview

Operational Deployment Scenario #2



PVSL Trailer



Traffic Detector Trailer

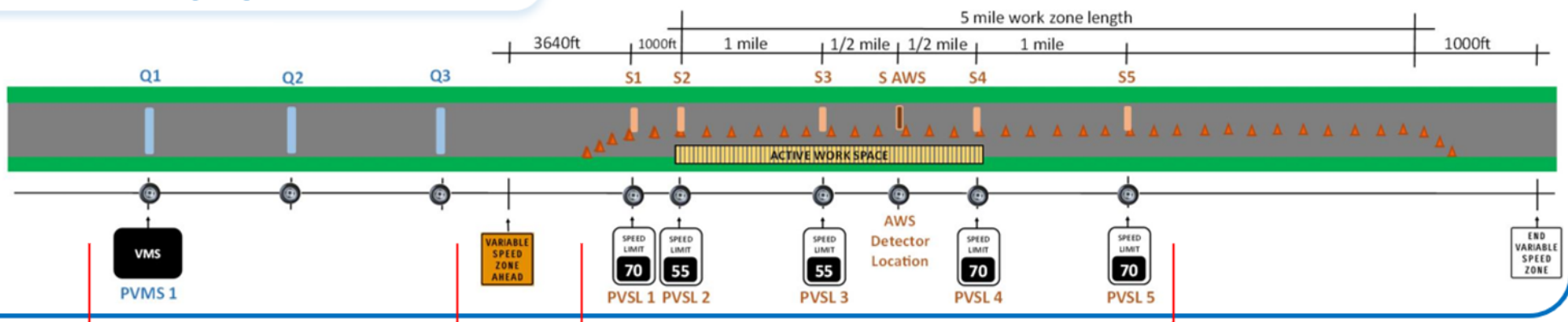
Queue Warning Subsystem

VSL Subsystem



PVSL System - Overview

Operational Deployment Scenario #3



Queue Warning Subsystem

VSL Subsystem



PVSL System - Overview

- Communications

- Wireless Cellular Gateway



- Power

- Solar Powered Trailers
- 7-day Battery Capacity with NO Sun Light

- Traffic Detectors

- Forward Fire K-Band Doppler Radar
- Easy/Fast Deployment

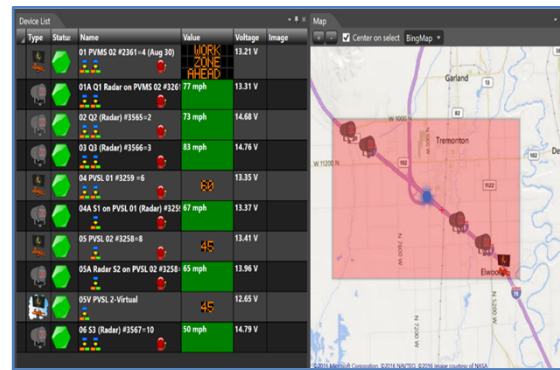




PVSL System - Overview

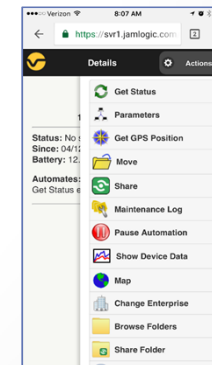
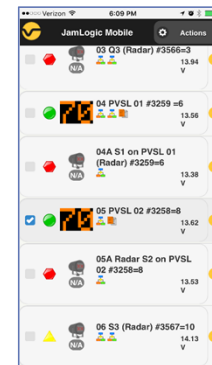
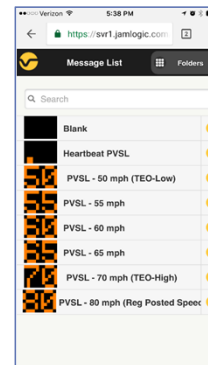
- Control System

- Remote / Web-based Platform
- Jam-Logic by Ver-Mac
- No Integration with TMC
- Contractor Controlled



- Portable Operator Interfaces

- Laptop PC Application
- Cell Phone / Notebook Application

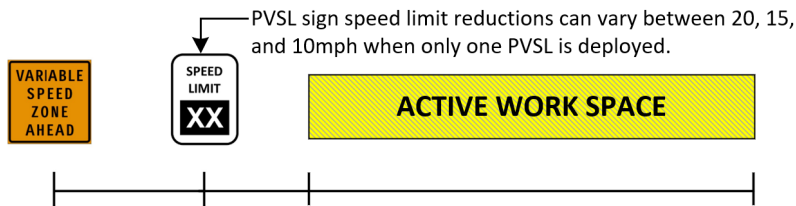




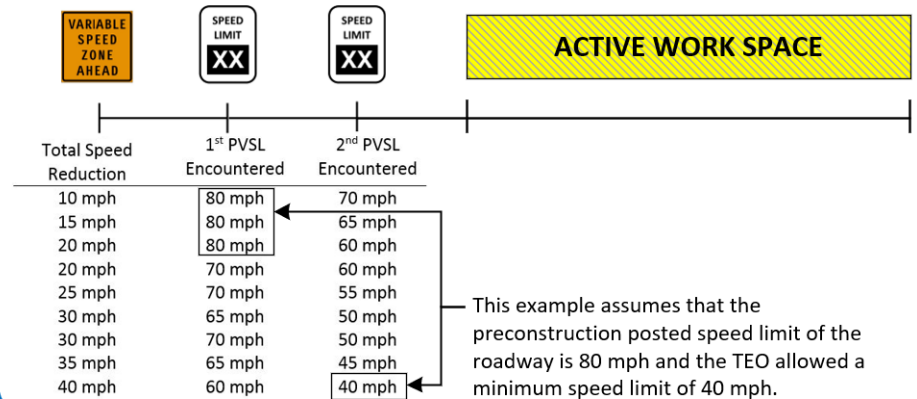
Challenges - Max Speed Limit Drop per PVSL Trailer

- 10-mph was UDOT's Standard Practice
 - 40-mph Drop = 4 Speed Limit Signs
- UDOT decided on 20-mph for PVSL Trailers

Speed Limit Rules For One-Step Speed Limit Reduction (20mph Max Drop)



Speed Limit Rules For Two-Step Speed Limit Reduction (40mph Max Drop)





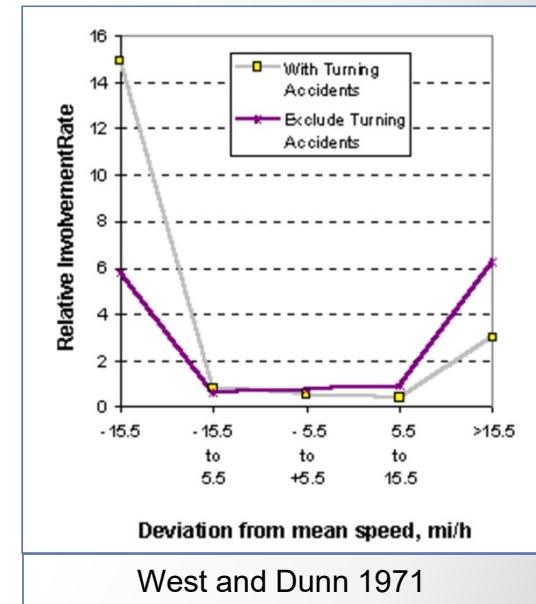
Challenges – Significant Reduction of Speed Limits

- UDOT Typical WZ Speed Limits (Max & Min)
 - Established by a Traffic Engineering Order (TEO)
 - Typically No more than 10 mph permitted
- Justification for Significant Reduction
 - Concept of Schools Zones
 - In Utah... only at crossings = excellent compliance
 - Why – Balance of Significant Speed Reduction w/ Shorter Length of Impact
 - Result – Greater Compliance
 - Limited AWS Length (1.5 – 2 miles)
 - More Significant Speed Reduction Permitted



Challenges – How to Automate Regulatory Speed Limits

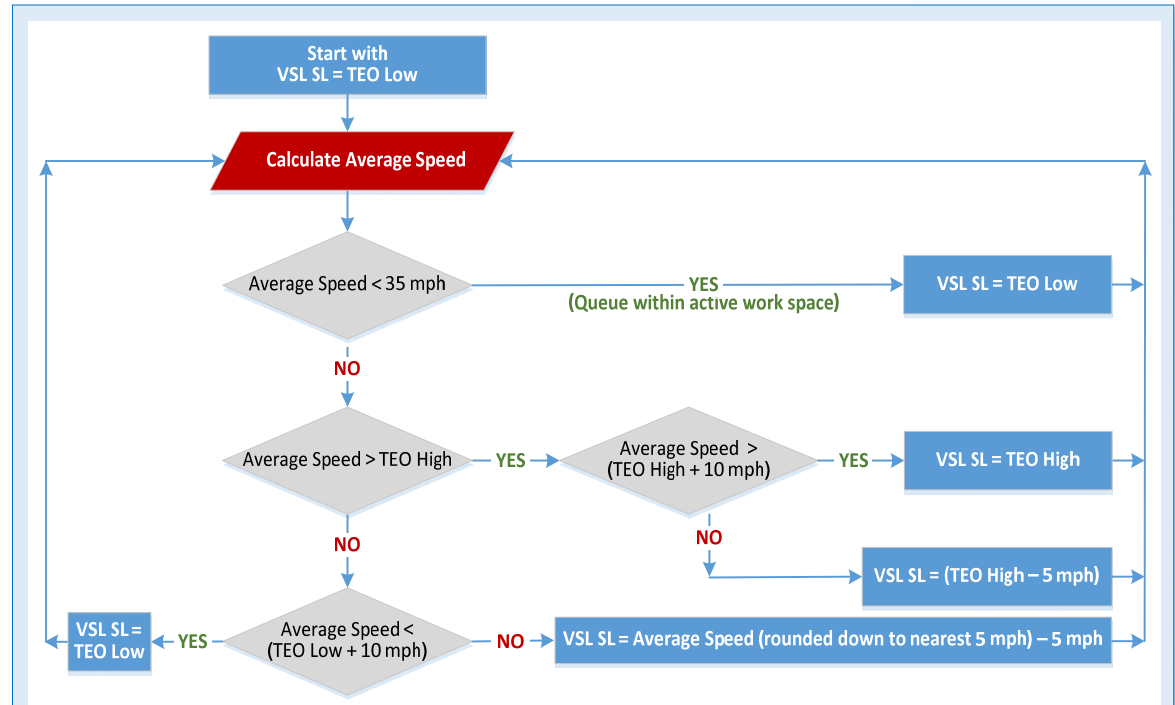
- Algorithm to Raise/Lower Speed Limits
 - Never Done Before
 - For this Type of SWZ Application
 - Speed Harmonization Principles
 - >15mph Deviation = More Accidents
 - Algorithm Lessons Learned
 - Current Speed => 5 Minute Rolling Average
 - Frequency of Speed Limit Change => 15 Minute Minimum
 - Bad or No Data Received => VSL Speed Limit = Last Known Limit





VSL Algorithm

- Algorithm Lesson Learned
 - VSL SL =
 - Average Speed
 - Rounded Down to 5mph Increment
 - Minus 5mph



Legend:

Average Speed = Calculated Average Speed based on rolling 5 minutes of speed measurements in active work space .

VSL SL = Speed limit posted on VSL sign.

TEO High = Maximum speed allowed by TEO, typically "Original Posted Speed" or "Original Posted Speed - 10 mph".

TEO Low = The lowest speed limit allowed by TEO.

Frequency of Speed Limit Change = Minimum of 15 minutes between speed limit changes

Bad or No Data Received => VSL SL = Last known VSL SL



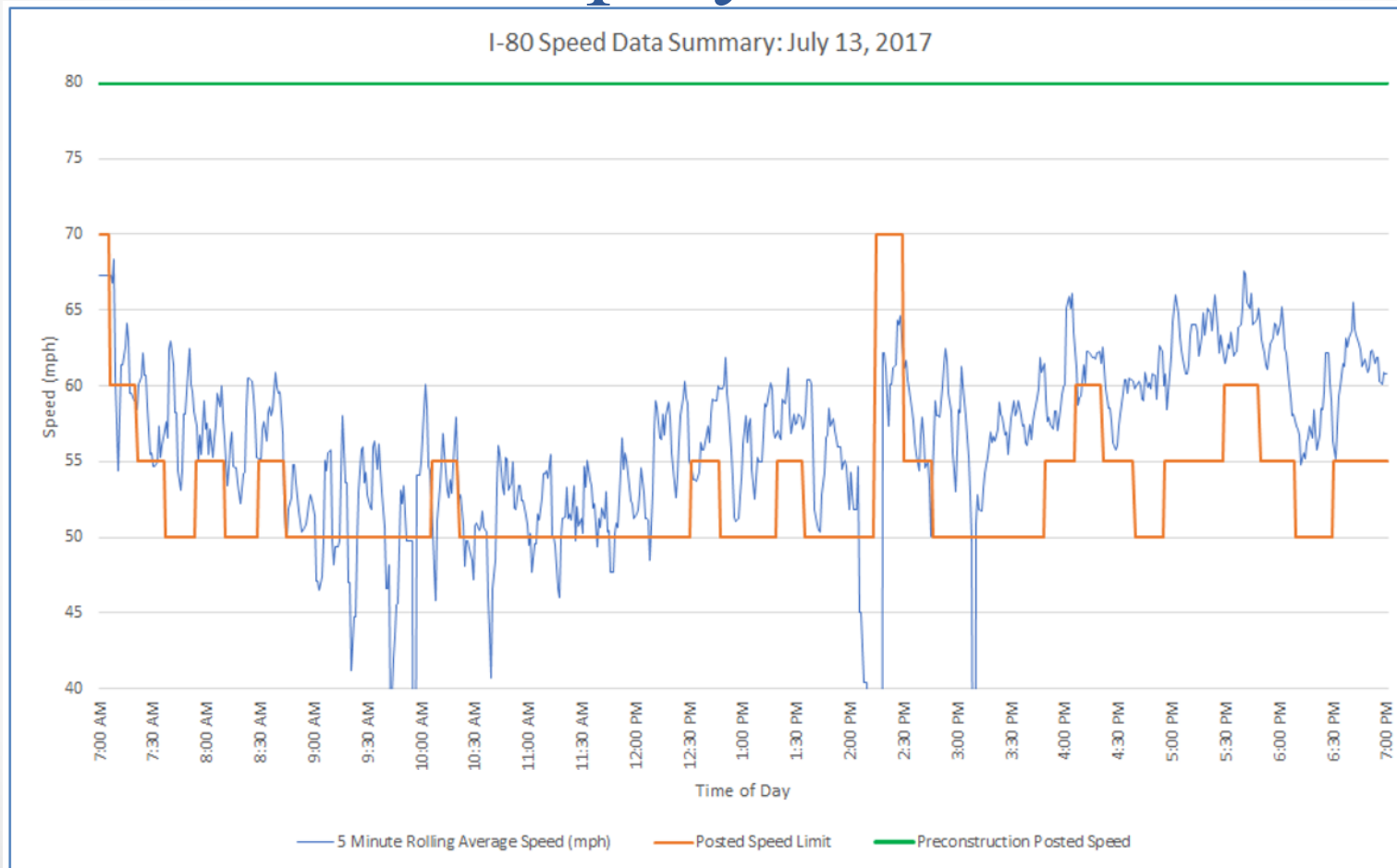
Work Zone Deployments / Evaluation

- Project Year Deployment Scheduling

Project/Name/Posted Speed/TEO LOW Speed		Location	Type of Construction	AADT and Number of Lanes	Operations Scenario Tested
Y1P1	Tremonton Posted Speed Limit = 80 mph TEO LOW Speed = 45 mph	I-15; Honeyville to Tremonton	Mill, paving, and bridge repair	22,000 AADT 4-lane divided highway	Scenario #2
Y2P1	Meadow Posted Speed Limit = 80 mph TEO LOW Speed = 50 mph	I-15; Baker Canyon to Meadow	Mill and paving	12,000 AADT 4-lane divided highway	Scenario #2
Y2P2	Honeyville Posted Speed Limit = 80 mph TEO LOW Speed = 50 mph.	I-15; Corinne to Honeyville	Mill and paving	22,000 AADT 4-lane divided highway	Scenario #2
Y2P3	I-80 Posted Speed Limit = 80 mph TEO LOW Speed = 50 mph	I-80; milepost 20 to 30	Mill and paving	7,500 AADT 4-lane divided highway	Scenario #3



Work Zone Deployments / Evaluation





Speed Compliance

Project	Speeds < 10mph Over Posted Speed		10mph < Speeds < 15mph		Speeds >=15mph Over Posted Speed	
	Baseline	PVSL	Baseline	PVSL	Baseline	PVSL
Y1P1, Tremonton	23%	37%	10%	15%	67%	48%
Y2P1, Meadows	88%	58%	9%	29%	3%	13%
Y2P2, Honeyville	N/A	60%	N/A	29%	N/A	10%
Y2P3, I-80	43%	81%	42%	14%	15%	6%

Speed Compliance After Finetuning Algorithm Parameters



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