Automated Variable Speeds in Rural and Urban Environments in Oregon

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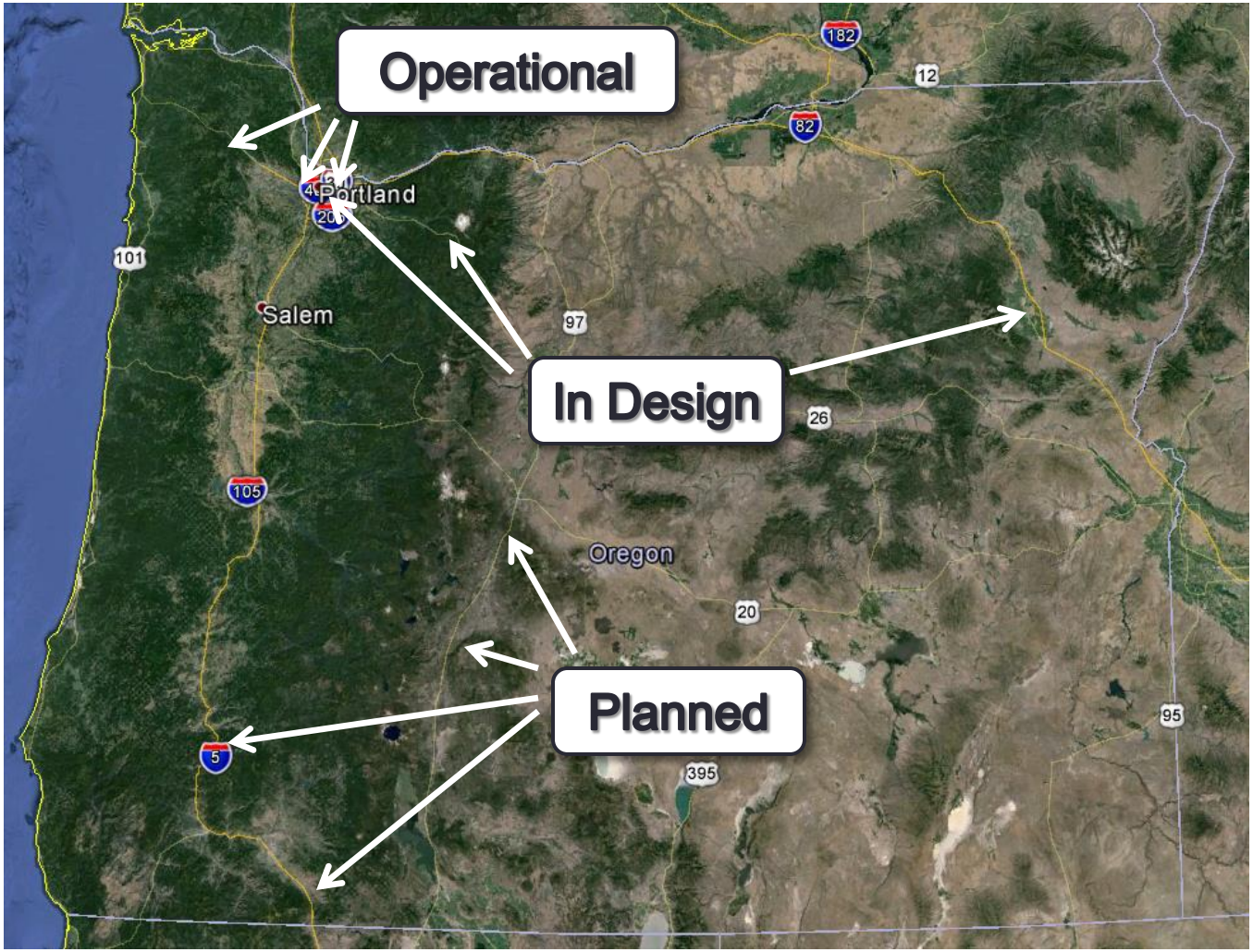
Outline

1. Variable Speed Systems in Oregon
2. Variable Speed Concepts
3. Variable Speed Algorithms
4. Deployment Planning Example
5. Implementation Results

Variable Speed Systems in Oregon



Variable Speed Systems in Oregon

Oregon DOT brands their system as “ODOT RealTime”

http://www.tripcheck.com/realtime/

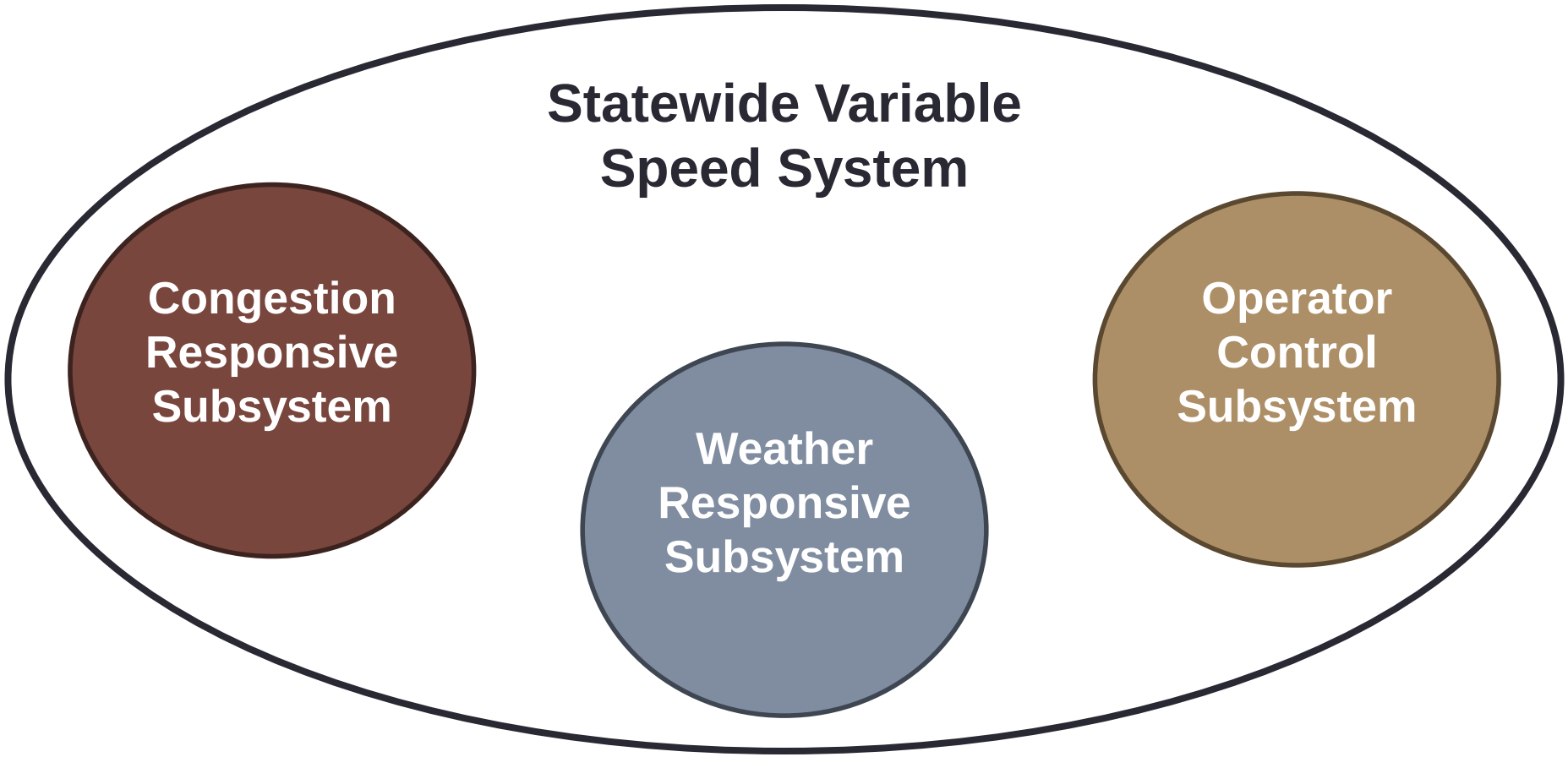
Statewide Variable Speed System

- **Primary Goal:** Provide an engineering solution that improves safety in high crash locations related to weather and/or congestion

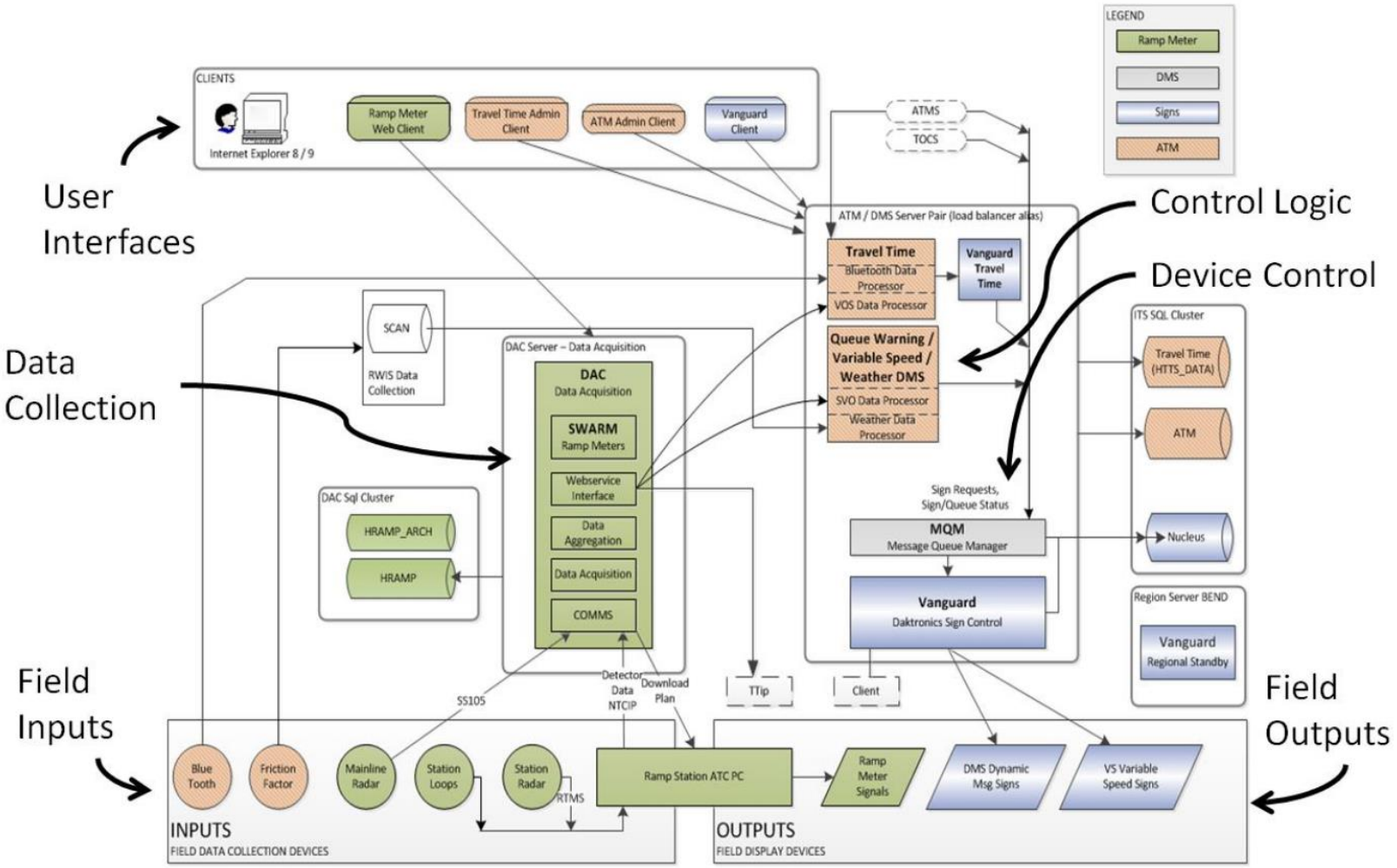
- **Secondary Goal:** Consistency of deployments and operations.

Source: gtspirit.com

Multiple Variable Speed Subsystems



Automation Requires Integration

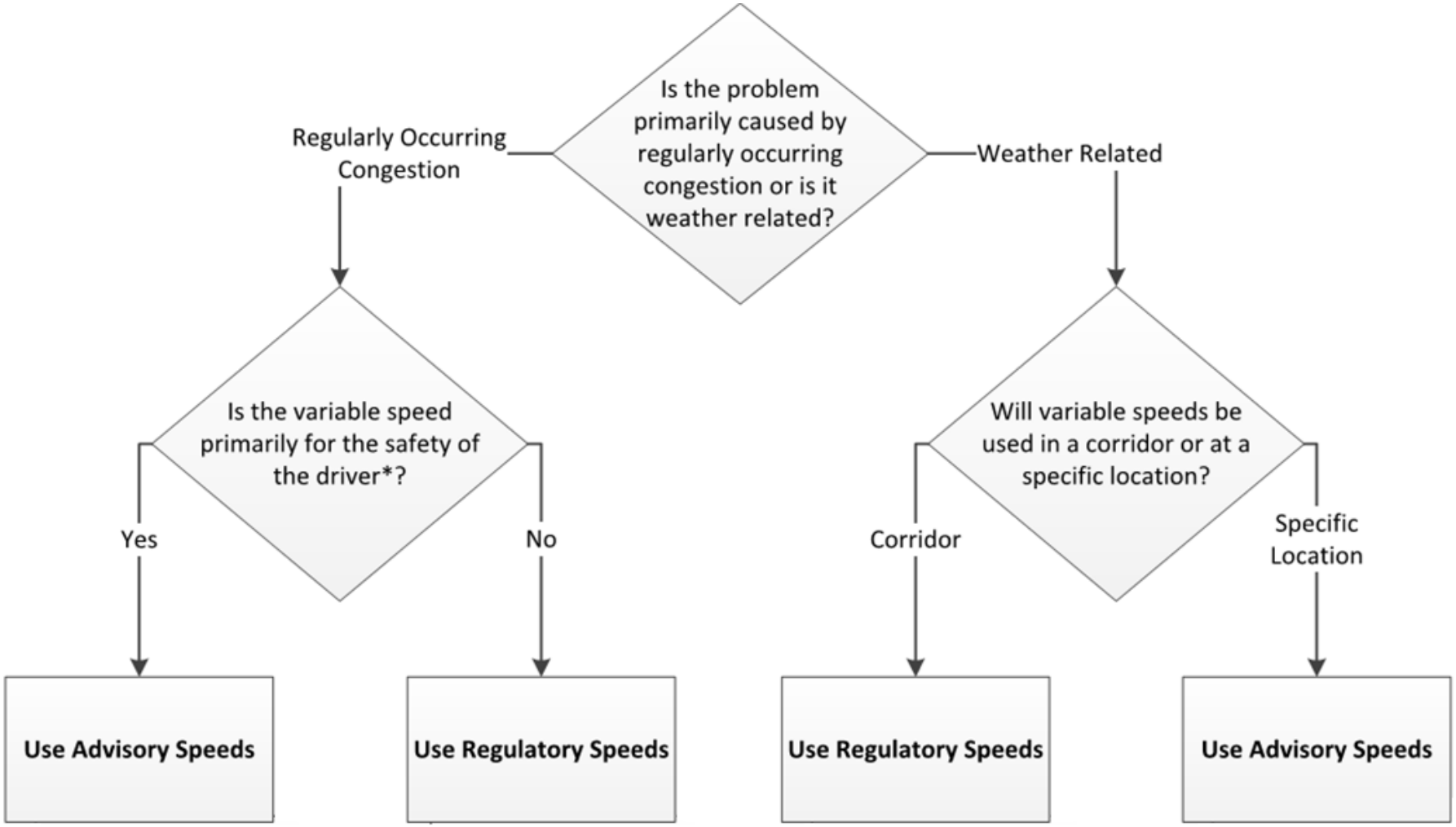


Regulatory vs. Advisory Speeds

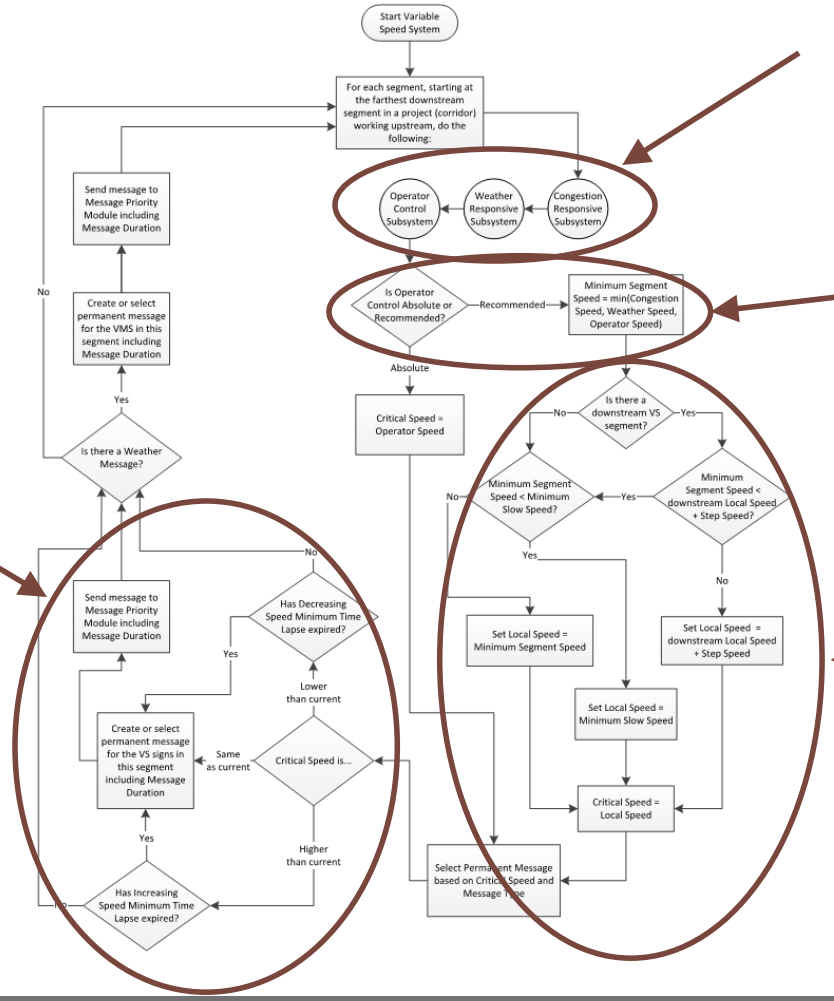
Key Differences

	Regulatory	Advisory
Compliance	• 40% exceed posted speed	• 75% exceed advisory speed
Enforcement	• Posted speed is directly enforceable	• Enforced through basic speed rule
Roadway	• > 2 miles	• Single geometric feature, or varying conditions
Public Perception	• Tied to revenue generation? • Larger responsibility to display credible speed limits	• More accepting, no direct financial implications
Legal Requirements	• Engineering study • Speed zone order • OAR amendment for freeways	• Engineering study recommended

Determine Correct System



Variable Speed Algorithms



3 variable speed subsystems

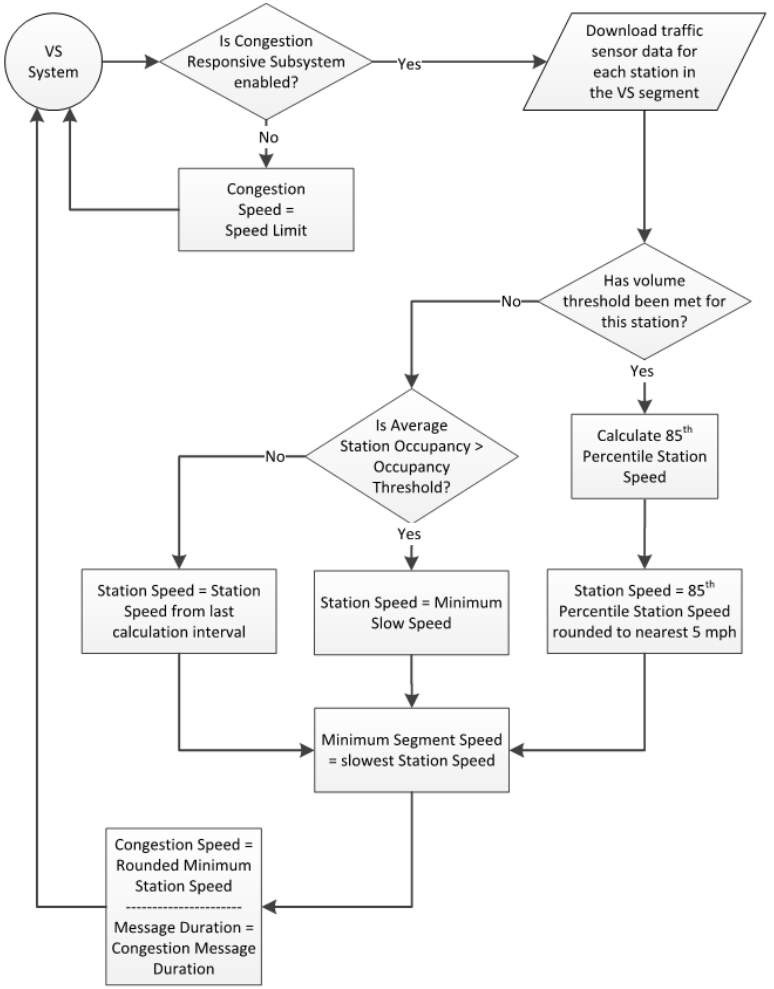
Identifies lowest recommended speed

Time requirements logic

Subzone relationship logic

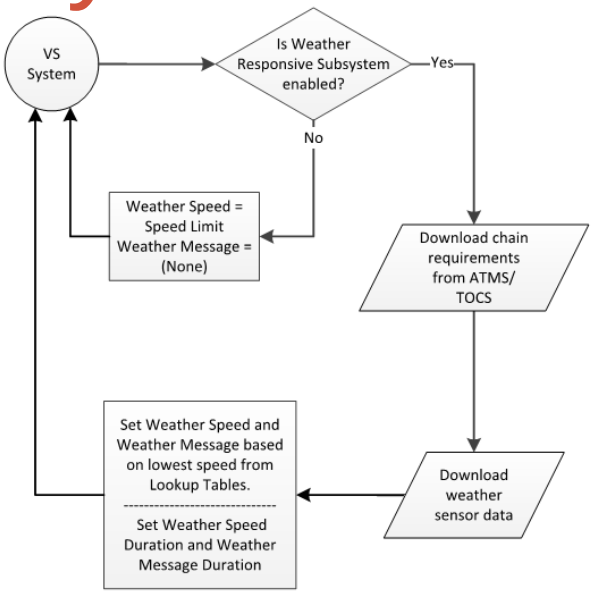
Congestion Responsive Subsystem

- Uses volume, occupancy, and speed from relevant detectors
- Performs volume and occupancy checks to determine traffic state
- Determines appropriate speed based on 85th percentile speeds
  - Must be within 9 mph of 85th percentile



Weather Responsive Subsystem

- Uses visibility and road surface conditions (grip factor) from relevant RWIS
- Depends on current chain requirements for the area



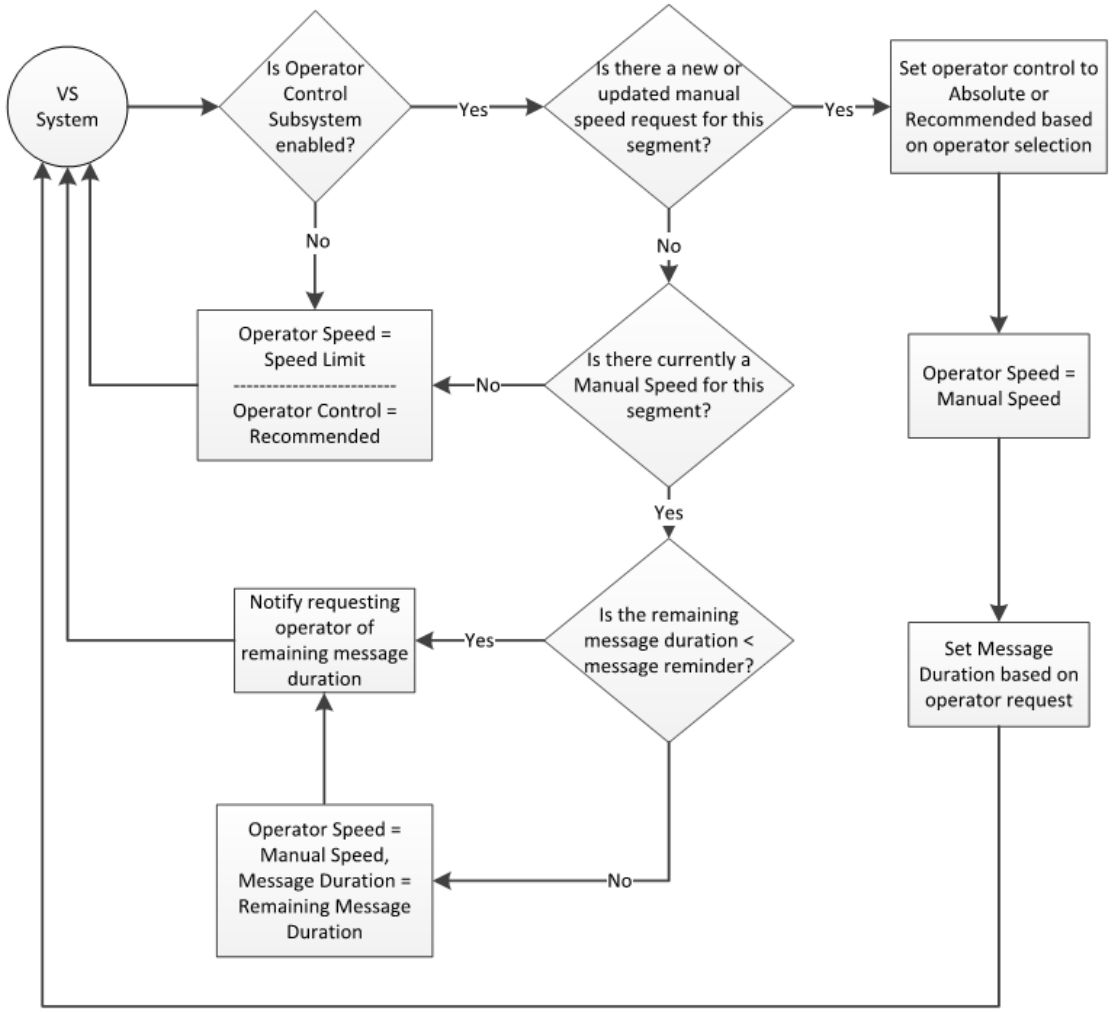
Weather Speed Lookup Tables

Visibility \ Grip Factor	> 0.70 (Dry to Wet)	0.70 > X > 0.30 (Very Wet)	< 0.30 (Snow or Ice)
> 500'	Speed Limit	Speed Limit - 10 MPH	Speed Limit - 20 MPH
< 500'	Speed Limit - 10 MPH	Speed Limit - 20 MPH	Minimum Speed

Visibility \ Chain Condition	B or B1 (Towing or > 10,000 lbs)	C (Chains Required)
> 500'	45 MPH	35 MPH
< 500'	35 MPH	Minimum Speed

Operator Control Subsystem

- Manual speed selection by segment or corridor
- Can be recommended or absolute control
- Automatic time expirations
- Non-engineer operators have 10 pre-approved responses



Pre-approved Operator Responses

- If automatic systems are not responding adequately, operator can recommend lower speeds
- Anything else requires state traffic engineer approval

Condition	Speed	Command Priority	Duration (Default)
Standing Water / Spots of Ice	Posted Speed - 10	Recommended	30 min
Black Ice / Packed Snow Significant Traction Problems	Posted Speed - 20	Recommended	30 min
Black Ice / Packed Snow Significant Traction Problems Not Resolved in Above Condition	Minimum Slow Speed	Recommended	30 min
Ice / Packed Snow Plus Low Visibility	Minimum Slow Speed	Recommended	30 min
Condition B or B1 Chain Requirement in Effect	45	Recommended	30 min
Condition C Chain Requirement in Effect	35	Recommended	30 min
Visibility Less Than 500 Feet	Posted Speed - 10	Recommended	30 min
High Winds	Posted Speed – 10	Recommended	30 min
Work Zones Based on Approved Temporary Speed Zone Order	Speed Zone Order Value	Recommended	1 week
False Sensor Readings	Posted Speed	Absolute	48 hours

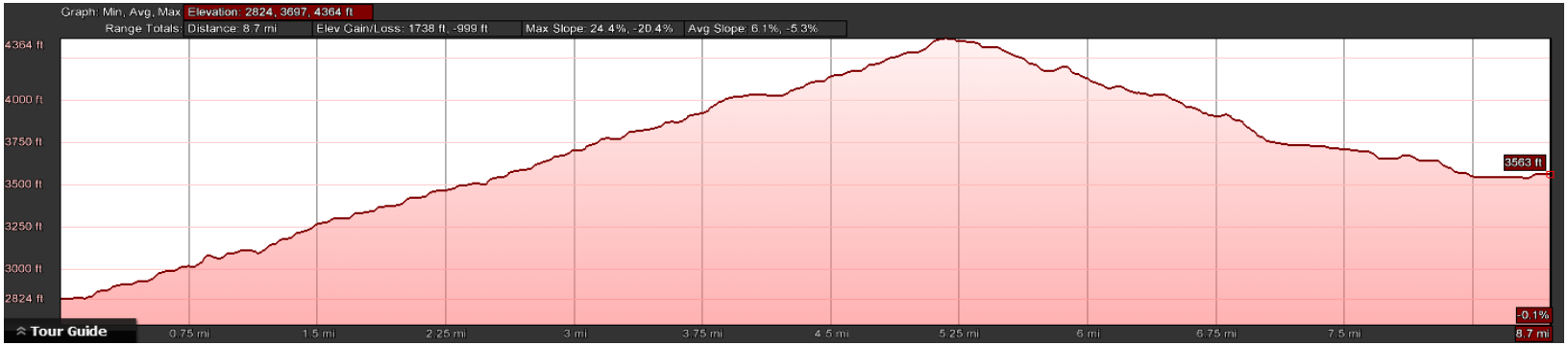
Deployment Planning

- Do your systems engineering analysis first.
  - Use the right tool to solve the problem.

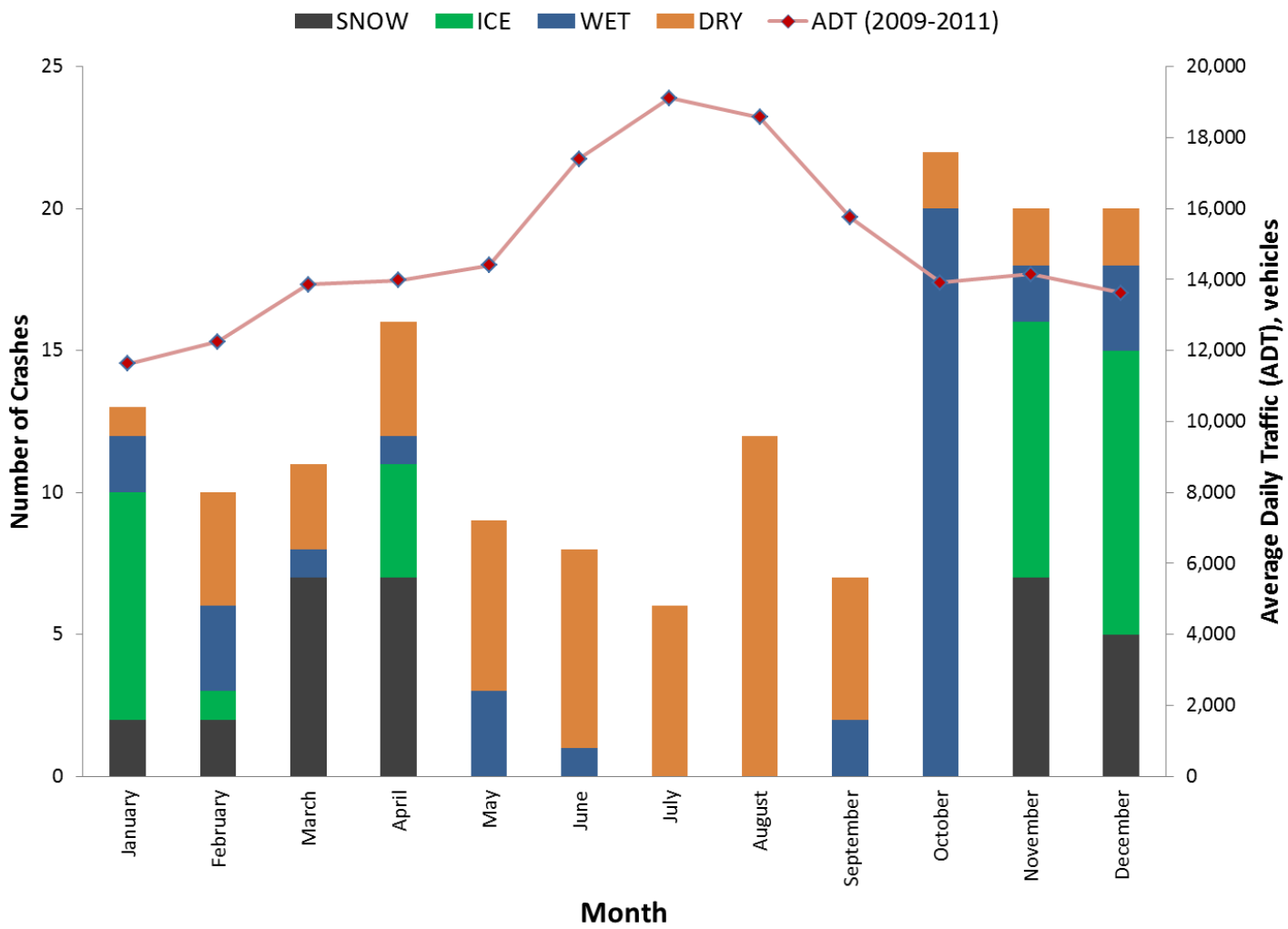
Legal Stuff

- Oregon Administrative Rules:
  - OAR 734-020-0018 requirements for public roads
  - OAR 734-020-0019 criteria for interstate freeways
- Engineering study must consider and document:
  - Same factors a prudent driver considers including congestion, road conditions, visibility, and weather
  - Boundaries of the variable speed zone
  - Location of each sign
  - Set of algorithms
  - Speed change intervals
  - Means, responsibilities, and procedures for changing speed
  - Means, responsibilities, and procedures for keeping records

Planning Example: I-5 Siskiyou Pass

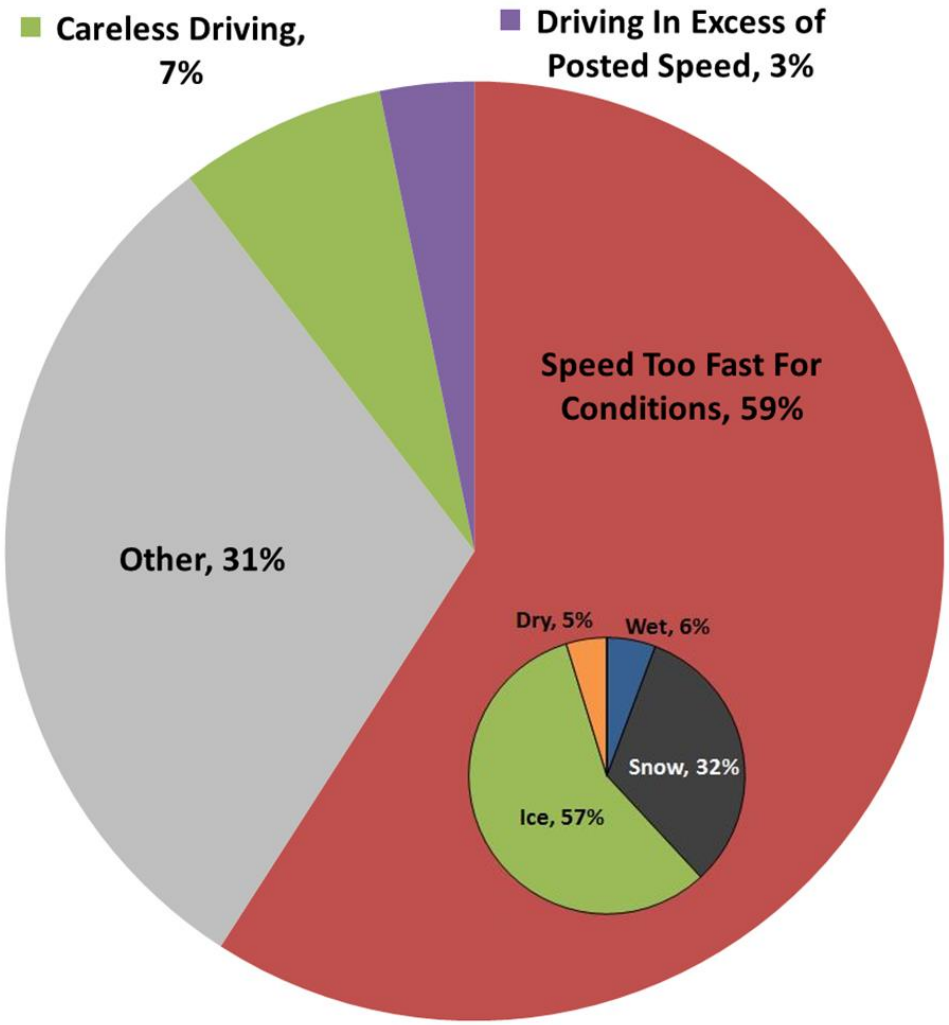


Crashes by Roadway Condition



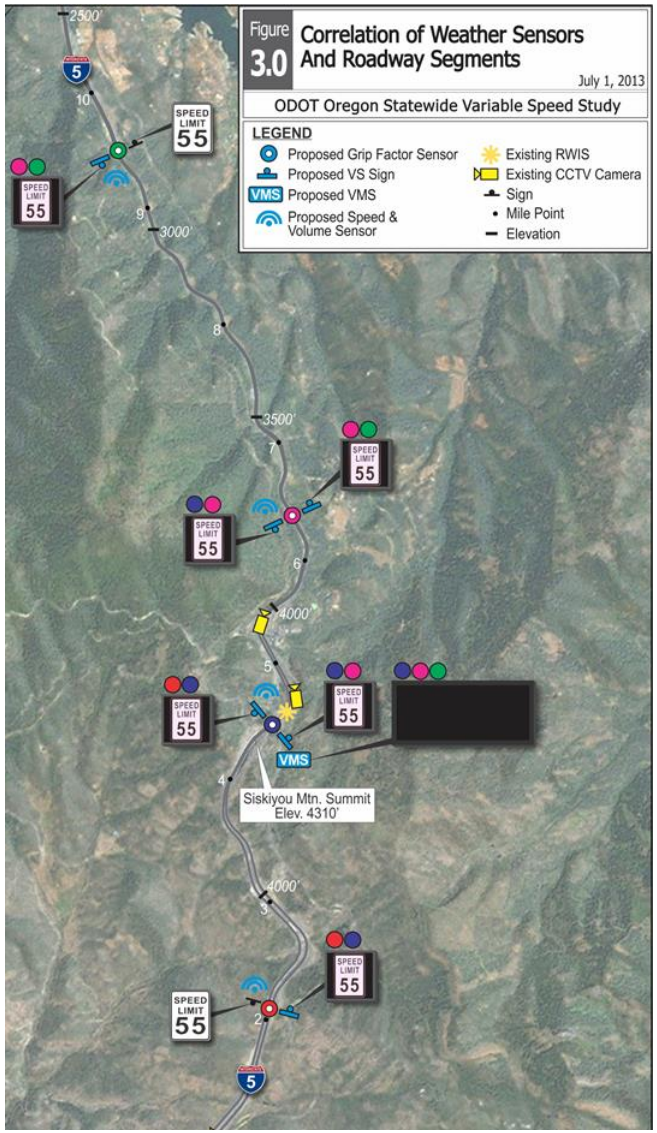
Crash Analysis

- Few crashes are because people are exceeding the speed limit
- Most crashes are driving speed exceeding conditions
  - 89% on ice or snow



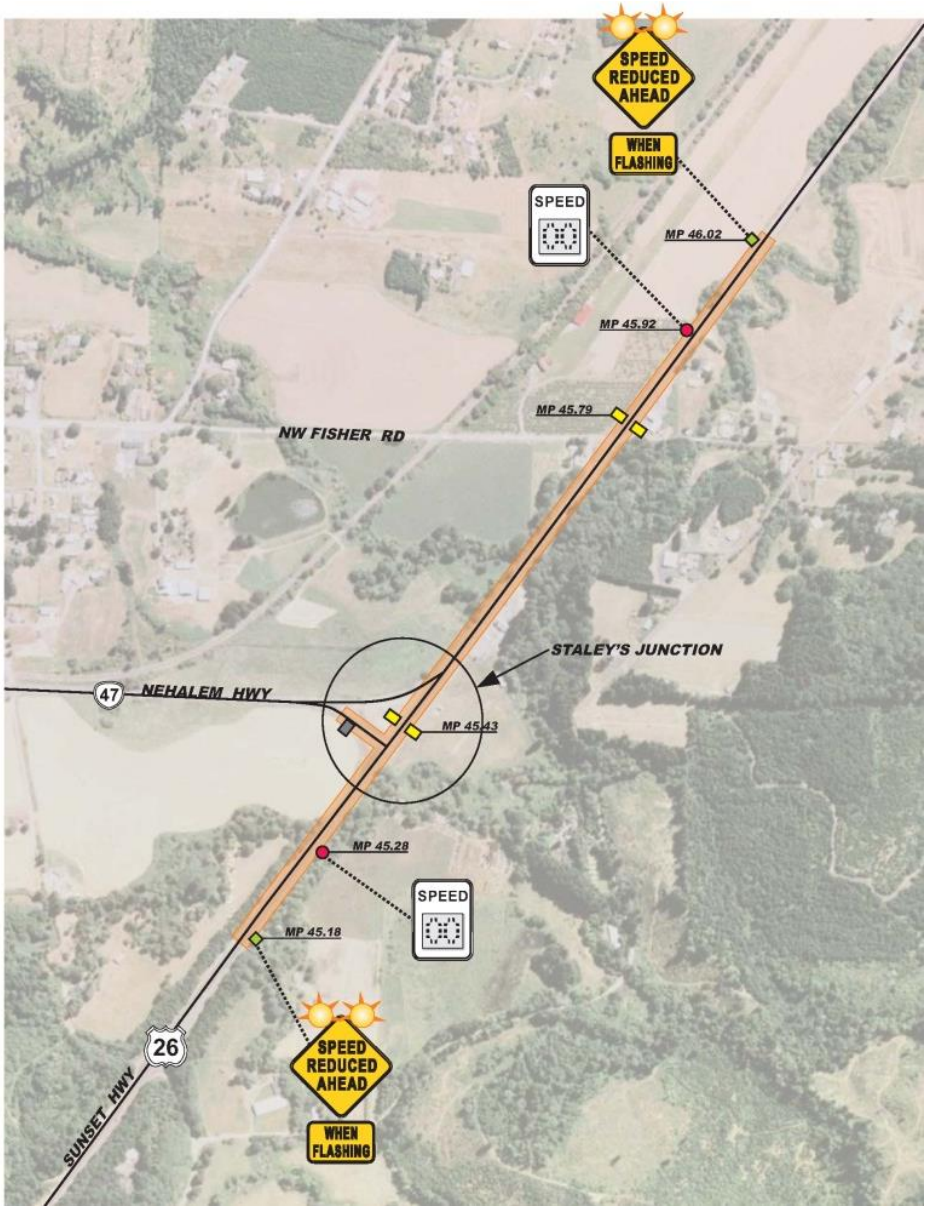
Signing Placement

- 3 subzones:
  - Uphill approaching summit
  - Summit area
  - Downhill
- Multiple traffic detectors
- Multiple weather stations
- Supplemental VMS
  - Also southbound, not shown



US 26 / OR 47 Staley's Junction

- Regulatory variable speed
- Short: 2/3 mile
- Goal: improve side street safety and mobility



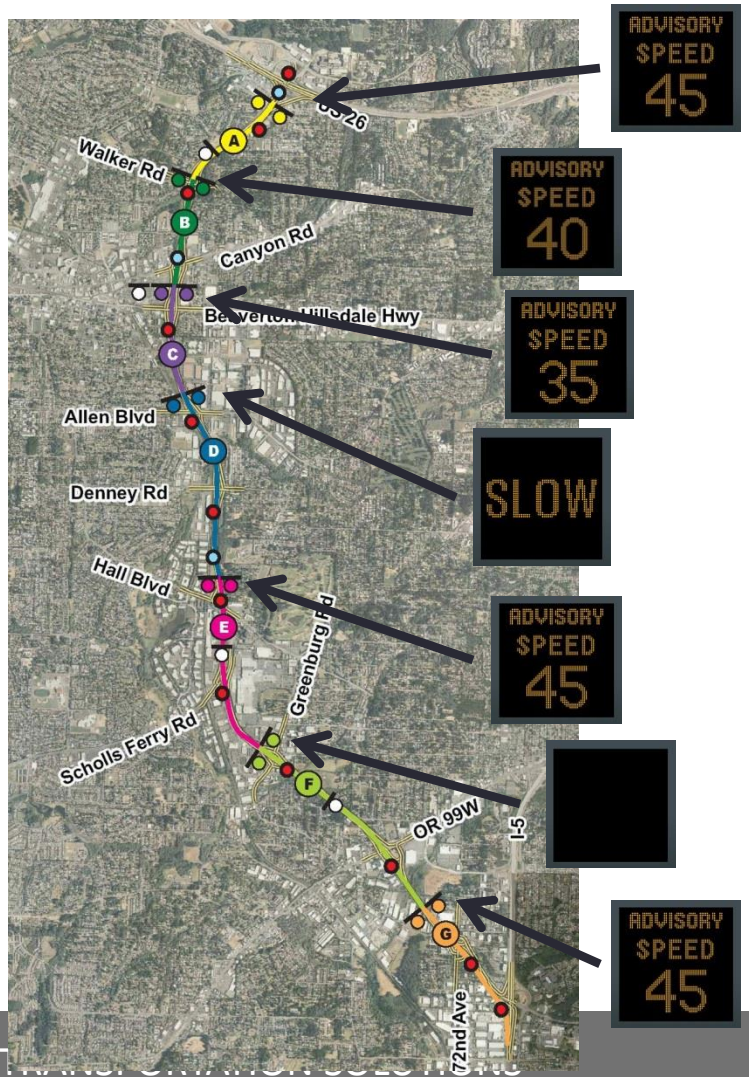
System Performance

- Lower vehicle speeds: average and 85th percentile
- Less side street delay, shorter queues
- Low volume makes crash analysis difficult
- No complaints

TABLE 7
STALEY'S JCT. VSL ANALYSIS BY POSTED SPEED SUMMARY
June 12 & July 24, 2011

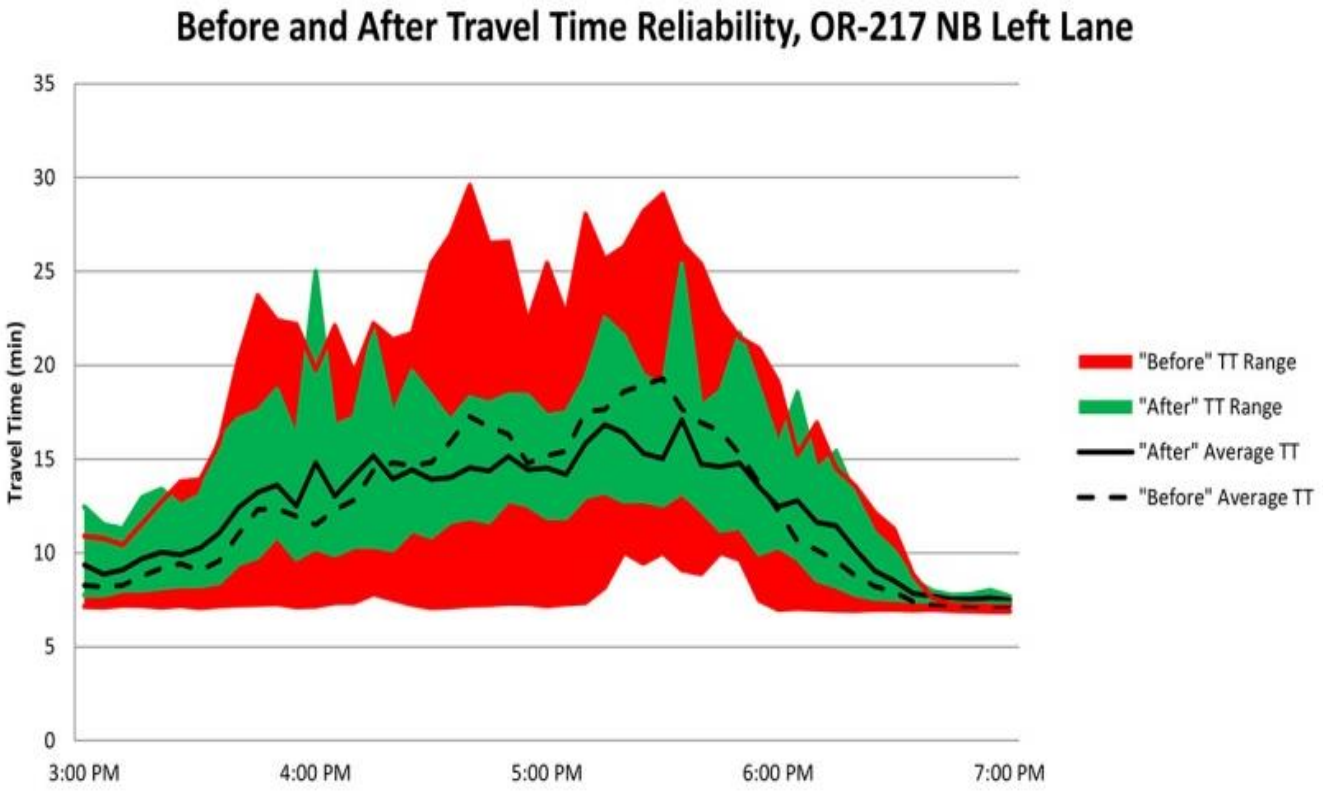
	Vehicles	Posted Speed	Average Speed	85% Speed	Percent Exceeding	Pace Limits	Percent In Pace	Maximum Speed
AVERAGES	231	50 MPH	47	52	>50=23%	43-53	82%	58
AVERAGES	217	45 MPH	44	48	>45=45%	39-49	81%	56
AVERAGES	282	40 MPH	35	41	>40=27%	32-42	75%	50
AVERAGES	278	35 MPH	31	37	>35=31%	26-36	68%	46
AVERAGES	316	30 MPH	23	29	>30=10%	20-30	66%	38

OR217 Active Traffic Management



- Urban expressway
- 135,000 AADT
- Advisory variable speed
- 7.4 miles
- 7 speed subzones
- Subzones tied together to reduce speed in steps
- Goal: improve safety and reliability
- Also has weather responsive

Early Results



- Average Buffer Index before VAS = 48.8%
- Average Buffer Index after VAS = 27.64%
- Before = July 2012 midweek days
- After = Midweek days from the past three weeks

Thank you

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