

Guide to Variable Speed Limits on the I-70 Mountain Corridor

Prepared for:

The Colorado Department of Transportation,
Region 1, Clark Roberts, Region Traffic Engineer



Version 1.0 (Final)

Prepared by:

apexdesign

ch2mSM

Project Manager: Ken DePinto

Apex Design Reference No. P150196

February 23, 2016

TABLE OF CONTENTS

PROJECT BACKGROUND	2
CDOT POLICY DIRECTIVE	2
COLORADO REVISED STATUES	3
MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES	4
SUMMARY OF PAST STUDIES ON VSL IN OTHER STATES	5
GUIDANCE FOR VSL ON THE I-70 MOUNTAIN CORRIDOR	5
SYSTEM AUTOMATION.....	6
PEAK PERIOD SHOULDER LANE CONSIDERATIONS.....	9
TABLES OF SUGGESTED VSL SPEED ADJUSTMENTS.....	9
APPENDIX A: DRAFT CDOT POLICY DIRECTIVE FOR CHANGEABLE SPEED LIMITS	13
APPENDIX B: EXCERPT FROM THE COLORADO REVISED STATUES.....	15
APPENDIX C: EXCERPT FROM THE MUTCD	26
APPENDIX D: MUTCD INTERPRETATION LETTER 2(09)-3(I)	29
APPENDIX E: CASE STUDIES	30
APPENDIX F: VARIABLE SPEED LIMIT (VSL) SIGN AND LAYOUT	39
APPENDIX G: COEFFICIENTS OF FRICTION.....	40

LIST OF TABLES

Table 1: Comparison of 13 Case Studies	5
Table 2: Comparison of System Automation (Pros and Cons)	8
Table 3: Suggested PPSL VSL Speeds for the I-70 Mountain Corridor	11
Table 4: Suggested VSL Speeds for the I-70 Mountain Corridor.....	12

PROJECT BACKGROUND

The Interstate-70 (I-70) mountain corridor experiences a range of weather conditions and congestion between Golden and the Town of Vail. Due to the recreational nature of the corridor, it attracts both Front Range residents and out-of-state tourists alike. The highway has been studied for the past 25-plus years to find a balance regarding improvements that are environmental and aesthetically appealing, sensitive to the surrounding communities, provide safety benefits to the public, and help with congestion relief. Dozens of improvements have been made to improve traffic flow, but these simply cannot keep up with the travel demand and the quickly changing weather in the mountainous terrain.

There are two acronyms that are used interchangeably amongst transportation professionals; Variable Speed Limits (VSL) and Changeable Speed Limits (CSL). Both uses have the same meaning and VSL is the terminology that will be referred to in this document. In addition, there is the assumption that the audience for this paper has a good understanding of the processes, references, documents, concepts, and requirements for VSL. Furthermore, this document is not intended to be a concept of operations plan; the I-70, Vail to Golden, Variable Speed Limit Concept of Operations Plan provides the framework regarding the details, rules, and ITS requirements for proper VSL operation and should be referenced before implementing VSL.

The purpose of this paper is to establish guidance for I-70 between MM 172 and MM 262 regarding the use of VSL. Policies and case studies from 13 different states have been reviewed on the use of VSL and it is believed that in Colorado the application can have benefits if applied appropriately. Also, it has been determined that VSL are permitted within the Colorado Revised Statutes (CRS) and Manual on Uniform Traffic Control Devices (MUTCD).

This document includes brief discussions of the following topics, and additional information is provided as Appendices:

- Draft CDOT Policy Directive (Nov 2014)
- Colorado Revised Statutes
- Manual on Uniform Traffic Control Devices
- Summary of past studies on VSL in other states
- Guidance for VSL on the I-70 Mountain Corridor
- System Automation
- Peak Period Shoulder Lane Considerations
- Tables of Suggested VSL Speed Adjustment

CDOT POLICY DIRECTIVE

The Colorado Department of Transportation (CDOT) has developed a draft Policy Directive on the use of VSL that is attached as Appendix A. Once this policy is final it will clearly establish CDOT's use for VSL. This document follows the draft policy rules and may need to be updated if the policy changes.

COLORADO REVISED STATUES

The Colorado Revised Statues (CRS) Section 42-4-1101 to 42-4-1104 by law allows CDOT to designate speed limits and post official traffic control devices enforcing the designated speed limits to advise drivers of the maximum acceptable and safe speed for normal travel conditions. Speed limits are set based on engineering studies that include an analysis of the current speed distribution of free-flowing vehicles, the characteristics of the road including shoulder condition, grade, alignment, sight distance, roadside development and environment, parking practices, pedestrian activity, and crash history. Additionally, drivers are required to drive their vehicle at a speed that is reasonable and prudent under existing conditions. For example, if roadway conditions are less than ideal due to weather, congestion, or construction, then the posted speed limit may not be an appropriate, reasonable, or safe speed to travel.

Supporting sections taken directly from the CRS are quoted below; the full sections 42-4-1101 through 42-4-1104 can be found in Appendix B.

- 42-4-1101. Speed limits

(1) No person shall drive a vehicle on a highway at a speed greater than is reasonable and prudent under the conditions then existing.

- 42-4-1102. Altering of speed limits

(1) (a) Whenever the department of transportation determines upon the basis of a traffic investigation or survey or upon the basis of appropriate design standards and projected traffic volumes in the case of newly constructed highways or segments thereof that any speed specified or established as authorized under sections 42-4-1101 to 42-4-1104 is greater or less than is reasonable or safe under the road and traffic conditions at any intersection or other place or upon any part of a state highway under its jurisdiction, said department shall determine and declare a reasonable and safe speed limit thereat which shall be effective when appropriate signs giving notice thereof are erected at such intersection or other place or upon the approaches thereto; except that no speed limit in excess of seventy-five miles per hour shall be authorized by said department.

(4) No alteration of speed limits on state highways within cities, cities and counties, and incorporated towns is effective until it has been approved in writing by the department of transportation. Upon the request of any incorporated city or town, the department of transportation shall conduct any traffic investigation or survey that is deemed to be warranted for determination of a safe and reasonable speed limit on any street or portion thereof that is a state highway. In conducting such a traffic investigation, the department may receive and consider traffic and engineering data provided by the city or county engineer of any requesting local government that will be impacted by a proposed alteration of speed limits. Any speed limit so determined by the department becomes effective when declared by the local authority and made known by official signs conforming to the state traffic control manual.

(8) The department of transportation shall not set a speed limit on interstate 70 for commercial vehicles or any other motor vehicle that differs from the highest authorized speed for any other type of motor vehicle on the same portion of a highway by more than twenty-five miles per hour.

MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES

The Manual of Uniform Traffic Control Devices (MUTCD) is approved by the Federal Highway Administration as the national standard for traffic control devices used to warn, regulate, and guide traffic. The MUTCD, Section 2B.13 allows the use of changeable speed limit signs for traffic and ambient conditions provided that the appropriate speed limit is displayed at the proper times.

The MUTCD does not provide any guidelines for reducing speeds for such reasons as incidents, weather, narrow lanes, reduced shoulders, HOV, managed lanes, congestion, and mixed use, leaving those decisions to state and local jurisdictions.

The MUTCD's criteria for the application of VSL are as follows and the full sections quoted below can be found in Appendix C.

- MUTCD Section 2B.13

(MUTCD source Paragraph 01): Speed zones (other than statutory speed limits) shall only be established on the basis of an engineering study that has been performed in accordance with traffic engineering practices. The engineering study shall include an analysis of the current speed distribution of free-flowing vehicles.

(MUTCD source Paragraph 06): In general, the maximum speed limits applicable to rural and urban roads are established:

- C. Statutorily – a maximum speed limit applicable to a particular class of road, such as freeways or city streets, that is established by State law; or
- D. As altered speed zones – based on engineering studies.

(MUTCD source Paragraph 18): A changeable message sign that changes the speed limit for traffic and ambient conditions may be installed provided that the appropriate speed limit is displayed at the proper times.

- MUTCD Interpretation letter 2(09)-3(I)-Legend Color for Electronic-Display Changeable Message Signs (Appendix D).

The interpretation from FHWA clarifies that the color for a regulatory condition shall be white.

SUMMARY OF PAST STUDIES ON VSL IN OTHER STATES

A brief summary provided in Appendix E includes 13 case studies regarding VSL. The table below shows the conditions under which VSL are used in each of these 13 states, as well as if the systems utilize manual intervention of speeds or if an automated system is in use.

Table 1: Comparison of 13 Case Studies

State	Weather (fog, rain, snow, ice, wind)	Congestion (speed and/or occupancy)	Manual intervention with auto system detection
Alabama	X	X	Yes
Delaware	X		Yes
Florida		X	Yes
Maine	X	X	Yes
Missouri	X	X	Yes
New Jersey	X	X	Yes
Pennsylvania	X		Yes
South Carolina	X		Yes
Tennessee	X	X	Yes
Utah	X		No
Virginia	X	X	No
Washington	X		Yes
Wyoming	X		Yes

Each state has developed their own criteria regarding how their VSL system will operate. Some states use algorithms that measure current speeds, others use closed circuit television cameras, maintenance patrols, or state police to visually monitor the traffic conditions, and still others use atmospheric data from road and weather information systems to determine safe travel speeds. In addition, each state has a process in place to change the speeds displayed based on current conditions. For example, the changes can be manual from a remote location such as a Traffic Management Center, automated based on weather station data, or semi-automated which requires human intervention to acknowledge a system suggestion based on an algorithm.

GUIDANCE FOR VSL ON THE I-70 MOUNTAIN CORRIDOR

This section includes suggestions that could be applied to the I-70 corridor between Golden and Vail for VSL operations based on weather, incidents, construction zones, congestion, and managed lanes. Specific requirements should be developed to implement the VSL concepts due to the variety of terrain and ITS instrumentation required to implement VSL.

The following items listed in priority order are recommended to be completed prior to implementation of VSL:

- Adopt the Draft CDOT Policy Directive for Changeable Speed Limits.
- Review the I-70, Vail to Golden, Variable Speed Limit Concept of Operations Plan.
- Identify a specific section of highway on which to implement VSL.
- Develop specific software requirements as prescribed in Section 3 of the Concept of Operations Plan for a manual, semi-automated, or fully automated process as desired.
- Implement a VSL plan for that section of highway with the baseline speed limit based on the 85th percentile speeds including volume and occupancy using data available from the existing ITS infrastructure, where feasible.
- Adopt specific VSL rules for lowering the baseline speed limit using the tables below as a starting point.
- Run an aggressive public information campaign on VSL to educate the public.

The future vision of VSL technology is to implement a proactive system at a later date that can sense pulses in the speeds and implement a change in the posted speed limit before an incident occurs. This would be a complex system and would require more research using historical data and accident prediction models comparing and predicting safety, speeds and risk. VSL sign graphics are included in Appendix F to show examples of what these signs can look like.

SYSTEM AUTOMATION

There are three basic strategies for VSL to implement changes to the posted speed limits. These include manual implementation, semi-automated, or fully automated systems, all of which implement changes to the VSL signs using CDOT's communications network.

- Manual Implementation - A manually implemented operation requires the CTMC operator to change multiple VSL signs at a time when notified, if a condition is observed through CCTV imagery, or based on other alerts. The current CTMC software allows the operators to make changes to one sign or several signs at once and send the information instantly to the sign. Rules for manual implementation would need to be established such as those shown in Tables 3 and 4.
- Semi-Automated Implementation - A semi-automated process would use an algorithm which collects field data (speed, volume and occupancy) and atmospheric data. In some cases, depending on the application, the algorithm could be very complex. After the data is quickly processed and measured against pre-determined thresholds, the operator could be prompted by the software to concur or dismiss suggested changes to the VSL signs. With a semi-automated system, operators could also manually implement changes (override the system).
- Fully Automated Implementation - A fully automated system has all of the capabilities of the previously mentioned systems but does not require any human intervention. These systems are expensive and not advised for most complex applications. However, a fully automated system, when only connected to a few devices such as a weather station and

a VSL sign, can effectively detect road conditions and change a few VSL signs in the immediate vicinity of the condition. For implementations such as this example, fully automated systems have proven to be cost effective and beneficial.

Based on the existing level of field instrumentation and density of devices along the I-70 mountain corridor, it is recommended that a semi-automated system be developed. A semi-automated system would require operator intervention and confirmation, which is seen as a definite advantage.

A fully automated system would require a considerable amount of time and monetary investment, and the benefits when compared to a semi-automated system may not be worthwhile. In addition, a fully automated system would require extensive instrumentation and may only be applicable to certain areas along the mountain corridor. It would also require stringent maintenance requirements and testing to assure the algorithm does not compromise the safety of the traveling public.

Both the semi-automated and fully automated systems have the ability to ratchet speeds limits up and down on the VSL signs upstream of an incident or weather event in any increment designed into the system and at any timing interval. The algorithm allows different parameters to be set and, depending on the system performance, can be adjusted.

A manual system would require a higher level of device monitoring from staff, which may not be feasible given the current staffing level. Furthermore, it leaves decisions in the hands of the operators, and those decisions may vary somewhat from operator to operator, resulting in a non-uniform application of VSL. Continual training and monitoring of any system would be necessary for this type of operation.

All three options have advantages and disadvantages as shown in Table 2 below.

Table 2: Comparison of System Automation (Pros and Cons)

Pros and Cons	Manual	Semi-	Fully
	Implementation	Automated	Automated
Easy to implement	X		
Weather applications	X	X	X
Speed harmonization applications	X	X	X
Heavy instrumentation requirements		X	X
Accident reduction potential	X	X	X
MUTCD compliant	X	X	X
Colorado Revised Statutes compliant	X	X	X
Cost	\$	\$\$	\$\$\$
Effective in high volume (over 20,000 VPD) areas		X	X
Effective in low volume (under 20,000 VPD) areas	X		
Fiber communications abilities	X	X	X
Wireless communications abilities	X	X	X
Standalone applications (isolated to small areas only)		X	X
TMC operator intervention required	X	X	
Database requirements for performance measures	X	X	X
Customized software required		X	X
Easy to maintain	X		
Algorithm required (complex)		X	X
Ability to implement truck and vehicle speeds	X	X	X
Ability to implement vehicle and managed lane speeds	X	X	X

PEAK PERIOD SHOULDER LANE CONSIDERATIONS

It is likely that the operating speeds in the Peak Period Shoulder Lane (PPSL) (also referred to as managed lane or express lane) will be higher than the general purpose lanes. The managed lane will have congestion pricing and the speed limit will be adjusted with the goal to maintain a reliable travel time through that section of the corridor. It is equally important to maintain safe roadway conditions and speeds between the PPSL and general purpose lanes. Thus, if the general purpose lanes are stopped or slow, it would make sense to post a speed limit for the PPSL that is lower than the baseline speed limit. It should be noted that the CRS 42-4-1102(8) allows up to a maximum of 25 MPH speed difference to be posted. During congested periods, it would make sense to drop the speed through the PPSL corridor below the baseline speed limit; it is not likely that the congested general purpose lanes would be moving fast enough to meet that speed limit, but it will reduce speeds in the PPSL lane and minimize the speed differential between the PPSL and the general purpose lanes.

On December 12, 2015 the PPSL opened to traffic. The cross section of the roadway consists of a 1' left shoulder, 11' managed lane open during peak times, two 11-12' general purpose lanes and a 4' right shoulder. The speed limits vary along the length of the PPSL from 65 mph West of Idaho Springs to 55 mph East of Idaho Springs. The pricing in the managed lane will be dynamic based on the volume of the general purpose lanes and the free flow condition in the PPSL. This will cause the PPSL lane to travel at a higher speed than the general purpose lanes.

It is suggested that this section of I-70 should have a speed study conducted in the very near future (Winter 2016), and a process should be put into place to utilize the VSL signs under varying conditions.

TABLES OF SUGGESTED VSL SPEED ADJUSTMENTS

Tables 3 and 4 both show the suggested VSL speed adjustment criteria for the I-70 mountain corridor. Table 3 is for the VSL within the PPSL limits on I-70 for the eastbound direction only. This area currently has VSL signs but does not yet have an algorithm associated with it; any sign change are currently planned to be manually done by the CTMC operators. Table 4 depicts suggested VSL changes on I-70 for all other areas between Golden and Vail. While the terrain varies substantially VSL has applications based on the congestion, weather, incidents and maintenance.

The following are corresponding notes to each condition factor in the table:

- 1) A speed algorithm should be developed to measure when the 85th percentile speeds, volume and occupancy begin to degrade below a level of service D and then implement the VSL changes. Harmonizing the entire length of the corridor with one speed limit will eliminate pulses in traffic and lane changes. The algorithm can be used for both the PPSL operation and normal traffic flow during non-peak periods.
- 2) The road and weather information system atmospheric should be used to monitor the suggested factors to implement VSL changes. While the speed algorithm can be effective for speed, volume and occupancy, weather events are not always associated with congestion and should therefore be considered separately.
- 3) Incidents and accidents are random and requests from responders to lower the speed limit can be implemented using the VSL. There are no suggested values; however,

changes to the VSL should be implemented as far upstream as possible to notify approaching traffic. The distance of the upstream signing changes will need to be determined and it is suggested that the signing should be changed in 10 MPH increments until the VSL posted speed reaches 30 MPH minimum at the accident, depending on the situation.

- 4) Construction and maintenance projects should be able to utilize the VSL system to change the speed limit by coordinating the traffic control plans with the fixed placement of the VLS signs. The VSL signs should match the field temporary speed limits.
- 5) The Coefficient of friction data in Appendix F is used by the Colorado State Patrol for accident investigations and is a published source.

Table 3: Suggested PPSL VSL Speeds for the I-70 Mountain Corridor

Condition Factor	Indicator	Suggested PPSL VSL Speeds (I-70 Mountain Corridor)							
		General Purpose Lanes and PPSL	General Purpose Lanes and PPSL	General Purpose Lanes and PPSL	General Purpose Lanes and PPSL	General Purpose Lanes and PPSL	General Purpose Lanes and PPSL	General Purpose Lanes and PPSL	General Purpose Lanes and PPSL
Speed (MPH)		65	60	55	50	45	40	35	30 and below
Congestion and Speed harmonizaion should be based on an algorithm, using 85th Percentile Speeds which includes volume and occupancy look up tables (See Note 1)	Existing (resting state of speed limits)	Resting state West of Idaho Springs	Resting state middle of PPSL	Resting state East of Idaho Springs					
	Speed/Volume/Occupancy (algorithm)				Harmonize speeds using algorithm (one speed limit in PPSL)	Harmonize speeds using algorithm (one speed limit in PPSL)	Harmonize speeds using algorithm (one speed limit in PPSL)	Harmonize speeds using algorithm (one speed limit in PPSL)	Harmonize speeds using algorithm (one speed limit in PPSL)
Weather (based on RWIS data and CCTV's) (See Note 2 and 5)	Coefficient of friction (slush/ice/other)	Resting state West of Idaho Springs	Resting state middle of PPSL	Resting state East of Idaho Springs	Between .6 and .5	Between .5 and .4 and implement Chain Law code 17	.4 or less and implement Chain Law code 18	between .4 and .1	between 0 and .10
	Visibility (clear, fog, smoke, clouds,blowing snow, other)	Resting state West of Idaho Springs	Resting state middle of PPSL	Resting state East of Idaho Springs	between 1 mile and 1/2 mile	between 1/2 and 1/4 mile	between 1/2 and 1/4 mile	between 1/4 and 1/8 mile	< 1/8 mile
	Precipitation (Snowfall/slush)	Resting state West of Idaho Springs	Resting state middle of PPSL. Change VSL if light precipitation.	Resting state East of Idaho Springs. Change VSL if light slush.	Moderate	Moderate/Heavy	Heavy	Heavy	Heavy
	Precipitation (rain)	Resting state West of Idaho Springs	Resting State middle of PPSL. Change VSL if light precipitation.	Resting state East of Idaho Springs. Change VSL if light precipitation.	Moderate	Moderate/Heavy	Heavy	Heavy	Heavy
Incidents and Accidents based on field changes requested from incident commanders (See Note 3)	Visual, personnel, CCTV/other	Resting state West of Idaho Springs	Resting state middle of PPSL	Resting state East of Idaho Springs	Based on incident severity	Based on incident severity	Based on incident severity	Based on incident severity	Based on incident severity
Construction and maintenance projects (See Note 4)	Signed CDOT Form 568	Resting state West of Idaho Springs	Resting state middle of PPSL	Resting state East of Idaho Springs	Based on Form 568	Based on Form 568	Based on Form 568	Based on Form 568	Based on Form 568

Table 4: Suggested VSL Speeds for the I-70 Mountain Corridor

Condition Factor	Indicator	Suggested VSL Speeds (I-70 Mountain Corridor)							
		General Purpose Lanes	General Purpose Lanes	General Purpose Lanes	General Purpose Lanes	General Purpose Lanes	General Purpose Lanes	General Purpose Lanes	General Purpose Lanes
Speed (MPH)		65	60	55	50	45	40	35	30 and below
Congestion and Speed harmonizaion should be based on an algorithm, using 85th Percentile Speeds which includes volume and occupancy look up tables (See Note 1)		Posted Speed Limit							
	Speed/Volume/Occupancy (algorithm)	Harmonize speeds based on algorithm	Harmonize speeds based on algorithm	Harmonize speeds based on algorithm	Harmonize speeds based on algorithm	Harmonize speeds based on algorithm	Harmonize speeds based on algorithm	Harmonize speeds based on algorithm	Harmonize speeds based on algorithm
Weather (based on RWIS data and CCTV's) (See Note 2 and 5)	Coefficient of friction (slush/ice/other)	Resting state	N/A	N/A	Between .6 and .5	Between .5 and .4 and implement Chain Law code 17	.4 or less and implement Chain Law code 18	between .4 and .1	between 0 and .10
	Visibility (clear, fog, smoke, clouds,blowing snow, other)	Resting state	N/A	1 mile	between 1 mile and 1/2 mile	between 1/2 and 1/4 mile	between 1/2 and 1/4 mile	between 1/4 and 1/8 mile	< 1/8 mile
	Precipitation (Snowfall/slush)	Resting state	Light	Light/slush	Moderate	Moderate/Heavy	Heavy	Heavy	Heavy
	Precipitation (rain)	Resting state	Light	Light	Moderate	Moderate/Heavy	Heavy	Heavy	Heavy
Incidents and Accidents based on field changes requested from incident commanders (See Note 3)	Visual, personnel, CCTV/other	N/A	Based on incident severity	Based on incident severity	Based on incident severity	Based on incident severity	Based on incident severity	Based on incident severity	Based on incident severity
Construction and maintenance projects (See Note 4)	Signed CDOT Form 568	N/A	Based on Form 568	Based on Form 568	Based on Form 568	Based on Form 568	Based on Form 568	Based on Form 568	Based on Form 568

APPENDIX A: DRAFT CDOT POLICY DIRECTIVE FOR CHANGEABLE SPEED LIMITS

POLICY DIRECTIVE FOR CHANGEABLE SPEED LIMITS (11/30/14 draft)

I. PURPOSE

The Colorado Department of Transportation seeks to improve safety and travel-time reliability, reduce congestion and harmonize speeds through the utilization of changeable speed limits. The purpose of this Policy Directive is to ensure that the use of changeable speed limits is considered for deployment on roadways that can demonstrate improvements in safety and travel-time reliability, reduction in congestion and harmonization of speeds through the use of changeable speed limits. The Manual of Uniform Traffic Control Devices allows the use of a changeable message sign that changes the speed limit for traffic and ambient conditions.

II. AUTHORITY

Colorado Transportation Commission, 43-1-106 (8), C.R.S.

The Colorado Department of Transportation, 42-4-1101 to 42-4-1104, C.R.S.

2009 Uniform Manual of Traffic Control Devices, Section 2B.13, Adopted by CDOT Transportation Commission Resolution Number TC-2044.

III. APPLICABILITY

This Policy Directive applies to all divisions, region, offices and branches of CDOT with responsibility for maintenance and operations of the state highway system.

IV. DEFINITIONS

Changeable speed limits, also referred to as variable speed limits (VSL), are speed limits that can change based on road, traffic and weather conditions. The display of the speed limit is accomplished through the use of an electronic sign. The appropriate speed limit is determined based on traffic sensors, cameras and other Intelligent Transportation System devices that relay information to the Colorado Traffic Management Center where it is analyzed. When circumstances that would benefit from lowered speed limits the speed limit displayed is lowered to reduce the flow of traffic.

V. POLICY

The Department of Transportation has the authority to designate speed limits and post official traffic control devices enforcing the designated speed limits pursuant to 42-4-1101 to 42-4-1104 C.R.S. Speed limits are set to advise drivers of the maximum acceptable and safe speed for normal travel conditions. Speed limits are set based on engineering studies that include an analysis of the current speed distribution of free-flowing vehicles, the characteristics of the road including, shoulder condition, grade, alignment and sight distance, roadside development and environment, parking practices and pedestrian activity and crash history. Additionally, drivers are required to drive their vehicle at a speed that is reasonable and prudent under existing

conditions. For example, if roadway conditions are less than ideal due to weather, congestion or construction, the posted speed limit may not be an appropriate, reasonable or safe speed limit.

ITS infrastructure provides for the collection of real-time data and recommendation of enforceable and safer variable operating speeds to be used to address many different types of traffic problems. VSLs change the enforceable speed limits of a roadway based on real time conditions such as weather, traffic volumes, incidents, events, and roadway maintenance/construction. The use of variable speed limits assists drivers in the determination of an appropriate speed limit for conditions. The benefits of using VSL's include the ability to quickly respond to changing road and weather conditions by reducing the speed limit. The reduction in speed limits can improve safety through the harmonization of traffic flow which has been proven to lower accident rates, reduce congestion, sudden stops and improve travel reliability.

The Manual of Uniform Traffic Control Devices (MUTCD) is approved by the Federal Highway Administration as the National Standard for traffic control devices used to warn, regulate and guide traffic. The MUTCD allows the use of changeable speed limit signs for traffic and ambient conditions provided that the appropriate speed limit is displayed at the proper times.

Enforcement of the requirement to drive at a reasonable and prudent speed in accordance with road conditions can present difficulties for the enforcement personnel due to the subjectivity of prudent and reasonable.

This policy recognizes the numerous benefits that can be achieved through the use of VSL. It shall be the policy of the Department of Transportation to utilize VSL where its application can demonstrate safety improvements including reductions in crashes, congestion and increases in travel-time reliability and speed harmonization.

VI. FISCAL IMPACT

Implementation of VSL's will have a project specific fiscal impact dependent upon existing ITS infrastructure and the length of the project.

VII. IMPLEMENTATION PLAN

1. This policy is effective immediately upon approval and shall apply to all state highways that can demonstrate improved safety through the reduction in crashes and congestion and increases travel-time reliability.
2. CDOT staff shall develop guidance to support this Policy Directive.

VIII. REVIEW DATE

This Policy Directive shall be reviewed within five years of the approval date.

Transportation Commission Secretary

Date of Approval

APPENDIX B: EXCERPT FROM THE COLORADO REVISED STATUTES

C.R.S. 42-4-1101 (Copy w/ Cite)

Pages: 7

C.R.S. 42-4-1101

COLORADO REVISED STATUTES

* This document reflects changes current through all laws passed at the Second Regular Session of the Sixty-Ninth General Assembly of the State of Colorado (2014) and changes approved by the electorate at the November 2014 election *

TITLE 42. VEHICLES AND TRAFFIC REGULATION OF VEHICLES AND TRAFFIC ARTICLE 4. REGULATION OF VEHICLES AND TRAFFIC PART 11. SPEED REGULATIONS

C.R.S. 42-4-1101 (2014)

42-4-1101. Speed limits

- (1) No person shall drive a vehicle on a highway at a speed greater than is reasonable and prudent under the conditions then existing.
- (2) Except when a special hazard exists that requires a lower speed, the following speeds shall be lawful:
 - (a) Twenty miles per hour on narrow, winding mountain highways or on blind curves;
 - (b) Twenty-five miles per hour in any business district, as defined in [section 42-1-102 \(11\)](#);
 - (c) Thirty miles per hour in any residence district, as defined in [section 42-1-102 \(80\)](#);
 - (d) Forty miles per hour on open mountain highways;
 - (e) Forty-five miles per hour for all single rear axle vehicles in the business of transporting trash that exceed twenty thousand pounds, where higher speeds are posted, when said vehicle is loaded as an exempted vehicle pursuant to [section 42-4-507 \(3\)](#);
 - (f) Fifty-five miles per hour on other open highways which are not on the interstate system, as defined in [section 43-2-101 \(2\), C.R.S.](#), and are not surfaced, four-lane freeways or expressways;
 - (g) Sixty-five miles per hour on surfaced, four-lane highways which are on the interstate system, as defined in [section 43-2-101 \(2\), C.R.S.](#), or are freeways or expressways;
 - (h) Any speed not in excess of a speed limit designated by an official traffic control device.

(3) No driver of a vehicle shall fail to decrease the speed of such vehicle from an otherwise lawful speed to a reasonable and prudent speed when a special hazard exists with respect to pedestrians or other traffic or by reason of weather or highway conditions.

(4) Except as otherwise provided in paragraph (c) of subsection (8) of this section, any speed in excess of the lawful speeds set forth in subsection (2) of this section shall be prima facie evidence that such speed was not reasonable or prudent under the conditions then existing. As used in this subsection (4), "prima facie evidence" means evidence which is sufficient proof that the speed was not reasonable or prudent under the conditions then existing, and which will remain sufficient proof of such fact, unless contradicted and overcome by evidence bearing upon the question of whether or not the speed was reasonable and prudent under the conditions then existing.

(5) In every charge of violating subsection (1) of this section, the complaint, summons and complaint, or penalty assessment notice shall specify the speed at which the defendant is alleged to have driven and also the alleged reasonable and prudent speed applicable at the specified time and location of the alleged violation.

(6) The provisions of this section shall not be construed to relieve the party alleging negligence under this section in any civil action for damages from the burden of proving that such negligence was the proximate cause of an accident.

(7) Notwithstanding paragraphs (a), (b), and (c) of subsection (2) of this section, any city or town may by ordinance adopt absolute speed limits as the maximum lawful speed limits in its jurisdiction, and such speed limits shall not be subject to the provisions of subsection (4) of this section.

(8) (a) (Deleted by amendment, L. 96, p. 578, § 2, effective May 25, 1996.)

(b) Notwithstanding any other provisions of this section, no person shall drive a vehicle on a highway at a speed in excess of a maximum lawful speed limit of seventy-five miles per hour.

(c) The speed limit set forth in paragraph (b) of this subsection (8) is the maximum lawful speed limit and is not subject to the provisions of subsection (4) of this section.

(d) State and local authorities within their respective jurisdictions shall not authorize any speed limit which exceeds seventy-five miles per hour on any highway.

(e) The provisions of this subsection (8) are declared to be matters of both local and statewide concern requiring uniform compliance throughout the state.

(f) In every charge of a violation of paragraph (b) of this subsection (8), the complaint, summons and complaint, or penalty assessment notice shall specify the speed at which the defendant is alleged to have driven and also the maximum lawful speed limit of seventy-five miles per hour.

(g) Notwithstanding any other provision of this section, no person shall drive a low-power scooter on a roadway at a speed in excess of forty miles per hour. State and local authorities shall not authorize low-power scooters to exceed forty miles per hour on a roadway.

(9) The conduct of a driver of a vehicle which would otherwise constitute a violation of this section is justifiable and not unlawful when:

(a) It is necessary as an emergency measure to avoid an imminent public or private injury which is about to occur by reason of a situation occasioned or developed through no conduct of said driver and which is of sufficient gravity that, according to ordinary standards of intelligence and morality, the desirability and urgency of avoiding the injury clearly outweigh the desirability of avoiding the consequences sought to be prevented by this section; or

(b) With respect to authorized emergency vehicles, the applicable conditions for exemption, as set forth in [section 42-4-108](#), exist.

(10) The minimum requirement for commission of a traffic infraction or misdemeanor traffic offense under this section is the performance by a driver of prohibited conduct, which includes a voluntary act or the omission to perform an act which said driver is physically capable of performing.

(11) It shall not be a defense to prosecution for a violation of this section that:

(a) The defendant's conduct was not performed intentionally, knowingly, recklessly, or with criminal negligence; or

(b) The defendant's conduct was performed under a mistaken belief of fact, including, but not limited to, a mistaken belief of the defendant regarding the speed of the defendant's vehicle; or

(c) The defendant's vehicle has a greater operating or fuel-conserving efficiency at speeds greater than the reasonable and prudent speed under the conditions then existing or at speeds greater than the maximum lawful speed limit.

(12) (a) A violation of driving one to twenty-four miles per hour in excess of the reasonable and prudent speed or in excess of the maximum lawful speed limit of seventy-five miles per hour is a class A traffic infraction.

(b) A violation of driving twenty-five or more miles per hour in excess of the reasonable and prudent speed or in excess of the maximum lawful speed limit of seventy-five miles per hour is a class 2 misdemeanor traffic offense; except that such violation within a maintenance, repair, or construction zone, designated pursuant to [section 42-4-614](#), is a class 1 misdemeanor traffic offense.

(c) A violation under subsection (3) of this section is a class A traffic infraction.

HISTORY: Source: L. 94: Entire title amended with relocations, p. 2363, § 1, effective January 1, 1995.L. 96: (2)(f), (2)(g), (8)(a), (8)(b), (8)(c), (8)(d), (8)(f), and (12) amended, p. 578, § 2, effective May 25.L. 2003: (2)(e) amended, p. 717, § 1, effective August 6.L. 2008: (12) amended, p. 2082, § 7, effective June 3.L. 2009: (8)(g) added, ([HB 09-1026](#)), [ch. 281](#), [p. 1277](#), [§ 54](#), effective October 1.

Editor's note: This title was numbered as numerous articles within chapter 13, C.R.S. 1963. The provisions of this title were amended with relocations in 1994, effective January 1, 1995, resulting in the addition, relocation, and elimination of sections as well as subject matter. For amendments to this title prior to 1994, consult the Colorado statutory research explanatory note and the table itemizing the replacement volumes and supplements to the original volume of C.R.S. 1973 beginning on page vii in the front of this volume. Former C.R.S. section numbers

are shown in editor's notes following those sections that were relocated. For a detailed comparison of this title, see the comparative tables located in the back of the index. Cross references: For registration and use of snowmobiles, see article 14 of title 33; for licensing and regulation of automobile dealers, see part 1 of article 6 of title 12; for the antimonopoly financing law, see part 2 of article 6 of title 12; for the Sunday closing law, see part 3 of article 6 of title 12; for the regulation of commercial driving schools, see article 15 of title 12; for the provisions providing for the manufacture of license plates and highway signs by state correctional facilities, see article 24 of title 17; for provisions relating to highway safety, see article 5 of title 43. Cross references: For exemption of members of the military forces from traffic regulation, see § 28-3-504; for disposition of fines and penalties under this article, see § 42-1-217; for crimes that involve the operation of motor vehicles, also see § § 18-3-106, 18-3-205, 18-4-409, 18-4-512, 18-9-107, and 18-9-114 to 18-9-116.5. Cross references: For the penalties for class 2 misdemeanor traffic offenses and class A traffic infractions, see § 42-4-1701 (3).

Editor's note: This section is similar to former § 42-4-1001 as it existed prior to 1994, and the former § 42-4-1101 was relocated to § 42-4-1201.

Cross references: Section 1 of chapter 412, Session Laws of Colorado 2008, provides that the act amending subsection (12) shall be known and may be cited as the "Charles Mather Highway Safety Act".

ANNOTATION

Annotator's note. Since § 42-4-1101 is similar to § 42-4-1001 as it existed prior to the 1994 amending of title 42 as enacted by SB 94-1, relevant cases construing that provision have been included with the annotations to this section.

Speeding classifications constitutional. Decision to treat higher rates of speeding as more serious making them criminal acts is within legislature's discretion and does not create a suspect class or infringe on a fundamental right. Drawing a distinction based on speed is rationally related to legislative purpose of safety and fuel conservation. *People v. Lewis*, 745 P.2d 668 (Colo. 1987).

It was the legislative intent of the general assembly in enacting the provisions of this section effective January 24, 1974, to fix a speed limit of 55 miles per hour for the period during which federal restrictions, as originated in the emergency highway energy conservation act, continued under the federal aid highway amendments of 1974, until such time as the general assembly took further action. *People v. Driver*, 189 Colo. 276, 539 P.2d 1248 (1975).

The general assembly clearly intended to enact an enforceable 55 mile-per-hour maximum speed limit, because maintenance of federal highway funding was contingent upon enactment of such a statute. *Olinyk v. People*, 642 P.2d 490 (Colo. 1982).

The policy considerations behind the enactment of this section prohibiting the driving of a vehicle in excess of the maximum speed of 55 miles per hour is that a driver must be charged as a matter of public policy, with the responsibility of ensuring that his vehicle is safe, so as to minimize the risk inherent in travel on our public highways. *People v. Caddy*, 189 Colo. 353, 540 P.2d 1089 (1975).

Intent to enact enforceable speed limit. It was obviously the intention of the general assembly to

enact a maximum speed limit enforceable through penal sanctions. *Olinyk v. People*, 642 P.2d 490 (Colo. 1982).

Speed limit is enforceable. Since the penalty applicable to violation of the 55 mile-per-hour speed limit charged by complaint and summons is ascertainable, the speed limit is enforceable. *Olinyk v. People*, 642 P.2d 490 (Colo. 1982).

Speed should be no greater than is reasonable and prudent. The driver of a motor vehicle must at all times so operate it as to maintain reasonable control over it, at a speed no greater than is reasonable and prudent under the conditions then existing. *Bennett v. Hall*, 132 Colo. 419, 290 P.2d 241 (1955); *Union P. R. R. v. Snyder*, 220 F.2d 388 (10th Cir. 1955); *Eagan v. Maiselson*, 142 Colo. 233, 350 P.2d 567 (1960); *Mayer v. Sampson*, 157 Colo. 278, 402 P.2d 185 (1965).

The appropriate signs erected pursuant to subsection (2) of this section indicate the speed limit starts at the physical location of the sign and continues to be in effect until the next different speed limit sign pursuant to the manual adopted by the department of transportation pursuant to § 42-4-104. *Shafron v. Cooke*, 190 P.3d 812 (Colo. App. 2008).

Crime irrespective of intent or scienter. Although the absence of a specified "culpable mental state" in this section is not conclusive on the issue, it is well settled that the general assembly may make a prohibited act a crime, irrespective of the elements of intent or scienter, when public policy so requires. *People v. Caddy*, 189 Colo. 353, 540 P.2d 1089 (1975).

Offense of strict liability. In the absence of a specified element of "criminal intent", and because of the strong public policy considerations, speeding is an offense of strict liability. *People v. Caddy*, 189 Colo. 353, 540 P.2d 1089 (1975).

Lack of culpable mental state no defense. Even though defendant presented evidence at trial that his speedometer reflected a speed 10 miles per hour below the true speed of his vehicle, and that he had no knowledge that the speedometer reading was in error, or that he should have known of the defective speedometer, his lack of a culpable mental state was not a defense to the charge of speeding. *People v. Caddy*, 189 Colo. 353, 540 P.2d 1089 (1975).

There is no element of mental culpability required in the speeding statute. *People v. Caddy*, 189 Colo. 353, 540 P.2d 1089 (1975).

Lack of criminal intent is not a defense to a charge of speeding. *People v. Caddy*, 189 Colo. 353, 540 P.2d 1089 (1975).

Justification is recognized as an affirmative defense to the charge of speeding, but the defendant must present credible evidence as to the specific threat of injury and the lack of a reasonable alternative other than commission of the offense. *People v. Dover*, 790 P.2d 834 (Colo. 1990).

A county court has jurisdiction over the subject matter of offenses alleged to have been committed under this section. *People v. Griffith*, 130 Colo. 475, 276 P.2d 559 (1954).

Violation is question for jury. In an action for damages resulting from an automobile accident, the question whether defendant was driving in excess of the statutory speed limit, and if not, whether he was driving at such a rate of speed, as would, under the circumstances constitute negligence, is for the determination of the jury. *Carlson v. Millisack*, 82 Colo. 491, 261 P. 657

(1927); *Amos v. Remington Arms Co.*, 117 Colo. 399, 188 P.2d 896 (1948); *Eagan v. Maiselson*, 142 Colo. 233, 350 P.2d 567 (1960); *Western Distrib. Co. v. United States*, 318 F.2d 353 (10th Cir. 1963).

Sufficiency of evidence to show violation of this section. *Lorenzini v. Rucker*, 95 Colo. 246, 35 P.2d 865 (1934); *Alden v. Watson*, 106 Colo. 103, 102 P.2d 479 (1940).

A person of reasonable intelligence may express an opinion of the speed of an automobile or other moving object coming under his observation without proof of further qualifications. *Eagan v. Maiselson*, 142 Colo. 233, 350 P.2d 567 (1960).

Administrator of general services administration properly delegated to the secretary of defense the authority to promulgate traffic and pedestrian regulations for military installations within the United States. Therefore secretary properly promulgated regulations adopting all traffic rules of state in which installation located and defendant could be charged with speeding in violation of this section, although charge was dismissed on other grounds. *U.S. v. Boyer*, 935 F. Supp. 1138 (D. Colo. 1996).

Applied in *City of Greenwood Vill. v. Fleming*, 643 P.2d 511 (Colo. 1982); *Smith v. Charnes*, 649 P.2d 1089 (Colo. 1982); *Corr v. District Court*, 661 P.2d 668 (Colo. 1983).

COLORADO REVISED STATUTES

* This document reflects changes current through all laws passed at the Second Regular Session of the Sixty-Ninth General Assembly of the State of Colorado (2014) and changes approved by the electorate at the November 2014 election *

TITLE 42. VEHICLES AND TRAFFIC
REGULATION OF VEHICLES AND TRAFFIC
ARTICLE 4. REGULATION OF VEHICLES AND TRAFFIC
PART 11. SPEED REGULATIONS

C.R.S. 42-4-1102 (2014)

42-4-1102. Altering of speed limits

(1) (a) Whenever the department of transportation determines upon the basis of a traffic investigation or survey or upon the basis of appropriate design standards and projected traffic volumes in the case of newly constructed highways or segments thereof that any speed specified or established as authorized under [sections 42-4-1101 to 42-4-1104](#) is greater or less than is reasonable or safe under the road and traffic conditions at any intersection or other place or upon any part of a state highway under its jurisdiction, said department shall determine and declare a reasonable and safe speed limit thereat which shall be effective when appropriate signs giving notice thereof are erected at such intersection or other place or upon the approaches thereto; except that no speed limit in excess of seventy-five miles per hour shall be authorized by said department.

(b) Repealed.

(2) Whenever county or municipal authorities within their respective jurisdictions determine upon the basis of a traffic investigation or survey, or upon the basis of appropriate design standards and projected traffic volumes in the case of newly constructed highways or segments thereof, that any speed specified or established as authorized under [sections 42-4-1101 to 42-4-1104](#) is greater or less than is reasonable or safe under the road and traffic conditions at any intersection or other place or upon any part of a street or highway in its jurisdiction, said local authority shall determine and declare a reasonable and safe speed limit thereat which shall be effective when appropriate signs giving notice thereof are erected at such intersection or other place or upon the approaches thereto. No such local authority shall have the power to alter the basic rules set forth in [section 42-4-1101 \(1\)](#) or in any event to authorize by resolution or ordinance a speed in excess of seventy-five miles per hour.

(3) Local municipal authorities within their respective jurisdictions shall determine upon the basis

of a traffic investigation or survey the proper speed for all arterial streets and shall declare a reasonable and safe speed limit thereon which may be greater or less than the speed specified under [section 42-4-1101 \(2\) \(b\)](#) or [\(2\) \(c\)](#). Such speed limit shall not exceed seventy-five miles per hour and shall become effective when appropriate signs are erected giving notice thereof. For purposes of this subsection (3), an "arterial street" means any United States or state-numbered route, controlled-access highway, or other major radial or circumferential street or highway designated by local authorities within their respective jurisdictions as part of a major arterial system of streets or highways.

(4) No alteration of speed limits on state highways within cities, cities and counties, and incorporated towns is effective until it has been approved in writing by the department of transportation. Upon the request of any incorporated city or town, the department of transportation shall conduct any traffic investigation or survey that is deemed to be warranted for determination of a safe and reasonable speed limit on any street or portion thereof that is a state highway. In conducting such a traffic investigation, the department may receive and consider traffic and engineering data provided by the city or county engineer of any requesting local government that will be impacted by a proposed alteration of speed limits. Any speed limit so determined by the department becomes effective when declared by the local authority and made known by official signs conforming to the state traffic control manual.

(5) Whenever the department of transportation or local authorities, within their respective jurisdictions, determine upon the basis of a traffic investigation or survey that a reduced speed limit is warranted in a school or construction area or other place during certain hours or periods of the day when special or temporary hazards exist, the department or the concerned local authority may erect or display official signs of a type prescribed in the state traffic control manual giving notice of the appropriate speed limit for such conditions and stating the time or period the regulation is effective. When such signs are erected or displayed, the lawful speed limit at the particular time and place shall be that which is then indicated upon such signs; except that no such speed limit shall be less than twenty miles per hour on a state highway or other arterial street as defined in subsection (3) of this section nor less than fifteen miles per hour on any other road or street, nor shall any such reduced speed limit be made applicable at times when the special conditions for which it is imposed cease to exist. Such reduced speed limits on streets which are state highways shall be subject to the written approval of the department of transportation before becoming effective.

(6) In its discretion, a municipality, by ordinance, or a county, by resolution of the board of county commissioners, may impose and enforce stop sign regulations and speed limits, not inconsistent with the provisions of [sections 42-4-1101 to 42-4-1104](#), upon any way which is open to travel by motor vehicles and which is privately maintained in mobile home parks, when appropriate signs giving notice of such enforcement are erected at the entrances to such ways. Unless there is an agreement to the contrary, the jurisdiction ordering the regulations shall be responsible for the erection and maintenance of the signs.

(7) Any powers granted in this section to county or municipal authorities may be exercised by such authorities or by any municipal officer or employee who is designated by ordinance to exercise such powers.

(8) The department of transportation shall not set a speed limit on interstate 70 for commercial vehicles or any other motor vehicle that differs from the highest authorized speed for any other type of motor vehicle on the same portion of a highway by more than twenty-five miles per hour.

HISTORY: Source: L. 94: Entire title amended with relocations, p. 2366, § 1, effective January 1, 1995.L. 95: (3) amended, p. 956, § 16, effective May 25.L. 96: (1), (2), and (3) amended, p. 579, § 3, effective May 25.L. 2010: (8) added, (SB 10-196), ch. 333, p. 1534, § 1, effective July 1.L. 2014: (4) amended, (SB 14-146), ch. 141, p. 486, § 1, effective May 2.

Editor's note: (1) This section is similar to former § 42-4-1002 as it existed prior to 1994, and the former § 42-4-1102 was relocated to § 42-4-1202.(2) Subsection (1)(b)(II) provided for the repeal of subsection (1)(b), effective July 1, 1998. (See L. 96, p. 579.)

ANNOTATION

Annotator's note. Since § 42-4-1102 is similar to § 42-4-1002 as it existed prior to the 1994 amending of title 42 as enacted by SB 94-1, relevant cases construing that provision have been included with the annotations to this section.

The statute is a proper delegation of legislative authority to department of highways with adequate safeguards to protect against an uncontrolled exercise of discretionary power. It allows for imposition of more than one speed limit for different vehicle types on a state highway or segment thereof, if this is necessary for public safety. *People v. Peterson*, 734 P.2d 118 (Colo. 1987).

The regulation of speed is not solely a matter of statewide concern. *Wiggins v. McAuliffe*, 144 Colo. 363, 356 P.2d 487 (1960).

The state has not so preempted the field by statute as to exclude a city from enacting valid ordinances on the regulation of speed. *Wiggins v. McAuliffe*, 144 Colo. 363, 356 P.2d 487 (1960).

Applied in *Waltemeyer v. People ex rel. City of Arvada*, 658 P.2d 264 (Colo. 1983).

COLORADO REVISED STATUTES

* This document reflects changes current through all laws passed at the Second Regular Session of the Sixty-Ninth General Assembly of the State of Colorado (2014) and changes approved by the electorate at the November 2014 election *

TITLE 42. VEHICLES AND TRAFFIC
REGULATION OF VEHICLES AND TRAFFIC
ARTICLE 4. REGULATION OF VEHICLES AND TRAFFIC
PART 11. SPEED REGULATIONS

C.R.S. 42-4-1104 (2014)

42-4-1104. Speed limits on elevated structures

(1) No person shall drive a vehicle over any bridge or other elevated structure constituting a part of a highway at a speed which is greater than the maximum speed which can be maintained with safety to such bridge or structure, when such structure is signposted as provided in this section.

(2) The department of transportation upon request from any local authority shall, or upon its own initiative may, conduct an investigation of any bridge or other elevated structure constituting a part of a highway, and, if it finds that such structure cannot with safety to itself withstand vehicles traveling at the speed otherwise permissible under [sections 42-4-1101](#) to [42-4-1104](#), said department shall determine and declare the maximum speed of vehicles which such structure can withstand and shall cause or permit suitable standard signs stating such maximum speed to be erected and maintained before each end of such structure in conformity with the state traffic control manual.

(3) Upon the trial of any person charged with a violation of this section, proof of said determination of the maximum speed by said department and the existence of said signs shall constitute conclusive evidence of the maximum speed which can be maintained with safety to

such bridge or structure.

(4) Any person who violates any provision of this section commits a class A traffic infraction.

HISTORY: Source: L. 94: Entire title amended with relocations, p. 2368, § 1, effective January 1, 1995.

Editor's note: This section is similar to former § 42-4-1004 as it existed prior to 1994, and the former § 42-4-1104 was relocated to [§ 42-4-1204](#).

APPENDIX C: EXCERPT FROM THE MUTCD

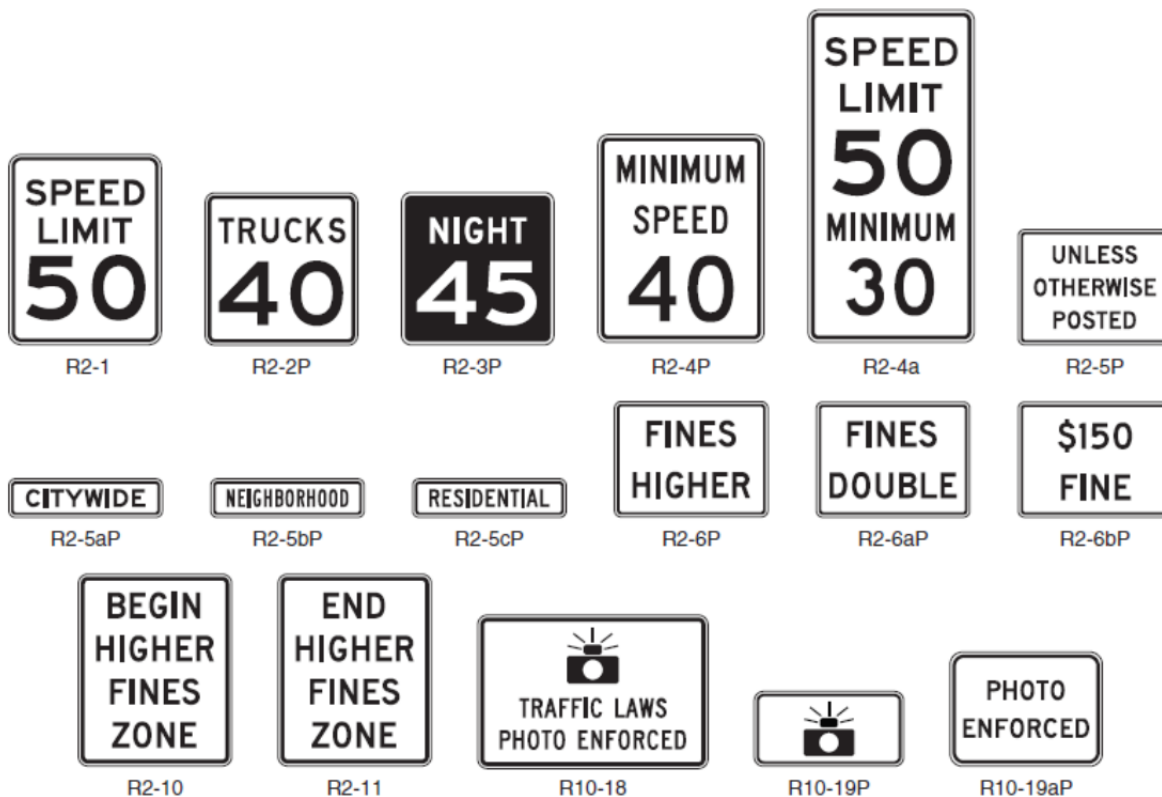
Section 2B.13 Speed Limit Sign (R2-1)

Standard:

01 Speed zones (other than statutory speed limits) shall only be established on the basis of an engineering study that has been performed in accordance with traffic engineering practices. The engineering study shall include an analysis of the current speed distribution of free-flowing vehicles.

02 The Speed Limit (R2-1) sign (see [Figure 2B-3](#)) shall display the limit established by law, ordinance, regulation, or as adopted by the authorized agency based on the engineering study. The speed limits displayed shall be in multiples of 5 mph.

Figure 2B-3 Speed Limit and Photo Enforcement Signs and Plaques



03 Speed Limit (R2-1) signs, indicating speed limits for which posting is required by law, shall be located at the points of change from one speed limit to another.

04 At the downstream end of the section to which a speed limit applies, a Speed Limit sign showing the next speed limit shall be installed. Additional Speed Limit signs shall be installed beyond major intersections and at other locations where it is necessary to remind road users of the speed limit that is applicable.

05 Speed Limit signs indicating the statutory speed limits shall be installed at entrances to the State and, where appropriate, at jurisdictional boundaries in urban areas.

Support:

06 In general, the maximum speed limits applicable to rural and urban roads are established:

- A. Statutorily – a maximum speed limit applicable to a particular class of road, such as freeways or city streets, that is established by State law; or
- B. As altered speed zones – based on engineering studies.

07 State statutory limits might restrict the maximum speed limit that can be established on a particular road, notwithstanding what an engineering study might indicate.

Option:

08 If a jurisdiction has a policy of installing Speed Limit signs in accordance with statutory requirements only on the streets that enter a city, neighborhood, or residential area to indicate the speed limit that is applicable to the entire city, neighborhood, or residential area unless otherwise posted, a CITYWIDE (R2-5aP), NEIGHBORHOOD (R2-5bP), or RESIDENTIAL (R2-5cP) plaque may be mounted above the Speed Limit sign and an UNLESS OTHERWISE POSTED (R2-5P) plaque may be mounted below the Speed Limit sign (see [Figure 2B-3](#)).

Guidance:

09 *A Reduced Speed Limit Ahead (W3-5 or W3-5a) sign (see [Section 2C.38](#)) should be used to inform road users of a reduced speed zone where the speed limit is being reduced by more than 10 mph, or where engineering judgment indicates the need for advance notice to comply with the posted speed limit ahead.*

10 *States and local agencies should conduct engineering studies to reevaluate non-statutory speed limits on segments of their roadways that have undergone significant changes since the last review, such as the addition or elimination of parking or driveways, changes in the number of travel lanes, changes in the configuration of bicycle lanes, changes in traffic control signal coordination, or significant changes in traffic volumes.*

11 *No more than three speed limits should be displayed on any one Speed Limit sign or assembly.*

12 *When a speed limit within a speed zone is posted, it should be within 5 mph of the 85th-percentile speed of free-flowing traffic.*

13 *Speed studies for signalized intersection approaches should be taken outside the influence area of the traffic control signal, which is generally considered to be approximately 1/2 mile, to avoid obtaining skewed results for the 85th-percentile speed.*

Support:

14 Advance warning signs and other traffic control devices to attract the motorist's attention to a signalized intersection are usually more effective than a reduced speed limit zone.

Guidance:

15 *An advisory speed plaque (see [Section 2C.08](#)) mounted below a warning sign should be*

used to warn road users of an advisory speed for a roadway condition. A Speed Limit sign should not be used for this situation.

Option:

16 Other factors that may be considered when establishing or reevaluating speed limits are the following:

- A. Road characteristics, shoulder condition, grade, alignment, and sight distance;
- B. The pace;
- C. Roadside development and environment;
- D. Parking practices and pedestrian activity; and
- E. Reported crash experience for at least a 12-month period.

17 Two types of Speed Limit signs may be used: one to designate passenger car speeds, including any nighttime information or minimum speed limit that might apply; and the other to show any special speed limits for trucks and other vehicles.

18 A changeable message sign that changes the speed limit for traffic and ambient conditions may be installed provided that the appropriate speed limit is displayed at the proper times.

19 A changeable message sign that displays to approaching drivers the speed at which they are traveling may be installed in conjunction with a Speed Limit sign.

Guidance:

20 If a changeable message sign displaying approach speeds is installed, the legend YOUR SPEED XX MPH or such similar legend should be displayed. The color of the changeable message legend should be a yellow legend on a black background or the reverse of these colors.

Support:

21 Advisory Speed signs and plaques are discussed in [Sections 2C.08](#) and [2C.14](#). Temporary Traffic Control Zone Speed signs are discussed in [Part 6](#). The WORK ZONE (G20-5aP) plaque intended for installation above a Speed Limit sign is discussed in [Section 6F.12](#). School Speed Limit signs are discussed in [Section 7B.15](#).

APPENDIX D: MUTCD INTERPRETATION LETTER 2(09)-3(I)

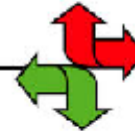
Interpretation Letter 2(09)-3(I) - Resources - FHWA MUTCD

http://mutcd.fhwa.dot.gov/resources/interpretations/2_09_3.htm



[FHWA Home](#) | [Feedback](#)

Manual on Uniform Traffic Control Devices (MUTCD)



[resources](#) > [interpretations](#)

Interpretation Letter 2(09)-3(I) - Legend Color for Electronic-Display Changeable Message Signs

[PDF Version](#), 50KB

You will need the [Adobe Acrobat Reader](#) to view the PDF on this page.



U.S. Department
of Transportation
**Federal Highway
Administration**

Memorandum

Subject: **INFORMATION:** 2(09)-3(I) - Color of Legend
on Electronic-Display Changeable Message
Signs

Date: July 15, 2010

From: Mark R. Kehri
Director, Office of Transportation Operations

In Reply Refer HOTO-1
To:

To: Mr. Joseph Dailey
Division Administrator (HDA-WY)
Cheyenne, Wyoming

We have reviewed your June 18 request for official interpretation of the *Manual on Uniform Traffic Control Devices* (MUTCD) regarding the requirements for the color of light-emitting diodes (LEDs) for regulatory changeable Speed Limit signs. It is our official interpretation of the provisions of the MUTCD that the color of the changeable electronic-display legend for a Speed Limit sign shall be white.

Section 2A.07, paragraph 8 states that the color of LEDs shall be white when used in regulatory signs other than Stop and Yield signs. Section 2A.10, paragraph 1 states that the colors to be used on standard signs and their specific use on these signs shall be as provided in the applicable Sections of the MUTCD. Table 2A-5 specifies common uses of sign colors, in which black is the background color for a regulatory changeable message sign and the color of the legend is white. The colors in this table are further referenced as a requirement in Section 2L.04, paragraph 14.

The use of amber or yellow LEDs in speed displays is for the application of a vehicle approach speed (YOUR SPEED) changeable message sign only, as provided in Section 2B.13.

For recordkeeping purposes, we have assigned your request the following official interpretation number and title: "2(09)-3(I) - Legend Color for Electronic-Display Changeable Message Signs." Please refer to this number and title in any future correspondence regarding this topic. If you have further questions, please contact Mr. Fred Ranck at 708-283-3545 or Mr. Kevin Sylvester at 202-368-2161.

FHWA

APPENDIX E: CASE STUDIES

Alabama

(https://www.dot.state.wy.us/files/live/sites/wydot/files/shared/Planning/Research/WYDOT_EIkmtnVSL_FinalReport.pdf)

For Alabama’s VSL deployment, the real-time variables that are monitored are weather (based on visibility) and congestion (based on vehicle speed). Dispatch approval is required before changing the speed posted on the sign and two system operators staff their tunnel control room 24 hours a day.

When fog is observed via CCTV cameras, operators consult the central computer which displays visibility sensor measurements by zone. The warning system is divided into six zones which can operate independently. Depending on visibility conditions in each zone, operators may display messages on DMS and alter speed limits with VSL signs. The thresholds for the system are given in the table below.

Alabama’s VSL Thresholds

Visibility Distance	Advisories on DMS	Other Strategies
Less than 900 feet	“FOG WARNING”	Speed limit at 65 mph
Less than 660 feet	“FOG” alternating with “SLOW, USE LOW BEAMS”	“55 MPH” on VSL signs “TRUCKS KEEP RIGHT” on DMS
Less than 450 feet	“FOG” alternating with “SLOW, USE LOW BEAMS”	“45 MPH” on VSL signs “TRUCKS KEEP RIGHT” on DMS
Less than 280 feet	“DENSE FOG” alternating with “SLOW, USE LOW BEAMS”	“35 MPH” on VSL signs “TRUCKS KEEP RIGHT” on DMS Street lighting extinguished
Less than 175 feet	I-10 CLOSED, KEEP RIGHT, EXIT ½ MILE	Road Closure by Highway Patrol

Delaware

(https://www.dot.state.wy.us/files/live/sites/wydot/files/shared/Planning/Research/WYDOT_EIkmtnVSL_FinalReport.pdf)

(http://safety.fhwa.dot.gov/speedmgt/ref_mats/fhwasa12022/chap_6.cfm)

With Delaware’s system, the speed limit is lowered based on incidents and weather conditions. The weather variables that are monitored include heavy precipitation, high winds, and reduced

visibility. The pavement surface conditions that are monitored are ice and/or snow on the road, black ice, and/or materials spilled on the roadway. The Chief Traffic Engineer decides whether or not a speed limit change is warranted and sends the request to the Delaware State Police (DSP).

Real-time traffic conditions such as speed, volume, and occupancy are collected at count stations along the roadway, and weather data is obtained from cameras and personnel in the field. Speed reductions of 5 to 20 mph can be made for any of the following conditions: traffic incidents, extreme weather conditions (heavy precipitation, high winds, reduced visibility due to precipitation, fog, or smoke), and poor roadway surface conditions (ice and/or snow covered pavement, "black ice" patches on pavement material, and object spills on the roadway pavement or roadsides).

The DSP maintains the authority to issue tickets to drivers when the issuing officer believes they are traveling too fast for conditions, regardless of the posted VSL. As per Delaware code, drivers have a responsibility to adjust their speeds based on the prevailing conditions regardless of the static signing. The same speed limit is typically displayed throughout the entire corridor, but it is possible for the signs to display different speeds.

Florida

(https://www.dot.state.wy.us/files/live/sites/wydot/files/shared/Planning/Research/WYDOT_EIkMtnVSL_FinalReport.pdf)

The system changes the speed limit based upon lane occupancy and vehicle speed. The thresholds for the system are based on three levels of traffic flow: free flow, light occupancy, and heavy occupancy. Each level has an Adjustment and a Recovery Threshold. The pair of boundaries provides "wobble" room to prevent the system from bouncing back and forth as it passes a barrier. The system requires dispatch approval/verification before being activated. The system has not yet been utilized, so no formal evaluations have been conducted.

Maine

(https://www.dot.state.wy.us/files/live/sites/wydot/files/shared/Planning/Research/WYDOT_EIkMtnVSL_FinalReport.pdf)

Specific weather variables that are monitored include precipitation types and amounts, speed drops of more than 20 mph, and other incidents. Speed readings are collected at ten minute intervals. The system attempts to set the posted speed to a value that is within 5 mph of the average speed on the highway segment. Alarms ring if the speed drops 20 mph or more. The system reads the real-time average speed of vehicles on that highway segment and then dispatchers validate any events that are taking place with on-site DOT crews or state police before activation. One thing that MaineDOT is struggling with is providing speed limit information in a timely manner and developing a protocol for turning the VSLs off when the road segment reaches an acceptable level of service.

Missouri

(https://www.dot.state.wy.us/files/live/sites/wydot/files/shared/Planning/Research/WYDOT_EIkMtnVSL_FinalReport.pdf)

The real time variable that the VSL is based on is lane occupancy. Weather can be monitored, but weather alone will not result in a reduction in the VSL. There are no specific thresholds associated with the system. Dispatcher approval/verification is necessary before the system is activated. The operator monitors the occupancy and decides to lower the speed limit.

New Jersey

(<http://puff.lbl.gov/transportation/transportation/pdf/casestudiesfinalv2-rpt.pdf>)

(https://www.dot.state.wy.us/files/live/sites/wydot/files/shared/Planning/Research/WYDOT_EIkmVSL_FinalReport.pdf)

Traffic and emergency management personnel in the TOC monitor environmental data to determine when speed limits should be lowered. When reductions are warranted, sign assemblies are manually activated to decrease speed limits in five-mph increments from 50, 55, or 65 mph to 30 mph depending on prevailing conditions. System operators may also disseminate regulatory and warning messages via DMS and HAR. State police officers enforce the lower speed limits by issuing summonses to drivers exceeding the posted limit. When the vehicle detection and RWIS subsystems indicate that traffic and weather conditions have returned to normal, the original speed limits are restored.

Each VSL sign is adjacent to an Emergency Speed Warning sign that gives six conditions associated with the speed change. The six conditions are: an accident, congestion, construction, fog, ice, and snow. The Turnpike Authority is replacing the current signs with static panels with LEDs. Since the systems are located over such long distances, they are located both in urban and rural settings. The real-time variables that the VSL is based on are weather, downstream incidents (congestion/accidents), and construction. The weather conditions that are monitored are fog, ice, and snow. The shift supervisor verifies with the state police for a visual observation before the system is activated. The speeds allowed for the VSLs are 55-30 mph, reduced in 5 mph increments. The thresholds for the system are given in the table below.

New Jersey's VSL Thresholds

Condition	Speed Limit
Accident within 2 miles of a sign	45 mph
Congestion within 2 miles of a sign	45 mph
Visibility within 2 miles of sign 500-800 yards	55 mph
Visibility within 2 miles of sign 300-500 yards	50 mph
Visibility within 2 miles of sign 200-300 yards	45 mph
Visibility within 2 miles of sign 150-200 yards	40 mph
Visibility within 2 miles of sign 100-150 yards	35 mph
Visibility within 2 miles of sign less than 100 yards	30 mph
Snow within 2 miles of a sign	Maintenance Crew Advises
Spot Salting of an affected area	50 mph
Full Salting of an affected area	45 mph
Plowing of an affected area	35 mph

Pennsylvania

https://www.dot.state.wy.us/files/live/sites/wydot/files/shared/Planning/Research/WYDOT_EIkmtnVSL_FinalReport.pdf

Speed limits are related to visibility levels that were based on the stopping sight distances taken from the ASHTO Policy of Geometric Design of Highway and Streets. Road Weather Information Systems determine visibility in fog prone areas. Dispatcher approval/verification is necessary before the VSL system is activated.

South Carolina

http://safety.fhwa.dot.gov/speedmgt/ref_mats/fhwas12022/chap_6.cfm

<http://puff.lbl.gov/transportation/transportation/pdf/casestudiesfinalv2-rpt.pdf>

The system automatically reduces the speed limit to 45 mph if non-ideal roadway conditions are present. Currently this is determined based on the amount of precipitation, which is collected by a standard weather station installed nearby. Sensors are installed in the pavement to read barometric pressure and determine if ice is forming on the pavement. Cameras are linked to the central system so that SCDOT can watch the VSLs. The VSL signs are supplemented by overhead variable message signs that display standard messages based on the type of weather condition being experienced.

The central computer's decision support software predicts or detects foggy conditions, correlates environmental data with predetermined response strategies, and alerts traffic managers in the district office. When alerted by the computer, system operators view images from the CCTV cameras to verify reduced visibility conditions. Operators may accept or decline response strategies recommended by the computer system. Potential advisory and control strategies include displaying pre-programmed messages on DMS, illuminating pavement lights to guide vehicles through the fog, extinguishing overhead street lights to minimize glare, and closing the freeway and detouring traffic to Interstate 26 and US Highway 17. When warranted, Highway Patrol officers erect barricades to close the freeway. Response strategies for various visibility ranges are shown in the table below.

South Carolina VSL Strategies

Visibility Conditions	Advisory Strategies	Control Strategies
700 to 900 feet	“POTENTIAL FOR FOG” and “LIGHT FOG CAUTION” on DMS	“LIGHT FOG TRUCKS 45 MPH” and “TRUCKS KEEP RIGHT” on DMS
450 to 700 feet	“FOG CAUTION” and “FOG REDUCE SPEED” on DMS	Pavement lights illuminated “FOG REDUCE SPEED 45 MPH” and “TRUCKS KEEP RIGHT” on DMS
300 to 450 feet	“FOG CAUTION” on DMS	Pavement lights illuminated and overhead street lighting extinguished “FOG REDUCE SPEED 35 MPH” and “TRUCKS KEEP RIGHT” on DMS
Less than 300 feet	N/A	Pavement lights illuminated and overhead street lighting extinguished “DENSE FOG REDUCE SPEED 25 MPH” and “TRUCKS KEEP RIGHT” on DMS If warranted, “PREPARE TO STOP”, “I-526 BRIDGE CLOSED AHEAD USE I-26/US 17”, and “ALL TRAFFIC MUST EXIT” on DMS

Tennessee

(https://www.dot.state.tn.us/files/live/sites/wydot/files/shared/Planning/Research/WYDOT_EIkmtnVSL_FinalReport.pdf)

By continually monitoring sensor data, the onsite computer predicts and detects conditions conducive to fog formation and detects significant reductions in traffic speed. The central computer sounds an audible alarm in the Highway Patrol office when established threshold criteria are met. When alerted, dispatchers post a reduced speed message on DMS and notify Highway Patrol troopers. Troopers are stationed in the project area from 5:00 AM to 10:00 AM when most fog events occur. Within five minutes of an alarm troopers verify conditions by counting the number of visible delineator posts.

Control software provides decision support by correlating field sensor data with pre-determined response scenarios. When troopers confirm low visibility conditions, managers select pre-programmed DMS messages, pre-recorded HAR messages, and appropriate speed limits

based upon scenarios proposed by the central computer. The system also allows the display or broadcasting of customized messages.

Managers are notified if visibility distance is less than 1,320 feet or if average speed falls below 45 mph. The speed limit is reduced from 65 to 50 mph when visibility is between 480 feet and 1,320 feet. The limit is lowered to 35 mph for visibility distances between 240 and 480 feet. Managers also notify local media when the warning system is activated. Under the worst-case scenario—visibility less than 240 feet —Highway Patrol troopers activate automatic ramp gates to close the interstate and detour traffic to US Highway 11.

There are two side-mounted LED signs located along the corridor that are changed when visibility is poor. When fog is detected on the corridor and the visibility drops below 1320 feet, the system goes into a preliminary mode. The overhead DMS displays a message of Fog conditions, but the speed limit is still 70 mph. When any other thresholds are met, the dispatcher activates the DMS with the appropriate message and lowers the VSL. The thresholds for the system are given in the table below.

Tennessee VSL Thresholds

Visibility Distance (ft)	Speed posted on VSL signs
>1320	70 mph
Between 1320 and 480	55 mph
Between 480 and 240	35 mph
<240	Corridor closed and traffic detoured

Utah

(https://www.dot.state.wy.us/files/live/sites/wydot/files/shared/Planning/Research/WYDOT_EIKMtnVSL_FinalReport.pdf)

The central computer identifies threats by using visibility distance, vehicle speed, and vehicle classification data in a weighted average algorithm to determine when conditions warrant motorist warnings. When visibility distance falls below 820 feet, the computer automatically displays a warning on DMS. Based on stopping sight distances, safe travel speeds are posted on DMS when visibility is less than 656 feet. Messages displayed for various visibility ranges are shown in the table below.

Utah VSL Thresholds

Visibility Conditions	Displayed Messages
656 to 820 feet	“FOG AHEAD”
492 to 656 feet	“DENSE FOG” alternating with “ADVISE 50 MPH”
328 to 492 feet	“DENSE FOG” alternating with “ADVISE 40 MPH”
197 to 328 feet	“DENSE FOG” alternating with “ADVISE 30 MPH”
Less than 197 feet	“DENSE FOG” alternating with “ADVISE 25 MPH”

Virginia

(https://www.dot.state.wy.us/files/live/sites/wydot/files/shared/Planning/Research/WYDOT_EIkMtnVSL_FinalReport.pdf)

The systems monitor and change the speed based on lane occupancy, incidents, and weather. The thresholds are based on mobility levels on the corridor. The mobility factor for each corridor with VSLs is used to select a speed limit from a “VSL Mapping Table” which contains a set of speed limit patterns derived from the VSL Rules and Constraints that were developed in collaboration with Project Traffic Engineers. The system is fully automated, but can be overridden by the VSL Operations Engineer. VDOT said that the VSL systems are believed to have a positive impact on alerting drivers to upcoming congestion.

Incident detection computer software contains statistical algorithms that continuously analyze field data to identify traffic flow disruptions caused by incidents. Traffic managers may select databases containing detection algorithms for “clear”, “rainy” or “snowy” conditions. When rain or snow events are observed on the monitor walls traffic managers access the incident detection computer and select the detection database most appropriate for prevailing conditions. The CCTV subsystem is also used to visually verify detected incidents and support incident management activities.

Washington Snoqualmie Pass

(https://www.dot.state.wy.us/files/live/sites/wydot/files/shared/Planning/Research/WYDOT_EIkMtnVSL_FinalReport.pdf)

(<http://puff.lbl.gov/transportation/transportation/pdf/casestudiesfinalv2-rpt.pdf>)

The speed limit is based on traction requirements, pavement conditions, visibility, weather (precipitation amount and type), and incident types. There are thresholds for the system, and the speed limit is based on a matrix of the conditions given above. Verification by Maintenance Personnel or the Washington State Patrol is required before changing the speed limit on the signs. The only real-time variable that WSDOT takes into consideration when lowering the VSL is the weather on the corridor.

The central control computer provides decision support by utilizing software algorithms to process field data, calculate safe speeds, and suggest speed limit reductions during adverse conditions. If system operators agree with the recommendations DMS and VSL signs are activated to display road weather advisories, reduced speed limits, and the reasons for lower speeds. The control computer allows system operators to modify speed limits by direction and by road section. DMS may also be used to alert drivers of roadway closures necessitated by winter maintenance and avalanche control activities. When warranted, the speed limit is reduced in 10-mph increments from 65 mph to 35 mph based upon prevailing road, weather, and traffic conditions. Vehicle equipment (e.g., tire chains) may be regulated to improve vehicle traction. Control strategies for various road weather conditions are shown in the table below.

Washington Snoqualmie Pass VSL Strategies

Weather Conditions	Pavement Conditions	Control Strategies
Light to moderate rain Visibility distance > 0.5 mi.	Dry Wet	Speed limit remains at 65 mph No tire regulations
Heavy rain Fog Visibility distance < 0.2 mi.	Slushy Icy	Speed limit remains at 65 mph No tire regulations
Heavy rain or snow Blowing snow Visibility distance < 0.1 mi.	Shallow standing water Compacted snow/ice Deep slush	Speed limit reduced to 45 mph Traction tires required
Freezing rain Heavy rain or snow Blowing snow Visibility distance < 0.1 mi.	Deep standing water Deep snow/slush	Speed limit reduced to 35 mph Tire chains required

Washington Urban

(WSDOT Active traffic Management Standard Operating Procedures I-5, SR-520, I-90 Version #6, August, 7 2009 Draft)

All special operating cases will be approved by the NW Region Traffic Engineer. Manual overrides occur when: the automated system is not responding as it should; conditions require an alternative display; or WSP, WSDOT Maintenance, or WSDOT Northwest Region Traffic engineer request an alternative display. All speeds shown in an ATM Zone will be regulatory. Speed limits will generally be set near the 85th percentile speed which is derived from the average speed collected by detection and adjusted against a chart correlating 85th percentile speed with this average. The posted speed calculation will occur every minute. New speeds can be posted every minute. Speeds calculated within a congested area with a variance not exceeding 10 mph will be smoothed by posting an average speed throughout the smoothed zone.

Special Cases: Situational Adjustments – Roadway geometrics (exit lanes backing up onto the freeway; curves; tunnels; bridges) in specific locations may require parameter adjustments specific to a given location. These locations will require adjustments to the software parameters within the automated module in the software. All “Situational Adjustments” will be pre-defined and approved by the NW Region Traffic Engineer.

Weather Speed Limit Reduction – WSP, WSDOT Maintenance, or the TMC supervisor may request a reduction in the maximum posted speed limit based on the snow, ice, wind or other weather conditions. The request will be reviewed by the region Traffic Engineer or delegate during the winter weather event. If approved, the signs will be posted with the reduced maximum speed limit. In a weather event, speed limits will not be posted below 30 mph. A weather speed reduction will be canceled when conditions improve with coordination with WSP and approval by the NW Region Traffic Engineer or delegate.

Wyoming

(http://safety.fhwa.dot.gov/speedmgt/ref_mats/fhwas12022/chap_6.cfm)

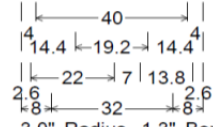
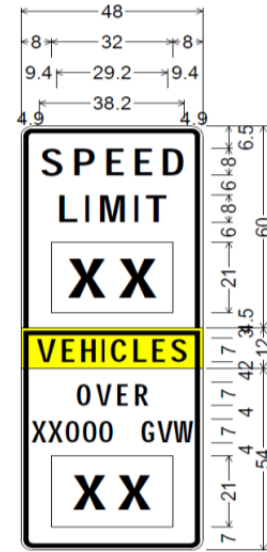
The VSL System does not rely on detection equipment or algorithms to establish weather conditions of concern; rather, the Wyoming State Patrol determined when conditions warranted a lowering of the posted speed limit.

The Wyoming Highway Patrol, maintenance foremen, and TMC operators are responsible for speed selection. Visibility, surface conditions, and vehicle speeds are used to determine appropriate speed limits. Wyoming Highway Patrol visually inspects conditions and reduces speed limits as deemed appropriate. The maintenance foreman can also lower speeds if the Wyoming Highway Patrol is not available. If the average vehicle speed drops 15 mph from the standard speed and no one else is on the corridor to confirm conditions, then the TMC Operator has the authority to reduce speed limits. Also, if there is a drop in visibility or a change in surface conditions, the TMC Operator has the authority to set the speed limits based on the criteria provided in the table below.

Wyoming VSL Thresholds

Reported Condition:	Wet or Dry	Slick Spots	Slick
Speed Limit (mph)	Visibility (feet)		
75	>950	>1625	
65	735-950	1225-1625	1025-1700
50	475-725	750-1225	1025-1700
35	<475	<750	<1025

APPENDIX F: VARIABLE SPEED LIMIT (VSL) SIGN AND LAYOUT



3.0" Radius, 1.3" Border, 0.8" Indent, Black on White;
 "SPEED" E;
 "LIMIT" E;
 3.0" Radius, 1.3" Border, 0.8" Indent, Black on Yellow;
 "VEHICLES" D 68% spacing;
 3.0" Radius, 1.3" Border, 0.8" Indent, Black on White;
 "OVER" C;
 "XX000 GVW" C 33% spacing;
 Table of letter and object lefts.

S	P	E	E	D
4.9	13.3	21.7	29.2	36.8
L	I	M	I	T
9.4	16.9	20.3	29.7	32.8

□
8.0

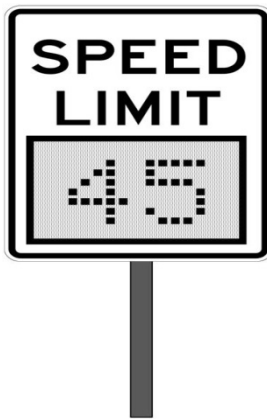
V	E	H	I	C	L	E	S
4.0	10.2	15.3	21.1	23.4	29.0	34.1	39.3

O	V	E	R
14.4	19.6	25.1	29.8

X	X	O	O	O
2.6	7.1	11.6	16.1	20.5

G	V	W
31.6	35.8	40.2

□
8.0



Static Sign with LED insert

APPENDIX G: COEFFICIENTS OF FRICTION

Coefficients of Friction

Page 1 of 2

Coefficients of Friction of Various Roadway Surfaces

DESCRIPTION OF ROAD SURFACE	< 48 kph < 30 mph		DRY		> 48 kph > 30 mph		WET	
	From	To	From	To	From	To	From	To
PORTLAND CEMENT								
New, Sharp	0.80	1.20	0.70	1.00	0.50	0.80	0.40	0.75
Traveled	0.60	0.80	0.60	0.75	0.45	0.70	0.45	0.85
Traffic Polished	0.55	0.75	0.50	0.65	0.45	0.65	0.45	0.60
ASPHALT or TAR								
New, Sharp	0.80	1.20	0.65	1.00	0.50	0.80	0.45	0.75
Traveled	0.60	0.80	0.55	0.70	0.45	0.70	0.40	0.65
Traffic Polished	0.55	0.75	0.45	0.65	0.45	0.65	0.40	0.60
Excess Tar	0.50	0.60	0.35	0.60	0.30	0.60	0.25	0.65
GRAVEL								
Packed, Oiled	0.55	0.65	0.50	0.60	0.40	0.60	0.40	0.60
Loose	0.40	0.70	0.40	0.70	0.45	0.75	0.45	0.75
SANDERS								
Packed	0.60	0.70	0.60	0.70	0.65	0.75	0.65	0.75
ROCK								
Crushed	0.50	0.75	0.50	0.75	0.55	0.75	0.55	0.75
ICE								
Smooth	0.10	0.25	0.07	0.20	0.05	0.10	0.05	0.10
SNOW								
Packed	0.30	0.55	0.35	0.65	0.30	0.60	0.30	0.60
Loose	0.10	0.25	0.10	0.20	0.20	0.60	0.30	0.60
OPEN METAL GRID	0.70	0.90	0.55	0.75	0.25	0.45	0.20	0.35
SLIDING ON ROOF OR SIDE								
Concrete	0.30							
Asphalt	0.20 - 0.40							
Gravel	0.50 - 0.70							
Dry Grass	0.20							
Dirt	0.20							
ROLLING RESIST.								
Drive Axle	0.10 - 0.20							
Non Drive Axle								
Normal Inflation	0.01							
Partial Inflation	0.015							
Flat Tire	0.017							
ENGINE BRAKING								
Low Gear	0.20 - 0.40							
High Gear	0.20							
BRAKING								
Light Braking	0.10 - 0.20							
Normal Braking	0.20 - 0.40							
LATERAL ACCEL.	0.20 - 0.30							
ROTATIONAL ACCELERATION								
Long Post Travel	0.20 - 0.30							
Short Post Travel	0.35 - 0.50							
ROLLOVER	0.30 - 0.55							
PEDESTRIAN (SLIDING)								
Grass	0.45 - 0.70							
Asphalt	0.45 - 0.60							
Concrete	0.40 - 0.65							