

Washington State Autonomous Vehicle Work Group Subcommittee Recommendation Form

Recommendation: Increased Investment in Roadway Pavement Markings

Subcommittee	Infrastructure and Systems
Date of Meeting	Introduced on September 11 th , 2020, Virtual vote, Week of October 26 th , 2020
Voting Members Present	Yes = 24 Votes, No = 1 Vote, Abstain/Neutral = 1 Vote For additional details and comments, please see accompanying Excel file "Final Votes Nov 4 2020"

Instructions:

- 1) List subject of discussion
- 2) Write a detailed description of the recommendation, including the timeframe recommended for adoption, the agencies and stakeholders affected, and any fiscal implications. Identify potential challenges, including funding, regulation, legislation, education, etc. List recommended remedies to address identified challenges.
- 3) Check all required changes and write in any that are not listed. Provide a brief explanation of the change needed
- 4) Check all impact areas affected and list recommendations for addressing identified impacts. Write in any impact areas not listed.
- 5) If the recommendation has been voted on, please list votes in favor and against. If no vote was taken, please note why.

1) RECOMMENDATION

Request for the Legislature to consider increased ongoing investments in enhanced roadway pavement markings during future, new revenue discussions to increase traveler safety and support Advanced Driver Assistive Systems deployed on Washington's roads today (SAE Levels 0-2) and Automated Driving Systems (SAE Levels 3-5) Technologies that are currently being tested on public roads. These enhanced markings have the potential for significant crash reductions and reduced societal costs.



2) RECOMMENDATION DESCRIPTION, CHALLENGES, AND MITIGATION

Existing Advanced Driver Assistive Systems operating on our roads today (SAE Levels 0-2) and Automated Driving Systems (SAE Level 3-5) technologies that are currently being tested on public roads utilize pavement markings. Specifically, vehicles use longitudinal center and edge lines to enable lateral positioning systems, commonly referred to as Lane Keep Assist.

As outlined on pages 53 and 54 of the final draft (awaiting FHWA Division Office Approval) 2020 Washington State Safety Implementation Plan (see excerpts below), High Visibility Edge Lines have the following Benefit Cost Ratio: *“The benefit/cost ratio is based on the annual potential benefits of reduced societal costs from crashes and the annual material and labor costs of installing the high visibility edge lines. At a 20% reduction the expected benefit/cost ratio is **78:1** »*

Recommended Remedies:

Consider increased funding during future, new revenue discussions. The majority of pavement markings are installed by public maintenance crews and, given the relatively short life cycle for pavement markings, the investment should be ongoing and earmarked specifically for roadway pavement marking associated expenditures.

Additional Notes:

As noted in the “WSDOT Roadway Striping and Markings” presentation given to the Infrastructure and Systems Subcommittee on September 11th, 2020 ([see here](#)) the precise application, (e.g. width, type of marking, spacing of markings, etc.) hasn’t been standardized at the National Level, but WSDOT does have an approach that could be implemented today and revised as needed to align with national direction as it unfolds.

3) REQUIREMENTS IDENTIFIED

“X” or blank	Type of Change Required	Brief Description of Change Needed
	Cost impact mitigation	
X	Legislative change	Increased Funding
	Regulatory change	
	Other	



4) IDENTIFIED IMPLICATIONS AND IMPACTS

"X" OR BLANK	Impact Area	Description of Implication / Impact
X	Infrastructure	Increased frequency and geographic coverage of pavement markings for ADAS and ADS Technologies
X	Safety	Potential crash reduction benefit of 78:1
X	Insurance	Vehicles with ADAS and ADA Technologies could benefit from more favorable premiums over time.
	Health and livability	
	Environmental	
	Economic	
	Workforce	
X	Equitable Access	Pavement Markings Benefit all Transportation System Users regardless of mode
	Other	

5) VOTES

24	Aye
1	Nay
1	Abstained



High Visibility Edge Lines

Edge lines are the solid white longitudinal markings at the outside edge of roadways. High visibility edge lines increase the driver's ability to see the markings, helping reduce lane departure crashes. The Edge Line Visibility Pilot will potentially reduce run-off-the-road crashes by installing high visibility edge lines on rural highways and freeways in Western Washington.

Introduction

The Edge Line Visibility pilot attempts to reduce lane departure crashes, which is one of the Target Zero focus areas. WSDOT will establish high visibility edge lines in three Western Washington regions. The pilot will focus on rural routes and freeways on the west side of Washington state. Studies have shown that increasing edge line visibility by having wider or thicker lines with high visibility beads can reduce run-off-the-road crashes by up to 35%. This pilot will install high build, or thicker than average, 4-inch wide edge lines on target roadways.

Methodology

Crash Modification Factors (CMF) are used to compute the expected number of crashes after implementing a strategy intended to reduce crash frequency or severity on a road or intersection CMF No. 4792 in the Federal Highway Administration's clearinghouse for crash modification factors increases the edge lines from 4 inches to 6 inches and has a value of 0.78, or a 22% reduction in crashes. The CMF has a rating of 4/5 and used a before/after study with empirical Bayes methodology, a type of statistical estimation that addresses randomness and increases precision compared to using a crash history.

WSDOT will examine the three Western Washington regions in this pilot, with a focus on rural highways and freeways. Urban highways were excluded as many have curbing and no edge line, and potentially have lower travel speeds. All injury lane departure crashes were included in the screening and a 20% crash reduction is assumed.

Key Takeaway

- Assuming a 20% reduction in crashes following edge line visibility treatments, the expected benefit/cost ratio is 78:1.

Using the proposed high build 4-inch edge lines will provide benefits for all conditions, according to the research cited in the introduction. Other benefits may include improved readability by smart vehicle technology and road stripes maintaining visibility over longer periods of time. Based on the available research and CMFs cited above, a 20% reduction in lane departure crashes is a reasonable estimate.



Table 22. All Injury Crashes in Western Washington¹
Annual average, 2014-2018

Severity	Annual Lane Departure ² Crashes	Annual Societal Costs	Annual 20% Crash Reduction	Annual Societal Benefits with 20% Reduction
Possible	952	\$130,916,000	184.0	\$26,1863,200
Evident	519	\$123,115,640	103.7	\$24,623,128
Serious	129	\$442,987,960	25.9	\$88,597,592
Fatal	56	\$191,710,400	11.2	\$38,342,080
All	1,624	\$888,730,000	324.8	\$177,746,000

Notes: 1. Includes three WSDOT regions: Southwest Region, Olympic Region and Northwest Region. 2. Lane Departure includes all run-off-the-road crashes, plus any crash resulting from leaving the traveled lane.

Benefits

The implementation of high visibility edge line in Western Washington could potentially result in 37 fewer fatal and serious injury lane departure crashes and \$177 million in societal benefit annually (see **Table 22** above).

Costs

For Western Washington, the traditional paint package (paint, beads, labor and equipment) costs \$3,602,000 per year. Applying high visibility stripes and beads would cost an additional \$2,259,000 per year for state highways excluding those in cities greater than 27,500 people. See **Table 23** at right for more details.

Benefit/Cost Ratio

The benefit/cost ratio is based on the annual potential benefits of reduced societal costs from crashes and the annual material and labor costs of installing the high visibility edge lines. At a 20% reduction the expected benefit/cost ratio is 78:1.

Table 23. Marginal Labor, Equipment, Materials and Operations (LEMO) Costs

Western Washington 4-inch high build package

Component	Estimated annual cost
Western Washington traditional paint LEMO	\$3,205,000
Western Washington high-build pain LEMO	\$4,543,000
<i>Paint delta</i>	\$1,338,000
Traditional beads	\$397,000
High-build beads	\$1,318,000
<i>Bead delta</i>	\$921,000
<i>High-build package delta</i>	\$2,259,000