Oregon Department of Transportation

**Research Stage 1 Problem Statement**

**Number 26-63 – "Develop Guidance on the Safety Performance of Edge Line Pavement Markers and Guardrail Delineations on Rural Oregon Roads"**

**1.** Concisely describe the **transportation issue** (including problems, improvements, or untested solutions) that Oregon needs to research.

Despite Oregon's efforts to reduce fatalities and serious injuries, crashes along curves (statewide) continue to be high-risk locations, particularly those involving roadway departures. Contributing factors such as speed, visibility, pavement quality, limited delineation, and adverse weather conditions exacerbate these risks. While Oregon incorporates edge line pavement markers and guardrail delineations, there is limited research on their safety performance on Oregon specific rural roads. It will also investigate whether combining edge line pavement markers with guardrail and barrier delineations as part of a systemic safety countermeasure strategy provides greater safety benefits than applying treatments individually. By addressing this through a Safe System Approach lens, the study will develop recommendations that support one of Oregon's rural safety challenges and may be incorporated into existing design and guidance manuals.

**2.** What **final product or information** needs to be produced to enable this research to be implemented?

This research will produce a guidance document outlining recommendations for the use of edge line pavement markers and guardrail delineations on rural curves. The document will provide:

- Criteria for identifying high-risk curves where these treatments will be most effective, taking into account factors such as crash history, speed, curve geometry, and environmental conditions.
- Guidance on combining edge line pavement markers with guardrail and barrier delineations as a systemic safety countermeasure strategy to achieve greater safety benefits.
- Cost-effective, scalable solutions tailored to rural curves that address Oregon's unique roadway environments and crash patterns.
- Additionally, the research will include a performance evaluation framework for ongoing assessment and monitoring of these countermeasures.
- Findings could potentially be integrated into Oregon's Highway Design Manual and other applicable guidance to ensure alignment with the Safe System Approach and statewide safety goals. The deliverables will also support local and state agencies in prioritizing investments in proven safety countermeasures that reduce roadway departure crashes on high-risk curves.

**3.** (Optional) Are there any individuals in Oregon who will be instrumental to the success of implementing any solution that is identified by this research? If so, please list them below.

| Name | Title | Email | Phone |
|---|---|---|---|
| Eric Finney | Engineering Manager | eric.finney@odot.oregon.gov | 971.719.6225 |
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**4.** Decision making lenses

Please complete the following three sections. Your answers to these questions will be applied on a programmatic basis to support agency decisions. Answering yes to the questions below is not required. Resolving a narrowly focused technical research problem may meet agency needs without answering yes to any of the following questions. The ODOT Research Section will seek a balanced portfolio some projects will answer yes to one of the three categories below (e.g. climate, equity, and/ or safety) and other projects in a different category.

We are looking for an overall program balance and no one project is expected to balance all categories. Generally, a research problem statement is expected to be able to answer yes with clear and verifiable information in only one of the three categories below, some projects may be able to answer yes in two or even three categories. Some projects (i.e. needs focused on specific elements of infrastructure design), may have no yes answers but may still be high value research need.

**Climate**

Oregon recognizes the climate crisis and makes systemic changes to reduce emissions caused by travel. Every mile driven in Oregon is powered by a clean source of fuel. We seek research that supports construction and maintenance operations are carbon neutral and investments in mobility that support travel by low and no emission modes. While every research project may not result in a reduction in emissions, transportation investments overall support emission reductions to achieve state goals. Oregon envisions a transportation system that is resilient in the face of seismic and climate events and impacts to the degradation of the natural environment are reduced. Our vision includes a transportation infrastructure is built in a way that avoids impacts on key habitat and results in better environmental conditions for wildlife and native vegetation. For definitions and details please review the equity vision, goals, and objectives of the ODOT Strategic Action Plan and Oregon Transportation Plan.

4f. Will addressing the **transportation issue** identified as a need in Question 1 develop, or validate methods for the estimation, measurement, or monitoring of transportation generated greenhouse gasses (GHG)?

☐Yes ☒No ☐Unsure

4g. If climate or GHG is not the focus of this **transportation issue** identified in this problem statement, will the research apply a GHG analysis to transportation infrastructure, planning, operations, maintenance, or materials?

☐Yes ☒No ☐Unsure

4h. Will the addressing the **transportation issue** include development or testing of construction practices, methods, or materials to establish potential reductions in greenhouse gas emissions?

☐Yes ☒No ☐Unsure

4i. Will the solving the **transportation issue** in question 1 study or support the reduction of vehicle miles traveled and single occupancy vehicle travel or support transition to electric vehicles (or other types of zero emission vehicles) or low-carbon alternative fuels?

☐Yes ☒No ☐Unsure

4j. Will the solving the **transportation issue** in question 1 lead to work that will support, measure, monitor, transportation system resilience in response to expected climate events, effects, or natural disasters in general?

☐Yes ☒No ☐Unsure

4k. Will the solving the **transportation issue** in question 1 lead to work that may result in better environmental conditions for wildlife and native vegetation ?

☐Yes ☒No ☐Unsure

4l. If you answered yes to any of the climate questions above or can provide alternative details related to climate, please provide additional information:

**Equity**

Equity can have many dimensions and impacts relating to communities, and transportation. It is important that problem statement proposals clearly explain in what capacities are equity dimensions or impacts being examined within problem statements. It is a goal of the OTP to "Improve access to safe and affordable transportation for all, recognizing the unmet mobility needs of people who have been systemically excluded and underserved. Create an equitable and transparent engagement and communications decision-making structure that builds public trust". Proposed research may have the intent of studying elements of this goal or apply analysis to specific transportation topics to ensure the resulting research recommendations is consistent with our equity goals. For definitions and details please review the equity vision, goals, and objectives of the ODOT Strategic Action Plan and Oregon Transportation Plan.

4a Is the **transportation issue** identified as a need in Question 1 specifically focused on transportation equity?

☐Yes ☒No ☐Unsure

4b If the **transportation issue** is not focused on transportation equity, will the primary topic be assessed for equity benefits or impacts within the research project?

☐Yes ☒No ☐Unsure

4c Is the implementation of potential findings from this research likely to directly involve participation from an identified group that would benefit from an equitable process or outcome?

☐Yes ☒No ☐Unsure

4d Is the intended final product or information expected to support ODOT's equity efforts (Including but not limited to supporting one of the equity related objectives of the ODOT's Strategic Action Plan or Oregon Transportation Plan) ?

☐Yes ☒No ☐Unsure

4e If you answered yes to any of the equity questions above or can provide alternative details related to equity, please provide additional information:

**Safety**

Research outcomes may include interventions and countermeasures to prevent or reduce the frequency of crashes or other causes of transportation-related injury or death; or may include measures to reduce severity of injury (including prevention of death) after a crash or other injurious event. For definitions and details please review the equity vision, goals, and objectives of the ODOT Strategic Action Plan, Oregon Transportation Safety Action Plan and Oregon Transportation Plan.

4m. Will solving the **transportation issue** in question 1 support improving **safety culture** for either transportation workers or the traveling public?

☐Yes ☒No ☐Unsure

4n. Will the solving the **transportation issue** support improving safety through **healthy and livable communities**?

☐Yes ☐No ☒Unsure

4o. Will solving the **transportation issue** support improving safety through using **best available technologies**?

☒Yes ☐No ☐Unsure

4p. Will solving the **transportation issue** support improving safety through **communication and collaboration**?

☐Yes ☒No ☐Unsure

4q. Will the solving the **transportation issue** support improving safety through **investing strategically**?

☒Yes ☐No ☐Unsure

4r. If you answered yes to any of the safety questions above or can provide alternative details related to safety, please provide additional information:

This study will contribute to safety both by using the best available technologies and strategic investment. Edge line pavement markers and barrier delinations represent an ongoing part of the state's investment in safety infrastructure with new and reconstruction projects, and with maintenance. Knowing the impact of these features on rural road safety can inform the agency's use of differing technologies that could have higher or lower safety outcomes in rural areas of the state. Strategically, this study supports targeted investments by focusing on the locations with the highest potential impact, ensuing efficient investments to reduce and mitigate the costs of crashes along rural curves in Oregon.

**5.** Other comments:

Previous research provides a strong basis for improvements in Oregon through this study. Driving simulator research shows the combination of median markings and horizontal warning signs impact driver behavior differently, which may be useful in guiding the combination of methods in the present problem statement (Babić and Brijs, 2021). Large-scale, naturalistic driving data shows the importance of curve infrastructure design on safety, but does not address the specific issues needed by this problem statement (Claros, et al., 2024). Guardrail height may significantly effect driver behavior, especially the lateral placement of a vehicle in curves (Lioi, et al., 2022). The only related study in Oregon provides evidence supporting construction practices that could support edge delineation (Dixon and Xie, 2012). This cursory review of related research supports further analysis of the problem of rural curve delination for safety in Oregon.

References

Babić, D., & Brijs, T. (2021). Low-cost road marking measures for increasing safety in horizontal curves: A driving simulator study. Accident Analysis & Prevention, 153(0). https://trid.trb.org/View/1769336

Claros, B., Chitturi, M., Vorhes, G., Bill, A., & Noyce, D. A. (2024). Horizontal Curve Safety Performance Evaluation Based on Naturalistic Vehicle Lane Position Data. Transportation Research Record: Journal of the Transportation Research Board, 2678(10). https://trid.trb.org/View/2362029

Dixon, K. K., & Xie, F. (2012). Evaluation of the Safety Edge SM Application in Oregon (No. FHWA-OR-RD-12-11). Article FHWA-OR-RD-12-11. https://trid.trb.org/View/1138332

Lioi, A., Hazoor, A., Castro, M., & Bassani, M. (2022). Impact on driver behaviour of guardrails of different height in horizontal-vertical coordinated road scenarios with a limited available sight distance. Transportation Research Part F: Traffic Psychology and Behaviour, 84(0). https://trid.trb.org/View/1899931

**6.** Corresponding Submitter's Contact Information:



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