

Research Stage 1 Problem Statement

PROPOSED TITLE: USING RECYCLED ASPHALT PAVEMENTS (RAP) FOR PAVEMENT PRESERVATION TO REDUCE MATERIAL COSTS AND ENVIRONMENTAL IMPACT

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

With the rising costs of asphalt concrete paving, more affordable pavement preservation options, such as chip seals, are becoming increasingly essential. The [2024 ODOT Pavement Condition Report](#) shows that the number of lane miles paved annually has declined since 2015, largely due to rising paving costs and reduced budgets. Despite this decline, chip-sealed lane miles have been gradually increasing and are projected to continue growing over the next decade.

Chip seals offer a high benefit-to-cost ratio and are particularly effective at sealing surface cracks and enhancing pavement conditions by adding a protective layer. This process often improves ride quality, reduces roadway roughness, and enhances user comfort. With chip sealing expected to cover a larger share of road maintenance in the coming years, modifications to the process and specifications that allow for the incorporation of recycled asphalt pavement (RAP) could lead to significant cost and emissions savings. Therefore, exploring methods to integrate RAP into chip seals without compromising performance is crucial.

According to the results from the ODOT Research Project [SPR858](#), using RAP aggregates for chip seal construction increases the adhesion between the aggregate and the emulsion layers and is expected to reduce chip loss, which is the major failure mechanism for chip seal roads in Oregon. Preliminary investigations with some limited laboratory testing also showed that it is possible to reduce virgin asphalt binder content by about 20-25% by using RAP aggregates to replace virgin aggregates. This finding was based on a limited evaluation with just a couple of tested specimens. Thus, the binder replacement rate can be increased further based on the findings of this proposed comprehensive research study. According to preliminary calculations, a 20% reduction in virgin asphalt binder content of the applied chip seal emulsions can result in a binder saving that is equivalent to a 5% to 10% increase in RAP content for typical Oregon asphalt concrete paving mixtures with 2-inch to 3-inch thickness. This significant reduction in virgin binder content will also result in a significant reduction in paving costs and GHG emissions for chip seal constructions in Oregon. However, since the asphalt binder around the RAP can blend into the thin emulsion layer over time with traffic and climatic effects, the virgin asphalt binder content for the chip seal emulsions must be carefully selected to avoid both the chip loss (might happen due to lack of binder and poor adhesion between the aggregates and the binder) and the bleeding issues (might happen due to excessive binder use).

This proposed research project will have the following components:

- A comprehensive literature review and assessment of the results and findings from the previous Oregon research studies.
- Laboratory investigations to determine the optimum emulsions, aggregate, and RAP types for ideal chip sealing. The test methods for adhesion (for chip loss) and bleeding evaluation developed by

OSU-AMaP in SPR858 will be used for the laboratory component of this study to determine the most promising strategies that should be tested via pilot section construction and performance monitoring.

- Pavement LCA and LCCA to determine the impact of RAP-based chip sealing on GHG emissions and long-term costs.
- Field implementation of mix designs (pilot sections) that are most promising based on the laboratory results and the corresponding EPDs.
- Long-term performance monitoring of the constructed field pilot sections by Automated Pavement Condition Surveys (APCS) to validate the long-term performance effectiveness of the selected strategies. The laser system and the process developed by OSU-AMaP in [SPR858](#) will be used to determine the bleeding and chip loss potential of chip seal sections.

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

The major products from this proposed research project would be:

- Modifications to the current chip seal design and construction methods and specifications to successfully implement RAP-based chip seals in Oregon.
- Potential RAP chip seal design recommendations that will create the highest level of reduction in GHG emissions while also considering the impact on overall costs.
- EPDs for the selected RAP and conventional chip seal designs to quantify the impact on GHG emissions.
- Specification revisions to include RAP-based chip seals in the current chip seal design process.
- A comprehensive research report with a literature review, all research components and results, and major conclusions.

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
Chris Duman	Pavement Quality & Materials Eng.	Christopher.L.DUMAN@odot.oregon.gov	(503) 559-4994
Timothy Earnest	Assist. Materials Engineer	Timothy.Earnest@odot.oregon.gov	(503) 986-3079
Jeff Shambaugh	State Pavement Engineer	Jeff.SHAMBAUGH@odot.oregon.gov	(503) 986-5764
Zechariah Heck	Sustain. Program Manager	Zechariah.HECK@odot.oregon.gov	(503) 779-4815
Kevin Shearmire	Sustain. Engineer	Kevin.J.SHEARMIRE@odot.oregon.gov	(503) 314-7823

4. Other comments:

REFERENCES:

Proudfoot, J., and A. Toney. 2022. *Oregon Department of Transportation Operational Greenhouse Gas Reductions: Best Practices & Recommendations*.

5. State of Oregon Decision Making Lenses

State decision making lenses are a part of the state of Oregon's policy structure. State policy and federal policy are not always aligned. The state will prioritize research according to state policy, however ODOT may be required to skip prioritized proposals based on constraints placed on the use of federal funds. If state funds are available ODOT will attempt to fund prioritized research that is deemed ineligible for federal funding.

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 a high value research need.

Climate

Oregon recognizes the climate crisis and makes systemic changes to reduce emissions caused by travel. To that end, we seek research that reduces carbon emissions from construction activities and materials, and from maintenance equipment and operations. Oregon envisions a transportation system that is resilient, this means a system that is durable in the face of seismic events and extreme weather to avoid negative impacts, withstand them or bounce back quickly to resume system function. We seek research that improves the ability of the transportation system to adapt or cope with more frequent and extreme weather events. This may include innovations in data and data sharing, construction materials and project design, communication, emergency planning and response, and more. Similarly, we seek research that avoids negative impacts on key habitats and ecosystems that can buffer or reduce damage to infrastructure and improve 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](#).

5a. 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 gases (GHG)?

☐ Yes☒ No☐ Unsure

5b. 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

5c. Will 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

5d. Will 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

5e. Will the solving the **transportation issue** in question 1 lead to work that will support, measure, or monitor, transportation system resilience in response to expected climate events, effects, or natural disasters in general?

☐ Yes☒ No☐ Unsure

5f. Will 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

5g. If you answered yes to any of the climate questions above or can provide alternative details related to climate, please provide additional information:

Using recycled asphalt pavements (RAP) for chip sealing can reduce both the environmental impact and the cost of paving. According to the results of [SPR858](#) calculations, a 20% reduction in virgin asphalt binder content of the applied chip seal emulsions can result in a binder saving that is equivalent to a 5% to 10% increase in RAP content for typical Oregon asphalt concrete paving mixtures with 2-inch to 3-inch thickness. This significant reduction in virgin binder content will also result in a significant reduction in paving costs and GHG emissions for chip seal constructions in Oregon. This aspect addresses the “Stewardship of Public Resources” and “Sustainability and Climate Action” priorities of the OTP.

According to an ODOT/FHWA research study ([Coleri et al. 2025](#)) recently completed by the OSU-Asphalt Materials and Pavements (AMaP) research group, the cost of fuel and tire wear that can be saved by reducing current pavement roughness levels by 20% is around \$73 million/year for the road users. The associated annual emissions savings are around 193,000 MT CO₂/year, while ODOT’s total annual emissions from all operations were calculated to be 182,592 MT CO₂/year (Proudfoot and Toney 2022). This important result shows that low-cost paving materials and strategies, such as chip seals, are needed in this low-paving-budget environment to keep the roadway roughness and rolling resistance low to reduce GHG emissions and road user costs.

Equity

Equity can have many dimensions and impacts relating to communities and transportation. It is important that problem statement proposals clearly explain the equity dimensions or impacts being examined. Oregon commits to social equity in the OTP, specifically 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.* We seek research that studies elements of this goal or applies analysis to specific transportation topics to ensure the resulting research recommendation is consistent with agency equity goals. For definitions and details please review the equity vision, goals, and objectives of the [ODOT Strategic Action Plan](#) and [Oregon Transportation Plan](#).

5h. Is the **transportation issue** identified as a need in Question 1 specifically focused on transportation equity?

☐ Yes

☒ No

☐ Unsure

5i. 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

5j. 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

5k. 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

5l. 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](#).

5m. Will solving the **transportation issue** in question 1 support improving **safety culture** for either transportation workers or the traveling public?

☐ Yes

☒ No

☐ Unsure

5n. Will the solving the **transportation issue** support improving safety through **healthy and livable communities**?

☐ Yes☒ No☐ Unsure

5o. Will solving the **transportation issue** support improving safety through using **best available technologies**?

☐ Yes☒ No☐ Unsure

5p. Will solving the **transportation issue** support improving safety through **communication and collaboration**?

☐ Yes☒ No☐ Unsure

5q. Will solving the **transportation issue** support improving safety through **investing strategically**?

☐ Yes☒ No☐ Unsure

5r. If you answered yes to any of the safety questions above or can provide alternative details related to safety, please provide additional information:

6. Corresponding Submitter's Contact Information:

Name:	Erdem Coleri
Title:	Professor
Affiliation:	Oregon State University
Telephone:	(541)737-0944
Email:	erdem.coleri@oregonstate.edu

7. ODOT Sponsor Contact Information (Required if Submitter is not an ODOT employee)

Name:	Timothy Earnest
Title:	Assist. Materials Engineer
Crew Number:	-
Telephone:	(503) 986-3079
Email:	Timothy.Earnest@odot.oregon.gov