Research Stage 1 Problem Statement

PROPOSED TITLE: Developing Testing and Acceptance Criteria for Binder Source Changes under Oregon's Balanced Mix Design Framework

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

A comprehensive Balanced Mix Design (BMD) process is currently being implemented in Oregon based on the findings from SPR852. Several pilot sections were constructed in 2023, and all sections have been performing well without any premature failures or unexpected performance issues related to BMD. BMD is expected to optimize the asphalt mix design process, resulting in significant long-term cost savings and reduced greenhouse gas (GHG) emissions for ODOT. However, ODOT's transition towards performance-based BMD specifications started to reflect issues related to the variability of asphalt binder sources.

Asphalt binder suppliers must conduct a series of experiments, following AASHTO M320/M332, to determine the performance grade (PG) of the binder. Recent observations from field and laboratory assessments have shown that asphalt mixtures produced using asphalt binders with identical performance grades may provide significantly different rutting and cracking resistance. This issue is more critical and challenging when the contractor changes their binder suppliers or the suppliers alter crude-oil sources or refinery processes in the middle of the construction season or during a major construction project due to cost and availability reasons. These changes were observed to result in significant differences in asphalt mixture stiffness, fatigue life, and aging behavior, potentially leading to premature failures, construction issues, and highly variable BMD performance test results.

The current ODOT processes and specifications do not require the disclosure of the binder's crude source or chemical composition, assuming that the binders with the same PG grades reflect uniform performance, and also to avoid any practical issues during the material production process. The only current requirement at the binder level is the expectation to meet the binder PG grade specified by ODOT for different climate regions and traffic levels in Oregon. However, since the PG grades of the binders are specified in 6°C intervals and the current AASHTO M320/M332 does not have any components to address the difference in the chemistry of the binder, asphalt binders with identical PG grades can perform significantly differently in the field and laboratory. This inconsistency in binder properties and the resulting impact on the long-term performance of the asphalt mixtures **expose ODOT and the contractors to high levels of risk** during the construction process due to the possibility of having an asphalt mix that performs significantly worse than it was designed for in the volumetric and BMD processes.

For all the reasons discussed in the previous paragraphs, a comprehensive research study should be conducted to answer the following major research questions:

1) How does the binder source variation affect the BMD test results of local materials under the unique traffic levels and climatic conditions of various locations across Oregon?
2) Is it possible to develop more practical and quicker BMD tests (such as Ideal RT rather than the Hamburg Wheel Tracking Test) that can only be used when a change in the binder source occurs, or

frequently enough to indicate a binder source change during the life of the production of a mix design?

3) Which binder level properties and parameters (such as ΔTc, MSCR, Glover-Rowe, etc.) are the most effective ones in identifying the long-term performance-related properties of asphalt mixtures?
4) How frequently should BMD mixture performance testing be conducted (e.g., at mix design, production start, every sublot, or after any binder source change) to achieve consistent quality without creating any unnecessary testing burden?
5) What criteria or quick and simple binder testing can be established to make sure that a binder source shift will not result in any major changes in the long-term mix performance?
6) How should the ODOT specifications and contractual language be revised to avoid any premature failures due to a change in binder source during an ongoing construction project in a performance-based BMD acceptance system?

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

A clear data-driven framework is needed to evaluate and manage binder source variability within Oregon's BMD system. The BMD process currently being implemented in Oregon should require a binder level assessment to eliminate any issues that may arise due to changes in the binder source or chemistry after the start of construction, as well as after the initial volumetric design and BMD processes. The final products and implementation deliverables expected from this proposed research study are listed below:

1) Develop practical laboratory and field-testing protocols to evaluate the impact of binder source variability on BMD results.
2) Identify and document relationships between binder properties and the results of mixture performance tests in the BMD process.
3) Develop a practical screening tool that will report the need to further assess the potential in-situ performance of the asphalt mix through a simpler BMD process after a significant change in binder properties.
4) Updating ODOT specifications and QA procedures to address issues related to: i) binder source disclosure, ii) verification, and iii) testing frequency.
5) Develop a clear roadmap for ODOT for a seamless implementation of the new binder level processes and their integration into the current BMD process.
6) Produce documents and videos to help ODOT and industry partners apply the new procedures effectively.

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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

Mike Stennett	Sr. Quality Assurance Engineer	Michael.J.STENNETT@odot.oregon.gov	(503) 318-9881
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4. Other comments:

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:

Avoiding any premature failures due to rutting and cracking is crucial in this low-budget environment to better manage ODOT's resources. For this reason, any early failures due to changes in the binder source or other related issues must be avoided through an experimental procedure. Failure to identify and address those binder-related issues during construction will reduce the service life of the pavement structure and will require early maintenance or rehabilitation. More frequent maintenance will drastically increase the greenhouse gas (GHG) emissions from the material production and construction phases, while the associated traffic congestion during construction will further increase the emissions.

High roughness levels of the roadways managed by ODOT will also negatively impact the environment through increased fuel consumption and tire wear in vehicles. 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 Toneys 2022). This important result indicates that strategies to

enhance the long-term performance of asphalt-surfaced pavements are necessary in this low-paving-budget environment to maintain low roadway roughness and rolling resistance, thereby reducing 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:

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

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