Oregon Department of Transportation

Stage 1 Research Problem Statement

Number*: 25-15*

Proposed Title: Remote Sensing Techniques for Applied Quantitative Analysis of the Kaser Ridge Rockfall Hazard Area, Columbia River Highway

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

Recurring rockfall originating from a steep, 500-foot tall, 7,300-foot-long basalt cliff band east of The Dalles known as Kaser Ridge has contributed to two damaging motor vehicle accidents on I-84 at MP 93.4 over the past year, including an accident on January 12, 2023 involving two commercial motor vehicles and a passenger vehicle, and an accident on August 21, 2023 involving a single commercial motor vehicle. The high relief and extreme exposure at Kaser Ridge preclude direct visual observation of the rock mass in potential rock fall source area(s), which presents a significant limitation for ODOT geohazard professionals tasked with developing safe and cost-effective mitigation design recommendations. To overcome the unique access challenges at Kaser Ridge, ODOT geology staff have worked closely with Geometronics in the weeks following the most recent rockfall event to collect high-density LiDAR data of the Kaser Ridge rockfall hazard area using an Unmanned Aircraft System (UAS) platform. ODOT now seeks to leverage this capability and other new technologies, including RAMBO software developed in partnership with OSU (SP 809 and 864), to optimize mitigation design with the goal of improving safety outcomes while reducing construction and long-term maintenance costs. This will require augmenting the traditional geologic hazard assessment workflow with new remote sensing data acquisition techniques and analysis methods adapted from past and ongoing ODOT research projects, including point cloud change detection and 3D rockfall modeling. Continued monitoring of this site by ODOT geology staff and Geometronics will create the temporal spatial dataset required to implement the latest rock fall hazard assessment tools developed by ODOT and OSU at an active rock fall hazard area on the historic Columbia River Highway.

2. Document how this **transportation issue** is important to Oregon and will meet the Oregon Research Advisory Committee Priorities

The Columbia River Highway (I-84), renowned for its sweeping vistas of the Columbia River Gorge, has long been recognized as one of the most scenic and historically significant highways in the state – and is among those most frequently impacted by damaging rockfall. Ensuring the safety and reliability of State transportation infrastructure is core to ODOTs mission, and the serious hazard that rock fall represents to the traveling public demands effective, proactive rock slope asset management. Unstable slopes also present a safety hazard to first responders, ODOT maintenance staff, field crews, and technical professionals required to work on or below slopes that are susceptible to rock fall. Using UAS for remote LiDAR data collection effectively reduces or eliminates occupational exposure to many of the hazards associated with rock slope assessment, including direct rock fall, steep slopes, and traffic hazards. Employing quantitative remote rock slope assessment and modeling tools to accurately identify the pathways traveled by rock fall at Kaser Ridge, from the source area through the runout zone, will demonstrate how the innovative application of new technologies can aid in the development of rockfall mitigation design recommendations at similar sites across the state. Furthermore, integrating these tools into the geologic hazard assessment workflow may improve the effectiveness of the prescribed mitigation strategy by narrowing the scope of the effort to focus on discrete problem areas, which can reduce construction costs while providing safety and maintenance benefits commensurate with less targeted, more costly solutions.

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

As a case study for the practical application of rockfall prediction methods developed in previous and ongoing ODOT research projects, this project will employ key research elements from SPR 809 and SPR 864 alongside other contemporary UAS LiDAR-based rockfall analysis techniques to inform the mitigation strategy at an active rockfall hazard area in Region 4. It will provide a real-world example for practitioners seeking to integrate these tools into their own geologic hazard assessment workflow, as well as a use-case scenario for ODOT geotechnical staff to evaluate the capability, scalability, and readiness of the technology for implementation at individual transportation project sites. Furthermore, the project will showcase the use of UAS remote sensing data acquisition methods to reduce the risk to personnel evaluating the site, and the high quality data - collected by an experienced pilot from ODOT Geometronics using the UAS platform - will be instrumental for performing the analysis needed to develop mitigation design recommendations; multiple repeat data acquisition events will enable point cloud to point cloud comparison and quantitative change detection to document rock falls, mass wasting, and deposition across the study area. Findings will be summarized as a case study and presented at the annual ODOT Geology/Geotech/HazMat workshop or similar forum as appropriate for the scope of the project upon completion, up to and including publication. Deliverables will highlight both existing capabilities and emerging applications for UAS remote sensing technology on rock slope mitigation design projects, which can have long-term implications for the safety of the traveling public and the financial health of agencies tasked with managing these assets in perpetuity.

4. (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.

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5. Other comments:

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