Research Problem Statement

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I. TITLE

17-018 Coastal Landslides Monitoring and Risk Assessment for Climate Change Adaptation

II. PROBLEM

Coastal landslides and shore cliff erosion imperils ODOT's infrastructure along the Pacific Coastline. Rising seas and extreme coastal weather events pose a significant and growing risk to the safety, reliability, and effectiveness of transportation infrastructure and operations. Landslides and shore cliff erosion are particularly sensitive to the climate drivers of sea-level rise, storm frequency and intensity, wave scour, and rainfall amounts. The rates at which coastal bluffs retreat is directly proportional to these climate change effects and in many locations directly threatens ODOT's coastal infrastructure. Landslides and coastal bluff erosion known processes, but information regarding the actual rate of movement and bluff retreat has not been effectively studied in the past. This research would provide the Agency with data that demonstrates when particular segments of the highway would be affected by landslides or coastal erosion, and would inform critical decisions for when actions must be taken to protect infrastructure. This information is also important with respect to justifying exceptions to land use goals and other environmental exemptions for projects to protect infrastructure.

III. PROPOSED RESEARCH, DEVELOPMENT, OR TECHNICAL TRANSFER ACTIVITY

This research will seek to build and improve upon previous research. The project will utilize new technologies and fill a critical need for collecting data at high-risk landslide sites that pose hazards to the travelling public. The project will collect landslide movement, groundwater data, and bluff erosion rates to inform risks and mitigation strategies for coastal infrastructure. The project will focus on representative sites reflecting a combination of coastal geologic terranes, landslide types, and coastal bluff erosion activities.

Goals of the research are: 1) Conduct slope geomorphology monitoring at up to five high-risk coastal landslide sites that are susceptible to sea level rise and increasing rates of ground movement/shore cliff retreat due to increased wave scour and higher, more intense precipitation events. 2) Continue research at the Arch Cape site on US 101, (MP 35.95) and begin monitoring at Siverpoint slide (MP 31.8), include other sites at Spencer Creek (MP 134), Arizona Inn (MP 312.3) and Hooskenaden Creek (MP 344.1). 3) Monitor changes over a 7-year period to inform rates of change and qualitative risk assessment for these sites.

Terrestrial Laser Scanning (TLS) provides the appropriate technology for rapid 3-dimensional data acquisition using Light Detection and Ranging (LiDAR) to measure, visualize, and understand the processes of coastal bluff retreat. LiDAR data can be used to rapidly survey a site or region repeatedly for change analysis and quantification. A series of annual TLS data set acquisitions and in-situ instrumentation are proposed for the representative sites. These datasets would provide a measurement from a baseline that would be used to determine annual differences between the initial and subsequent scan intervals.

IV. POTENTIAL BENEFITS

Results of this research will be used to develop mitigation strategies that enhance safety, access and mobility along coastal highways. Understanding these landform changes will inform planning and risks to the system, and appropriate solutions to high-risk hazards. This data can be used to determine the effect of erosion on the overall slope stability and to evaluate the most effective mitigation method(s). These surveys would be used to project the rate and nature of

slope retreat. This information would in turn be used to predict the actual time when impact to the roadway would be expected. Subsequent images would be enhanced to indicate areas and magnitudes of retreat or advance to facilitate rapid assessment of changes as well as to quantify movement visually. The rates of erosion would also be used to model the many other sites with similar conditions with respect to site geometry and underlying geology along the Oregon coastline. Having this information will allow for the proactive protection of transportation assets, and provide for long-term cost savings.

V. IMPLEMENTATION

In 2013, ODOT produced a coastal climate change vulnerability assessment and adaptation pilot (see section VI, References). Through this study coastal slides were assessed and recommendations were made to collect additional data. Specifically, the study recommends implementation of a program for monitoring and research at high-risk sites and to better utilize existing LiDAR technologies. The pilot study initiated baseline data collection at the Arch Cape site using ground-based LiDAR. The data collected through this project will be utilized by Technical Services and by Region project planning and scoping teams. Establishment of routine data collection at these sites is needed to determine stability and risk to the highway and would inform Region project priorities. Safe and cost-effective management of the system requires timely and accurate data that relates climate events to site conditions, changes, and risk levels. Results from this project will also inform climate impacts to groundwater changes, their effects on landslide movement, and to differentiate these effects from those related to coastal erosion at the most vulnerable sites.

VI. LIST OF REFERENCES *(optional)*

ODOT Climate Change Vulnerability Assessment and Adaptation Options Study - (December 2014).
http://www.oregon.gov/ODOT/TD/CLIMATECHANGE/docs/AdaptationPilot.pdf

VII. CONTACT INFORMATION

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