UNIVERSITY TRANSPORTATION CENTER

RESEARCH BRIEF

PROJECT TITLE: **Measuring the Impact of a Landslide on Transportation Infrastructure to Improve Mobility and Safety, Phase I**

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INSTITUTION: UNIVERSITY OF ALASKA, FAIRBANKS

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SPONSORS: THE PACIFIC NORTHWEST TRANSPORTATION CONSORTIUM, AKDNR

Background

The Dalton Highway (Alaska Route 11) is the only route connecting Fairbanks, Alaska to the North Slope energy resources. The highway is instrumental in supporting the Trans Alaska Pipeline System (TAPS), which transports the oil that provides the bulk of Alaska's revenue. Additionally, hunters, tourists, and local residents use the highway throughout the year. When this road is closed due to flooding or other geohazards, no detours are available; this impacts industry and stretches the already thin resources of state maintenance crews.

Frozen debris lobes (FDL) are slow-moving landslides in permafrost, many of which are located along the Dalton Highway in Alaska's southern Brooks Range. FDL-A is the largest and closest to the highway. It is currently moving over 6 m/yr, and as of August 2017, it was 29.1 m from the toe of the highway embankment. We estimate that FDL-A will arrive at the embankment as early as 2021, placing ~46,800 tons of material onto the highway embankment every year. Subsurface inclinometer measurements indicate that FDL-A is impacting the subsurface ahead of its toe, with shearing deeper than the ground surface. Recognizing the risk associated with this approaching geohazard, the Alaska Department of Transportation and Public Facilities (ADOT&PF) is realigning the Dalton Highway downslope of the existing alignment. As part of the construction plans, ADOT&PF will leave a portion of the existing embankment in place in front of FDL-A.

Research Project

The collision of FDL-A with the abandoned Dalton Highway embankment represents a unique opportunity; it is not often that engineers can observe a landslide impacting a roadway in a safe and controlled way and on a predictable schedule. This work will be done in multiple phases to accommodate ADOT&PF's construction schedule. Future phases will include: 1) measuring deformation of the embankment and subsurface; 2) measuring earth pressure during the collision of FDL-A with the embankment; and 3) documenting and visualizing the collision through repeat LiDAR scans and repeat photography. For this first phase, we will install sensors to measure pore water pressure and temperature changes in the subsurface as FDL-A approaches and covers the instrumentation locations. Additionally, we will use a back-pack mounted LiDAR system to measure surface deformation of the FDL and estimate volume change.

Through all phases of this research, we will learn more about the earth pressure a landslide imparts to an engineered structure, how the landslide deforms the embankment, and how FDLs modify the permafrost ahead of them. These results can be used to develop successful mitigation strategies for the FDLs, which will improve long-term mobility and safety along this stretch of the Dalton Highway. Additionally, the results can be incorporated into or used to check existing models for earth pressure on retaining walls or piles.