ALASKA DIVISION OF GEOLOGICAL &
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REPORT OF INVESTIGATION 2024-8
Nicolazzo and Larsen, 2025
SHEET 2 OF 3
Explanatory report accompanies map
http://doi.org/10.14509/31309

Shallow Landslide Susceptibility Map for Haines, Alaska

by

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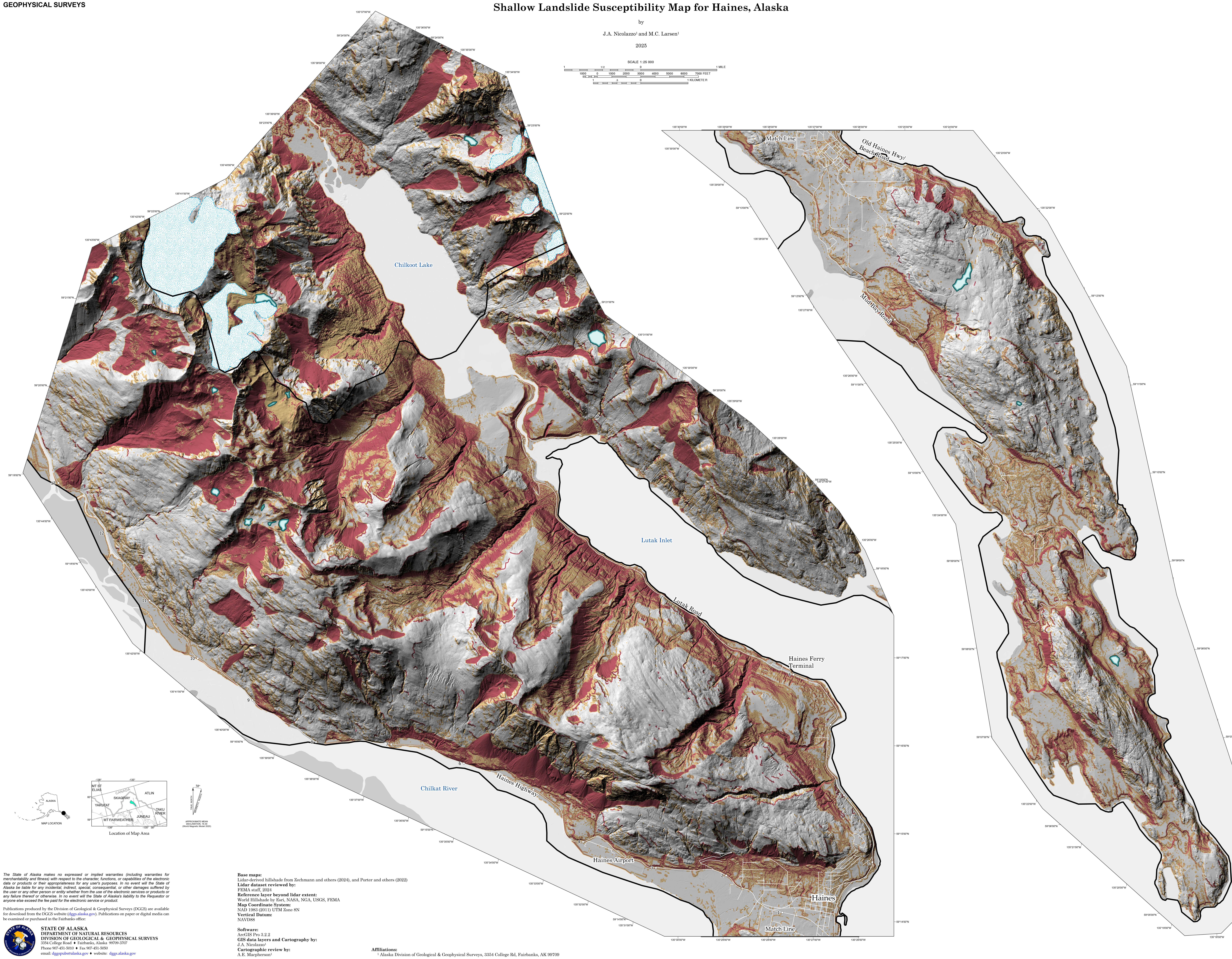
2025

SCALE 1:25 000



Location of Map Area

EXPLANATION

This map depicts slopes susceptible to movement within a portion of the Haines Borough. It combines the inventory illustrated on map sheet 1 with calculated factors of safety (FOS) following the protocols of Burns and others (2012). FOS is the relationship between forces acting to move material downslope and forces resisting that movement.

$$FOS = \frac{Resisting\ Forces}{Driving\ Forces}$$

A slope is theoretically stable where the resisting forces are greater than the driving forces (FOS > 1), and is theoretically unstable where the driving forces are greater than the resisting forces (FOS < 1). Due to variability and uncertainties across a slope or soil unit, and to be conservative, it is generally accepted that an FOS < 1.50 is considered unstable. For this project, an FOS < 1.25 is considered highly unstable, and an FOS between 1.25 and 1.50 is moderately unstable (Burns and others, 2012).

Following the protocol described by Burns and others (2012) to calculate FOS, we used the mapping completed by Larsen (2024) as the input surficial deposit extents. We referenced several sources for the soil engineering properties; see the report that accompanies this map for a list of these resources and description of the methods. Critical slopes were extracted from a 50-cm digital elevation model produced by Zechmann and others (2024). Where this high-resolution lidar data was not available, slope was extracted from the ArcticDEM (Porter and others, 2022). The ArcticDEM was compiled from several different sources, collected at different times, and at different resolutions, so results from this dataset have a lower confidence.

EXTENT OF LIDAR COVERAGE (ZECHMANN AND OTHERS 2024)

1 ○ MILEPOST

ROAD CENTERLINES

GLACIER

POND

SHALLOW LANDSLIDE SUSCEPTIBILITY

HIGH: High susceptibility to slope movement, FOS less than 1.25

MODERATE: Moderate susceptibility to slope movement, FOS 1.25 – 1.50

LITTLE TO NONE: Little to no susceptibility to slope movement, FOS greater than 1.50

LIMITATIONS

This shallow landslide susceptibility map was developed using the best available data with input from many sources. Several limitations are worth noting and underscore that this hazard map was designed for regional application and should not be used as an alternative to site-specific studies.

- This map is based on calculated factors of safety (FOS). The level of detail and accuracy of the final susceptibility map may be affected by the following:
  - FOS calculations were done per soil unit and are strongly influenced by the accuracy and resolution of the input data for soil unit extents, material properties, depth to failure, depth to groundwater, and slope angle. Material properties were estimated based on soils data from several sources and are conservative estimates. Slope angle was derived from a lidar digital elevation model.
  - FOS calculations were done per individual cell, without regard for the adjacent cells. We resampled slopes to 3-meter (~10-feet) resolution and applied focal statistics to reduce the "noise" of processing interpolation and local overestimation in areas of steep slopes with low relief; however, some localized overestimations are still possible.
  - Local conditions may vary substantially from the values used to make this map.
- Lidar provides a "snapshot" view of the landscape at the time of data collection; therefore, maps based on lidar data interpretation may become less accurate as new landslides or other changes to the landscape occur or new technology that would improve the data products becomes available.
- The lidar-based digital elevation model does not distinguish elevation changes that may be due to man-made structures. Because it would require extensive GIS and field work to locate all of these existing structures and remove them or adjust the material properties in the model, they have been included as a conservative approach, and therefore must be examined on a site specific basis.
- This map is intended for regional-scale purposes and to assist state and local agencies in land-use planning. The map does not replace site-specific investigations and is not suitable for land-use regulation, building-code development, or to answer legal questions. It should not be used to assess the hazard to any one property. However, the map can serve as a useful tool for estimating the regional slope failure hazard and as a starting place for future site-specific maps.
- This map does not predict landslides; it simply shows areas that might be more susceptible compared to areas that are less susceptible.
- This map is non-regulatory.

REFERENCES CITED

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Base maps:
Lidar-derived hillshade from Zechmann and others (2024), and Porter and others (2022)
Lidar dataset reviewed by:
FEMA staff, 2024
Reference layer beyond lidar extent:
World Hillshade by Esri, NASA, NGA, USGS, FEMA
Map Coordinate System:
NAD 1983 (2011) UTM Zone 8N
Vertical Datum:
NAVD88

Software:
ArcGIS Pro 3.2.2
GIS data layers and Cartography by:
J.A. Nicolazzo[1]
Cartographic review by:
A.E. Macpherson[1]

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