Landslide and Tsunami Hazard Assessment - 2026

- *Which slopes are susceptible to landslides?*
- *What type of impact will a landslide have if it reaches a portion of Glacier Bay and generates a wave?*
- *What research are we doing to understand these hazards?*
- *Where are people exposed to elevated risk from landslide-generated tsunamis?*

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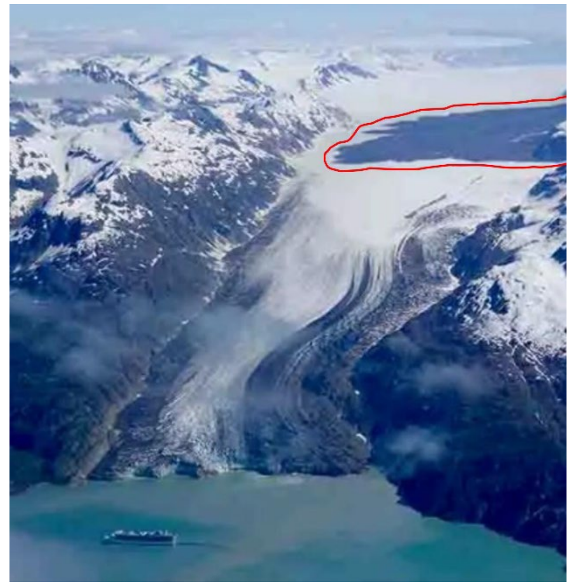
U.S. Geological Survey Landslide Hazards Program

Dates: NPS will assess movement of landslides in August of 2026 using data derived from aerial imagery and GPS. USGS will model landslides in 2026 and begin tsunami modeling in 2027.



The 6/23/2016 landslide on Lamplugh Glacier is the dark area in the top right outlined in red. A second landslide released onto the glacier on 9/17/2022. Note cruise ship for scale. Photo courtesy of Paul Swanstrom, Mountain Flying Service.

Did You Know?

Thawing permafrost, increasing rain, and retreating glaciers are increasing the frequency and size of landslides across coastal Alaska. Using remote-sensing imagery from planes and satellites, we have mapped over 70 areas with landslide features throughout the park. In 2024 we detected movement above Gilman Glacier and in 2025 a recently formed landslide head scarp (steep, upper-edge of a landslide) appeared above the McBride Glacier.

Introduction

Glacier Bay sits atop active geologic faults at the boundary of the North American and Pacific tectonic plates making the area susceptible to earthquake-triggered landslides. Today, however, changing weather patterns are increasing the risk of landslides. Increasing precipitation and temperatures, along with rapid de-glaciation of steep rock walls in narrow inlets (known as 'debuttressing') has resulted in increased frequency and volume of landslides. In McBride Inlet, the glacier toe has lost about 140 vertical meters of ice in six years; this debuttressing leads to less support for the adjacent rock walls. A recent analysis of 24 known landslides in the park that occurred between 1984 and 2016 demonstrated that meterological factors, not earthquakes, were the cause. When these landslides rapidly enter water, they generate tsunamis with extraordinary destructive power - an event that has become more frequent. Alaska alone has recorded major tsunami events: Lituya Bay 1958; Taan Fjord, 2015; Kenai Fjords, 2024; and Tracy Arm, 2025.

While it is not possible to predict exactly if or when a landslide will occur, surveys and science can help identify which areas may be at greater risk of a landslide-generated tsunami. To that end, a collaboration between the NPS and U.S. Geologic Survey (USGS) is focused on collecting information and generating models at representative sites that will help us understand the potential for landslides and tsunamis.

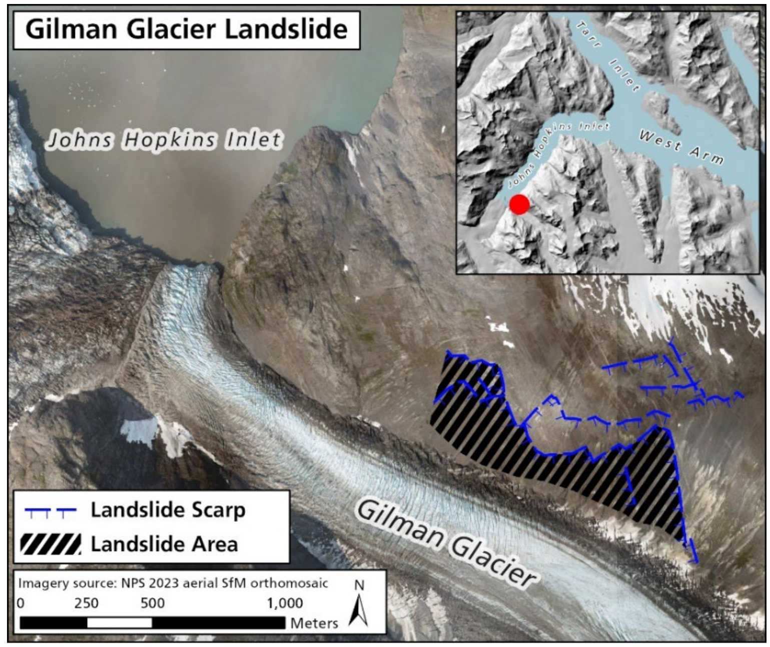
Methods

Satellite and airborne remote sensing datasets will be collected in key areas in 2026. This survey data will be coupled with measurements collected at certain sites in 2019, 2023 and 2025 to help characterize landslide features and detect vertical displacement or deformation of hillslopes. This data will build on information collected in 2025 by the USGS. They used geotechnical testing of bedrock material to assess possible failure geometries at seven locations characterized by fractures and head scarps, which are indices of hillside movement. The Gilman Glacier, Tidal Inlet, and Ace landslides will be the focus for further detailed landslide and tsunami modeling efforts in 2027. These sites are similar in that each location has a large creeping slide but differ in key features. Differing landslide features may influence wave height generation, including their potential landslide runout paths and adjacent fjord bathymetries.

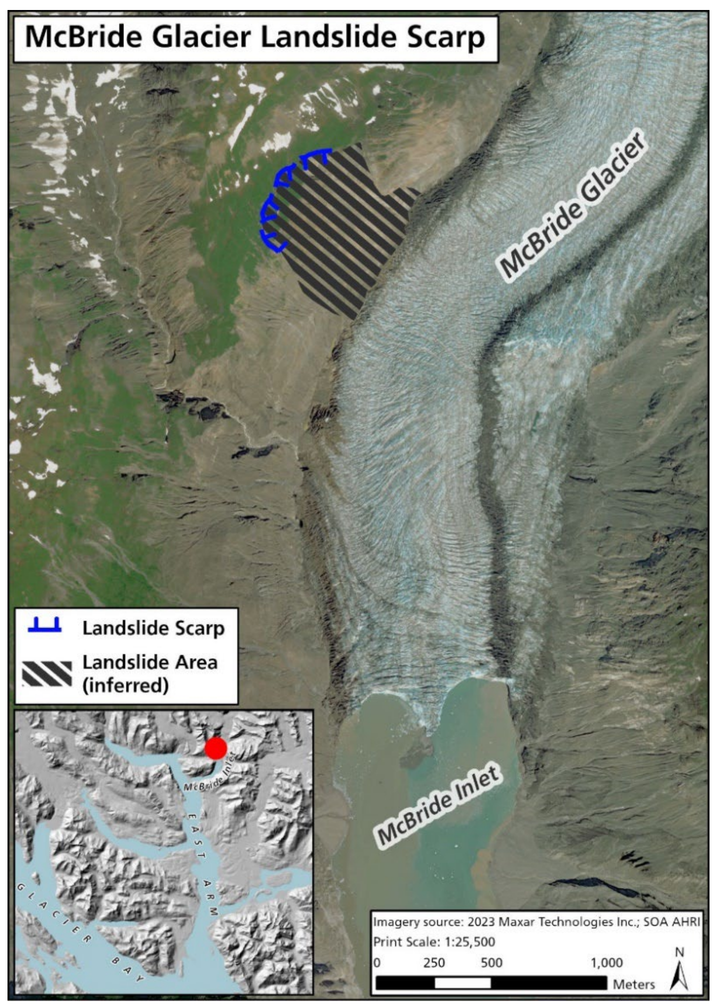
Field assessments will aid in characterizing the landslide processes at each of these locations, including the type of failure, style of movement, and the types of materials involved. By capturing deformation and structural measurements, a clearer understanding of the deformation processes of these unstable slopes will be gained and allow for better models of potential failure modes. This information is also critical for future modeling efforts that will be used to assess how far landslides travel, and whether they could generate tsunamis. We will model how potential tsunamis propagate out of an inlet and into Glacier Bay. With this information, we will be equipped to identify hazard zones and develop plans for reducing potential risks.

Preliminary Results

In 2023, digital elevation models (DEMs) derived from aerial photographs and GPS measurements were compared to DEMs constructed from LiDAR imaging in 2020. Preliminary results demonstrate that parts of the landslide above the Gilman Glacier moved downslope between 2020 and 2023. The amount of displacement varied greatly across the slide, from 0.8 to several meters. We are currently analyzing 2025 LiDAR imagery to determine if rates of movement have changed.

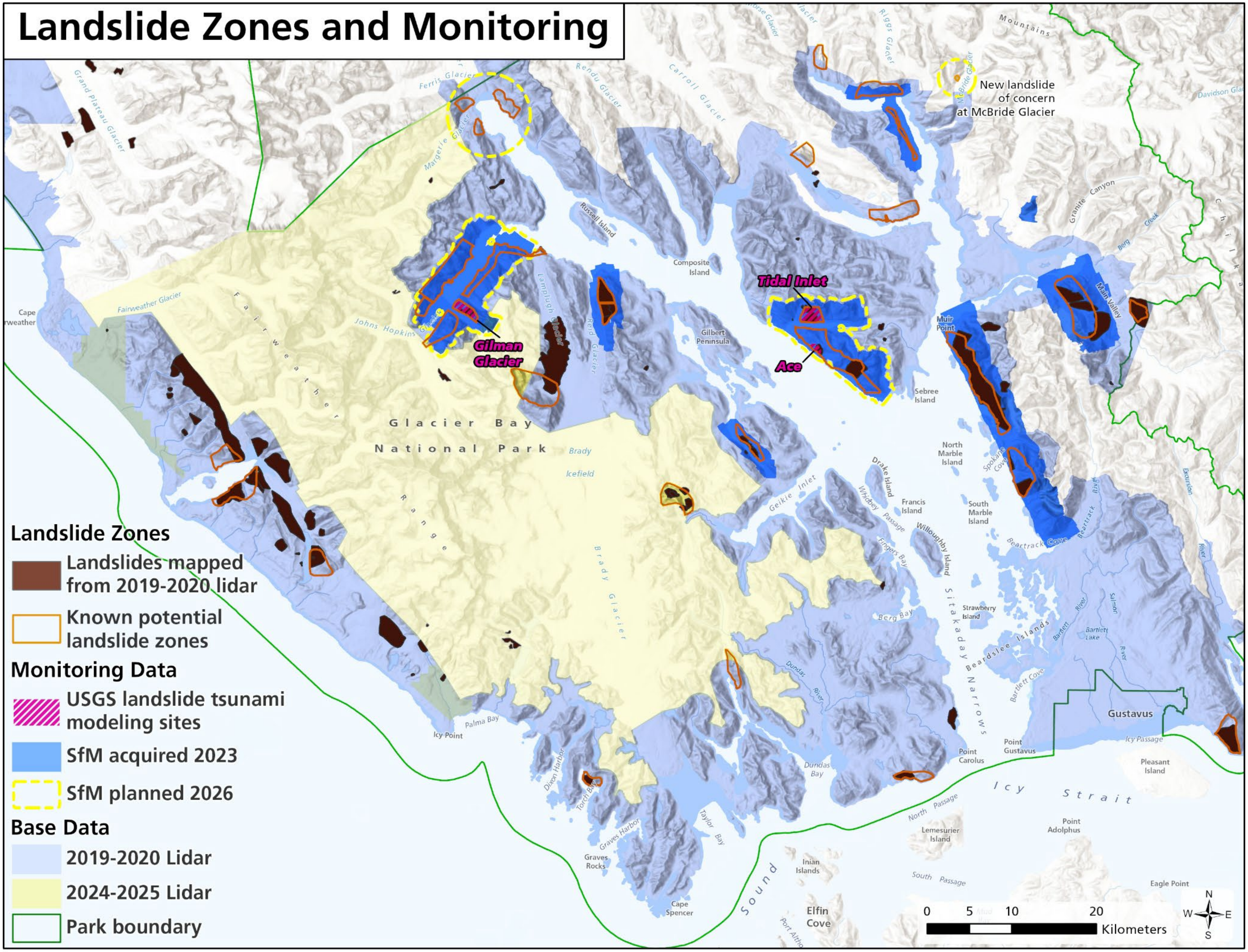


Satellite imagery and Sentinel-1 InSAR (satellite radar) data have revealed a developing landslide near the rapidly retreating terminus of McBride Glacier. Displacement began slowly around 2018 and started to accelerate with the apparent formation of a landslide head scarp by 2021. Although the behavior of the slide is not yet well understood, it may have the potential to reach the inlet and generate a tsunami. Surveys in 2026 are intended to gather baseline data and increase our understanding of the developing slide.



(Next page) Map figure displaying landslide monitoring zones in Glacier Bay, including LiDAR and Structure-from-Motion (SfM) acquisition areas and the three landslides selected for landslide and tsunami scenario modeling by USGS.

Landslide Zones and Monitoring



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To learn more about geohazards in Alaska National Parks, see the special issue of Alaska Park Science: https://www.nps.gov/articles/aps-18-1-1.htm