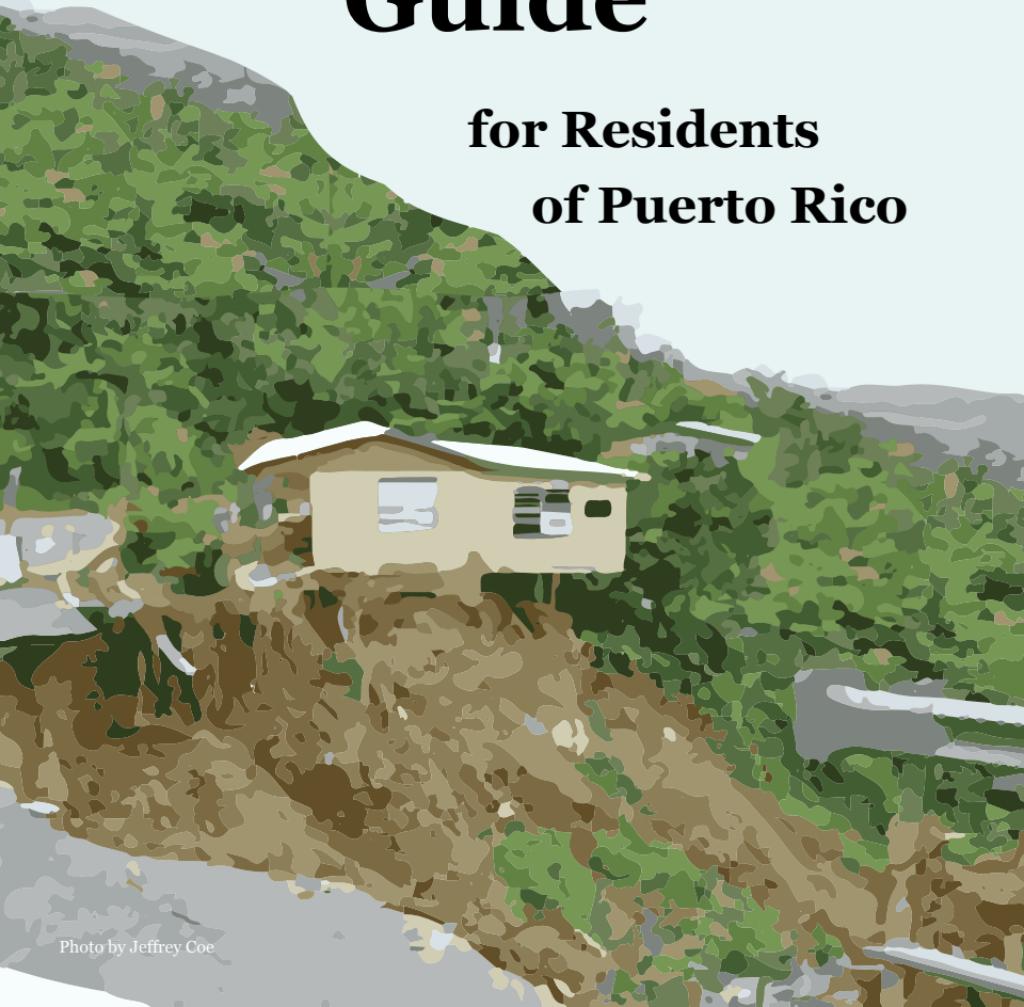


Landslide Guide

**for Residents
of Puerto Rico**



What is a landslide?

A downward movement of soil, rock, and organic material affected by gravity and influenced by the shape of the terrain.

It is important to take adequate mitigation measures to diminish the risk of losses to property and lives.

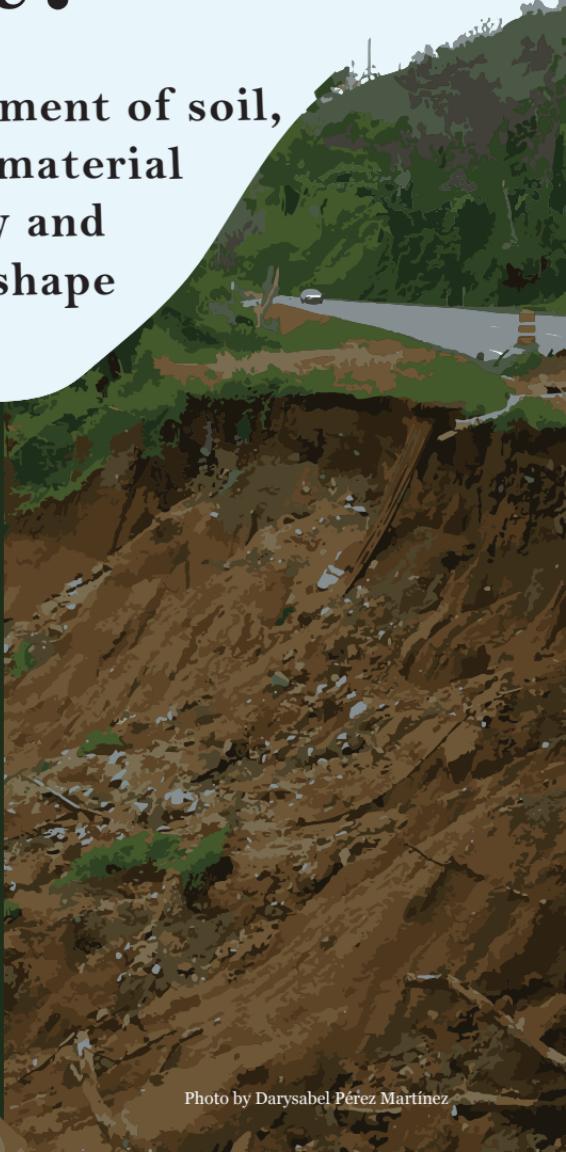


Photo by Darysabel Pérez Martínez

What do these look like?



Rock fall

Downward movement of rock and/or earth that detach from steep slopes or cliffs.

Flow

Rapid displacement in which rock and/or earth combine with water to form a mixture that flows down the slope.



Slide

Detachment of rock and/or earth that usually occurs slowly along a surface.

Landslides on the Island



Photos by:
K. Stephen Hughes
James Joyce
Ramón Alonso Harris
Jenniffer Santos-Hernández

Possible effects on infrastructure



Rock fall

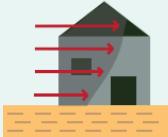
Fast



Sinking



Rock impact



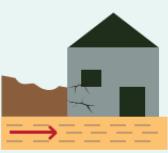
Airborn dust



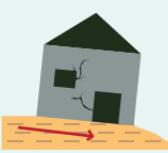
Flow



Burial



Lateral impact

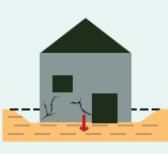


Lateral movement

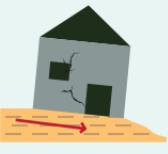


Slide

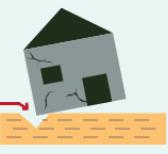
Slow



Sinking



Lateral movement



Undermining

Landslides can take only seconds to occur or can take years to develop.

Photo by Jennifer Santos-Hernández

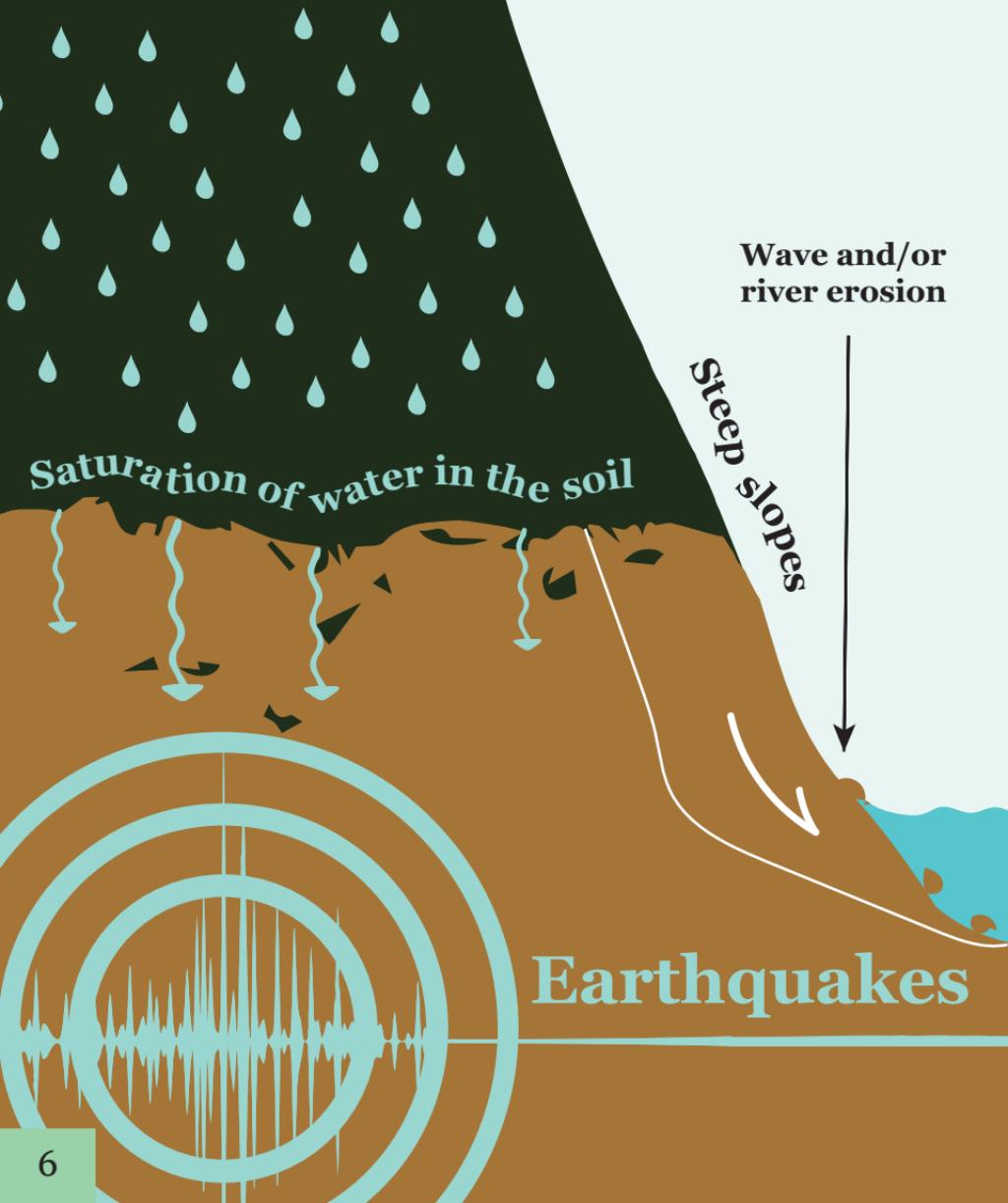


Photo by Lindsay Davis



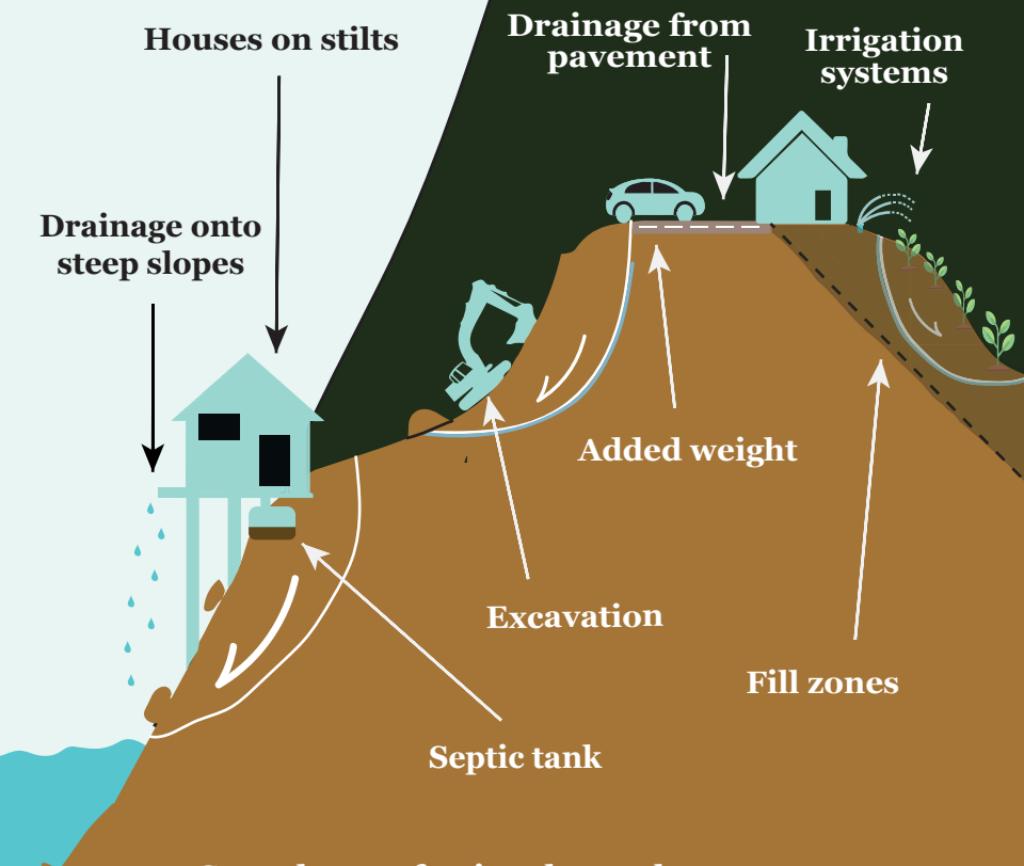
Natural phenomena

that provoke
landslides



Human activities

that contribute to landslide susceptibility



Consult a professional to make sure your property has proper drainage.

The effect of erosion is greater when deforestation occurs.

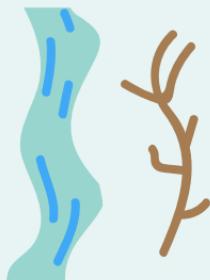
Possible signs of landslides

In nature

Tilted trees are evidence that a slow movement of land is occurring.



Photo by K. Stephen Hughes



Springs develop in new places at the surface, or streams stop flowing suddenly due to landslides obstructing the passage of water.



Photo by K. Stephen Hughes

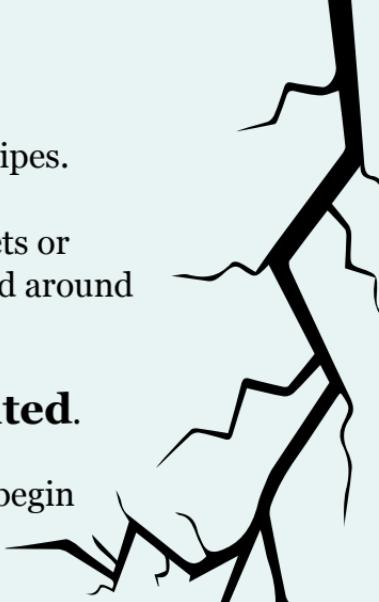
Cracks in terrain facilitate the infiltration of water.

Distortion of structures;
broken, displaced, or dislocated pipes.

Cracks that extend in the streets or
in the walls or floors of houses and around
windows or doors.

Floors, posts, or walls that are **tilted**.

Windows or doors that suddenly begin
to **stick**.



In infrastructure

Photos by K. Stephen Hughes

Important: These are a sample of some, but not all, of the signs that could indicate some danger associated with landslides. These signs could also have other causes. Consult with a professional engineer if you notice all or some of these features. Remember to monitor any type of change in your residence or surrounding area.

Mitigation

Before



Avoid making cuts
in steep slopes.



Use drains and culverts to direct
water away from slopes and
areas prone to landslides.



Avoid deforestation and increase
the planting of trees on slopes.



Do not build in areas prone to
landslides and consult with
a professional.

and preparedness

Keep yourself prepared with an
emergency backpack



Remember to have a family plan in which you have a meeting place and action plan identified.

Know your neighborhood. Pay attention to where potentially vulnerable residents such as the elderly or persons with disabilities may live.

Response

During



Stay alert to any change in noise.
Moving landslides can make
the ground shake.

Move away from windows or areas
where sediment could enter.



If you are not able to evacuate the
area in time, move away from
any area of the structure
that is more vulnerable.

Stay calm and evacuate the
affected structure immediately.

and recovery

After



Help the people that have been affected.



Stay informed and consult emergency management offices.



Report damage to houses and property as soon as possible.



If you have lost your home, go to a temporary shelter with your family.



Replant terrain that has been affected to avoid additional erosion.

Stay away from active landslide areas in case more landslides occur.

Construction

Before building in an area susceptible to landslides,
consult with an engineer, geologist, or geotechnical
professional.



Avoid building without a permit or
without a geotechnical
investigation.



Avoid building
houses on stilts.



Avoid drainage or septic systems
on steep slopes.



Avoid houses on top of or at
the bottom of a steep hill.

Book available through the University of Puerto Rico, Mayagüez:
Rehabilitación de casas en zancos, 2013: Martínez-Cruzado, J., López-Rodríguez, R., and González Avellanet, Y.: The Puerto Rico Strong Motion Program.

Home insurance with respect to landslides



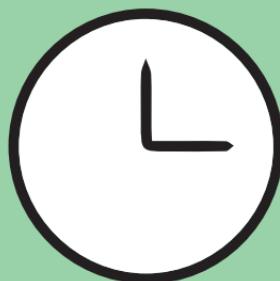
Familiarize yourself with your home insurance policy, they rarely cover landslides.



Take photos of your house before and after the event.



Have important documents in order (proof of residence, copy of geotechnical investigation, service invoice, etc.).



Remember that there is a time limit for making claims after an incident.

For more information:

USGS Landslides Hazards Program:

www.landslides.usgs.gov

SLIDES-PR:

www.facebook.com/SlidesPR

EcoExploratorio:

www.ecoexploratorio.org

Inundaciones y Derrumbes en Puerto Rico:

Guía de mitigación de daños

(CIAPR, AEMEAD, FEMA)

Department of Natural Resources Geology Division:

www.drna.pr.gov/oficinas/division-de-geologia/

Puerto Rico Seismic Network

www.redsismica.uprm.edu/english/

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This publication was produced with funding provided to USGS® as part of the Additional Supplemental Appropriations for Disaster Relief Requirements Act 2018 (P.L. 115-123).

Learn more:

<https://www.usgs.gov/natural-hazards/usgs-supplemental-disaster-recovery-activities/>

Photo by K. Stephen Hughes

hazards.colorado.edu/puertorico