Dick Jahns

Richard H. Jahns Lectures in Engineering Geoscience

2022-23

Vince Cronin

ASSOCIATION OF ENVIRONMENTAL & ENGINEERING GEOLOGISTS

THE GEOLOGICAL SOCIETY OF AMERICA®
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https://CroninProjects.org/Jahns/

Moving Experiences with Landslides


0
1 km

Acquiring the LiDAR-based digital elevation model used in the structural-geomorphic analysis

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3D visualization of lidar point cloud data of the Flatirons, Boulder, Colorado

Latest News

OpenTopography.org

Spring 2023 OpenTopography Webinar Series

Nov 21, 2022

OpenTopography invites you to join us for a series of weekly hour-long webinars beginning in March 2023. During the webinars, we will teach the basics of lidar, demonstrate how to use OpenTopography's growing set of on-demand processing tools, and...

New NCALM datasets in California, Oregon, and North Carolina now available

Jan 10, 2023

Request an API Key

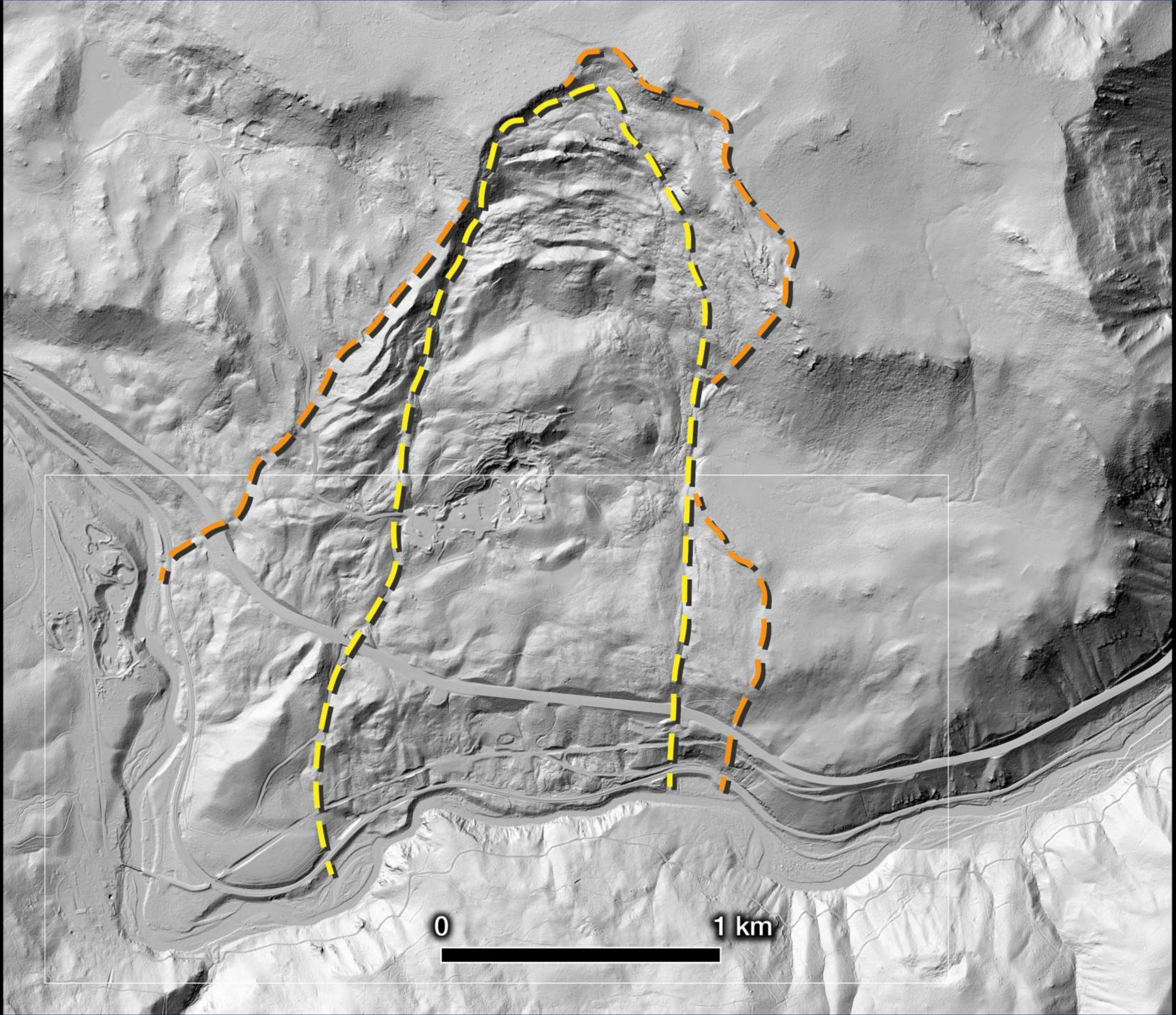
Latest Datasets:

- Lidar Survey of Sparta Earthquake Rupture, NC 2020
- USFS Illilouette Basin Lidar, CA 2011
- Linking Snowpack Heterogeneity to Subsurface Storage and Transmissivity, OR 2022


0
1 km


digital surface model
0
1 km


digital terrain model
0
1 km

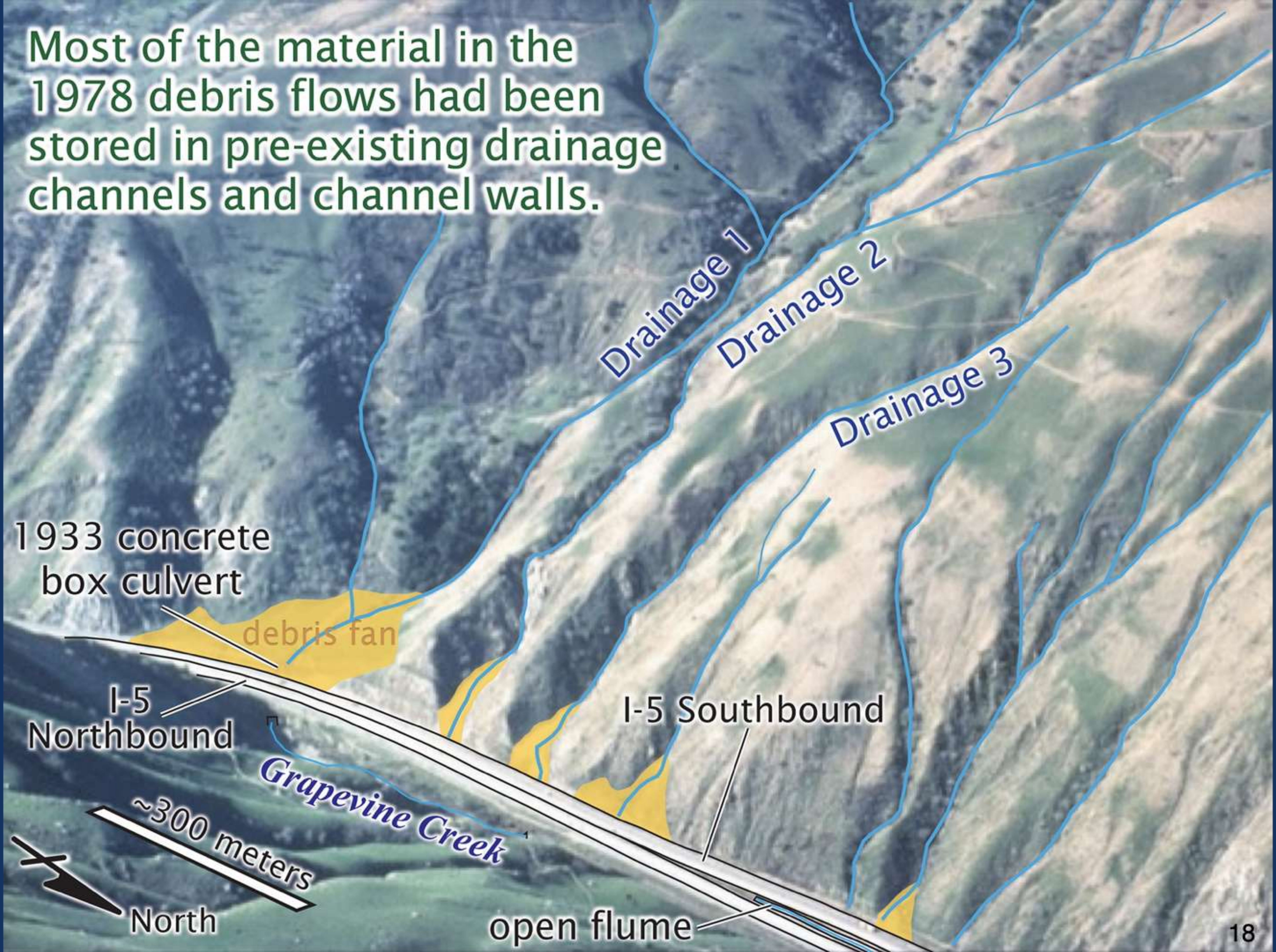

0
1 km

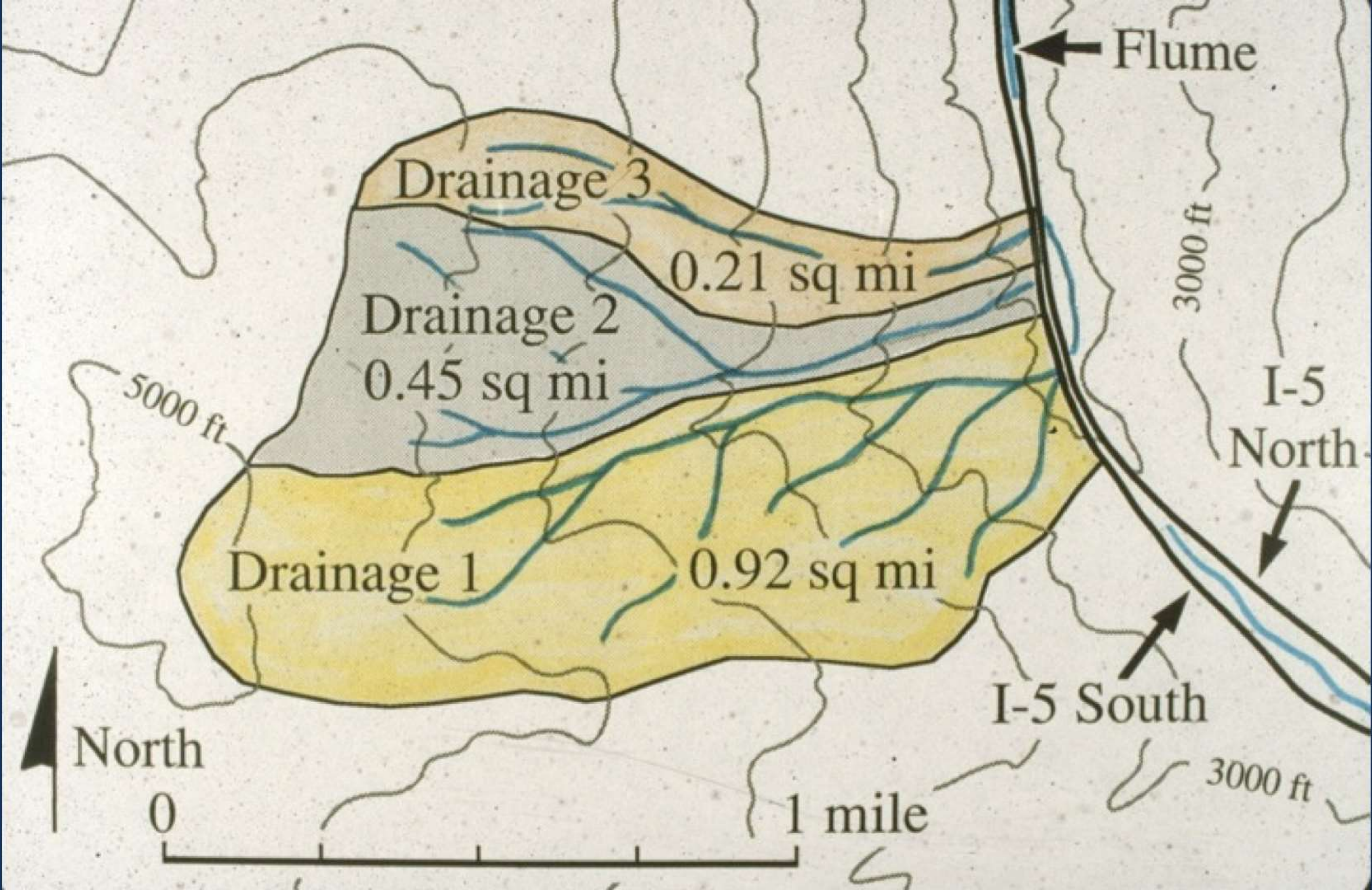

An appetizer of debris flows


Debris flows of February 5, 1978, along Interstate 5 near Grapevine, California
photo by Jim Slosson

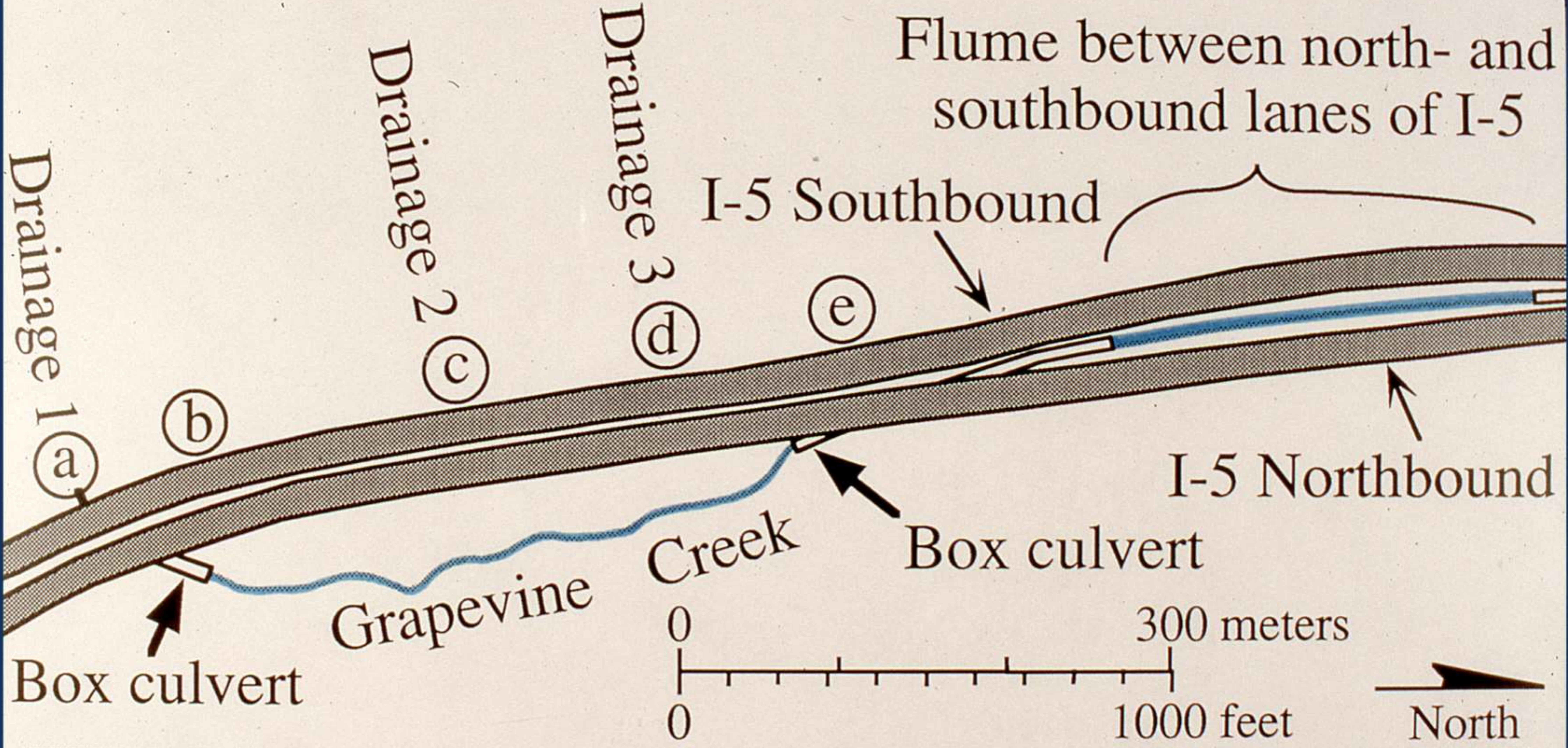

HIGHWAY PATROL

Most of the material in the 1978 debris flows had been stored in pre-existing drainage channels and channel walls.

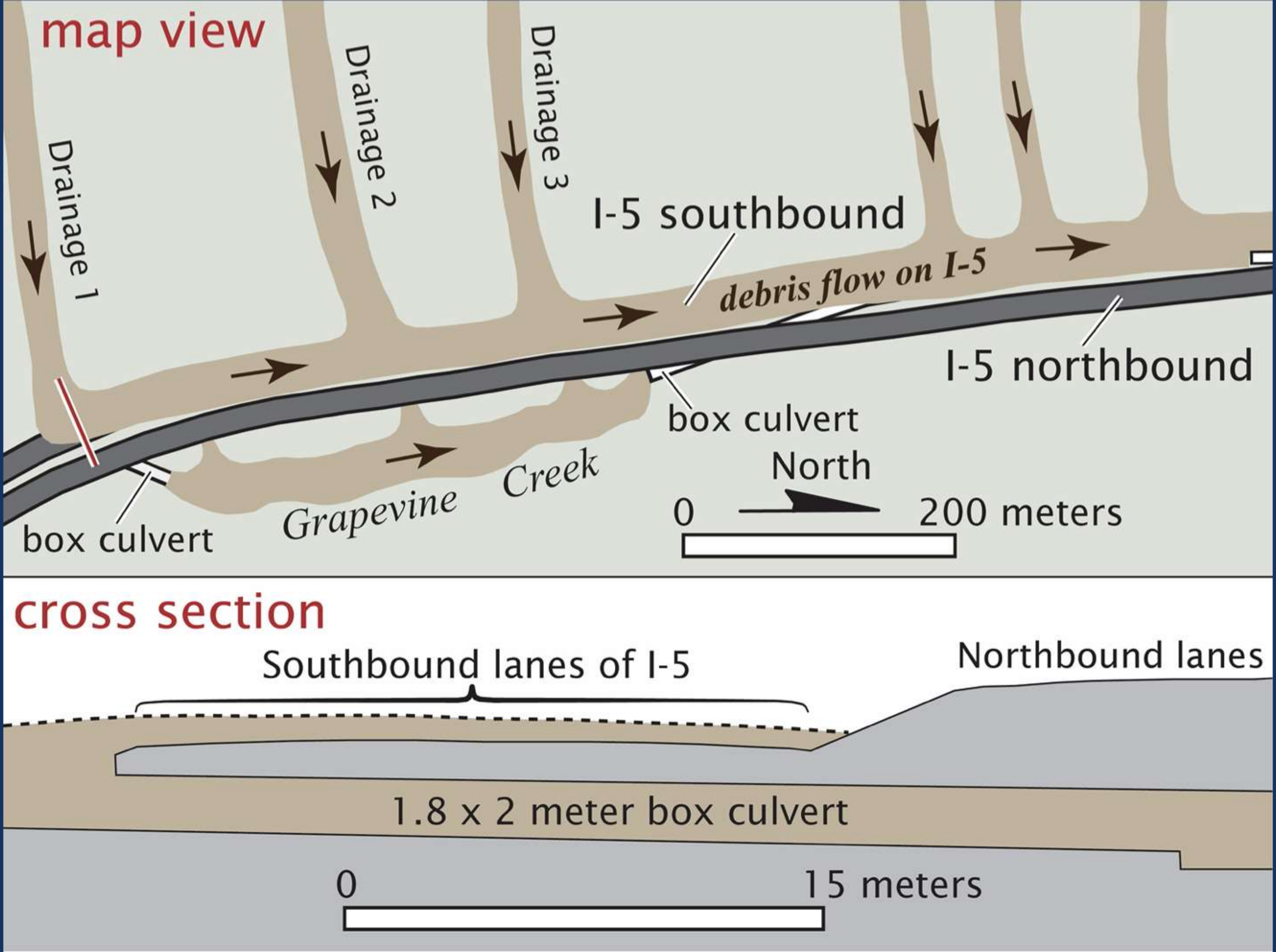




Flume
Drainage 3
0.21 sq mi
Drainage 2
0.45 sq mi
5000 ft
3000 ft
I-5
North
Drainage 1
0.92 sq mi
I-5 South
North
3000 ft
0
1 mile



a 6 x 7 ft box culvert
b 18 in CMP
c 42 in CMP
d 36 in CMP
e 24 in CMP


map view
Drainage 1
Drainage 2
Drainage 3
I-5 southbound
debris flow on I-5
I-5 northbound
box culvert
box culvert
Grapevine Creek
North
0
200 meters
cross section
Southbound lanes of I-5
Northbound lanes
1.8 x 2 meter box culvert
0
15 meters

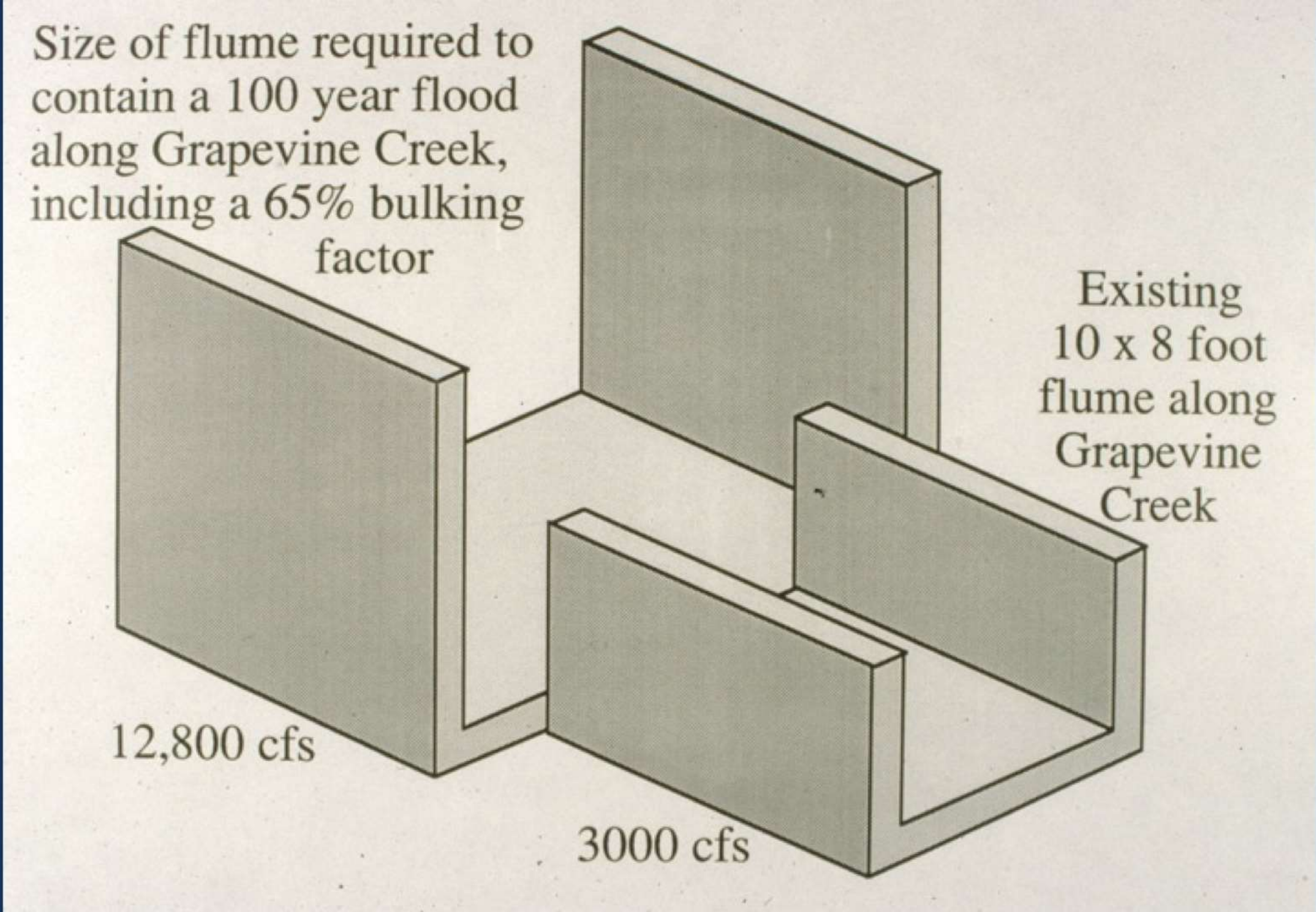

Size of flume required to contain a 100 year flood along Grapevine Creek, including a 65% bulking factor
Existing 10 x 8 foot flume along Grapevine Creek
12,800 cfs
3000 cfs

photo from CHP

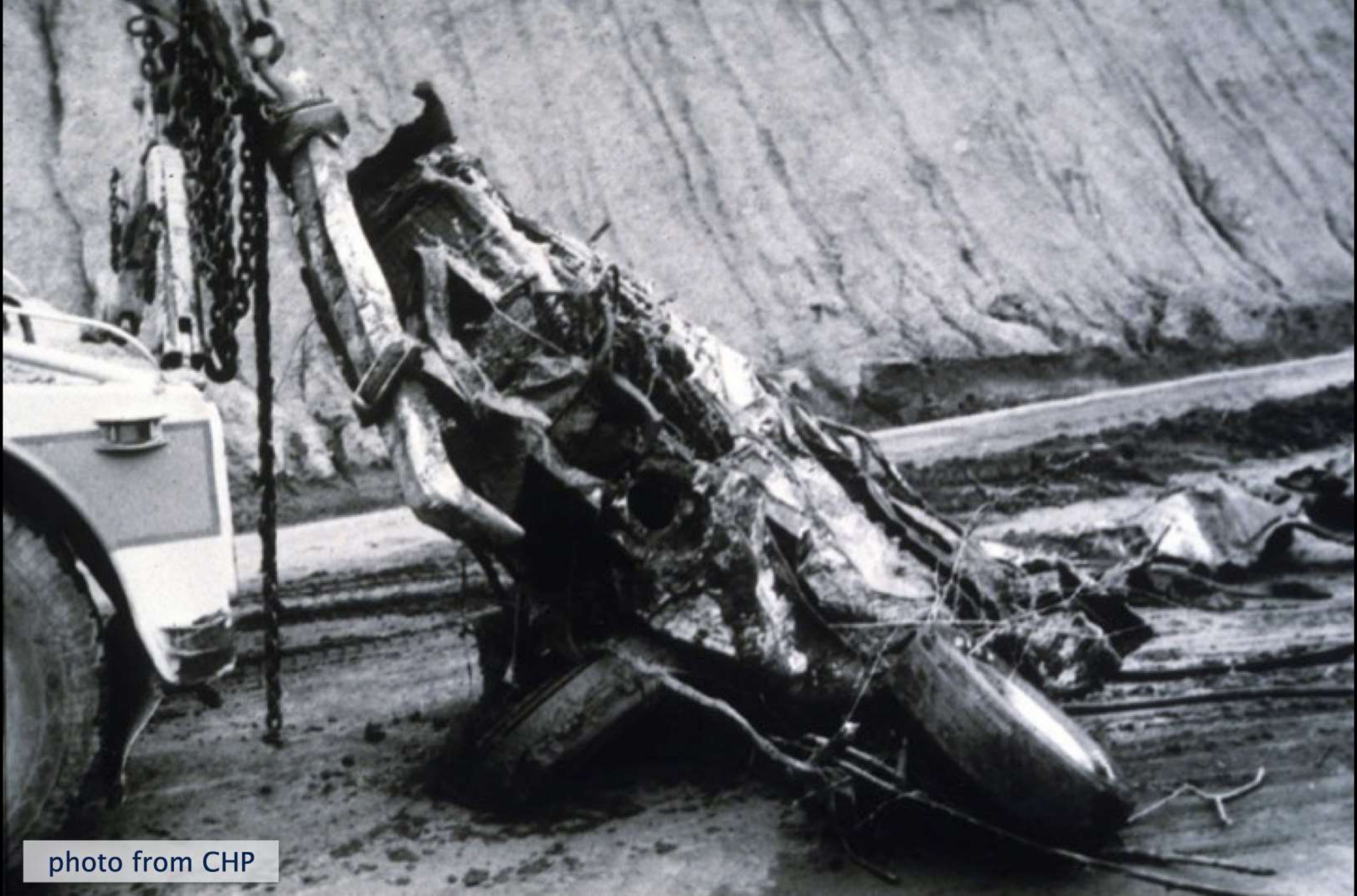


photo from CHP

Lessons Learned

Hillside runoff includes water, sediment, and usually other debris

Sediment and debris can be stored in/along drainage channels and mobilized during high-flow events

Drainage structures must be sized to accommodate liquid and entrained solids

Engineers need geologists.

Gilgit-Baltistan, NW Himalaya
Spring 1981


145


Debris flow of January 4, 1982, along Oddstad Blvd in Pacifica, California
photo from Jim Slosson

We have completed an investigation of the soil/*geologic conditions* of the subject site…

The investigation consisted of a soils and foundation study *and a geologic reconnaissance of the local area*…

Our findings indicate that the site is suitable for the proposed residential use…”

photo from Jim Slosson

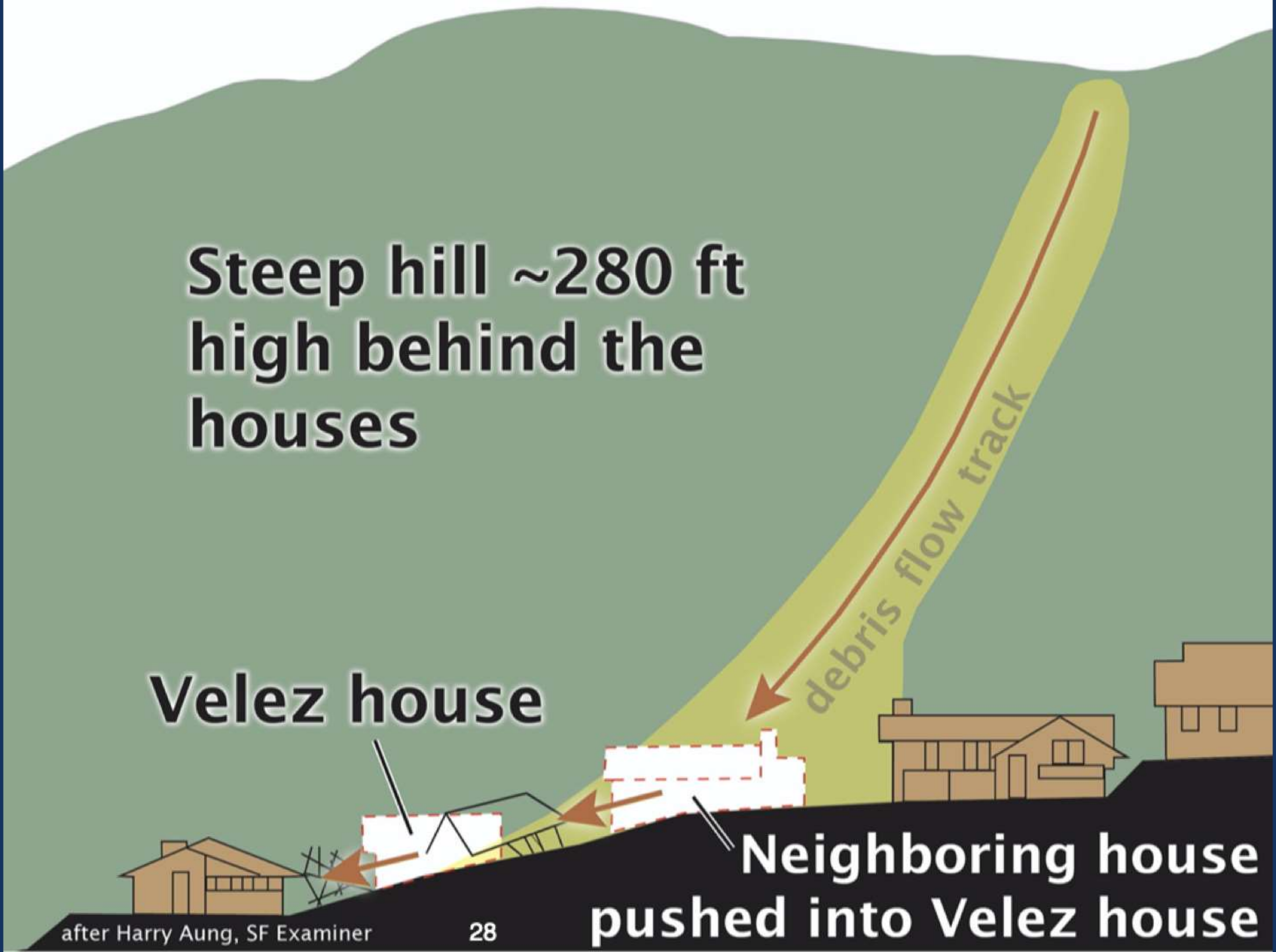

Steep hill ~280 ft high behind the houses
debris flow track
Velez house
Neighboring house pushed into Velez house
after Harry Aung, SF Examiner


photo from Jim Slosson

Reasons given to explain why the hazard potential was not recognized

The source of the debris was on the other side of the property line.

Colluvium-filled swales were not commonly recognized as potential hazards. It was beyond standard practice

This project was driven by the developer and engineers. Site geology was a minor consideration.


photo from Jim Slosson

Lessons Learned

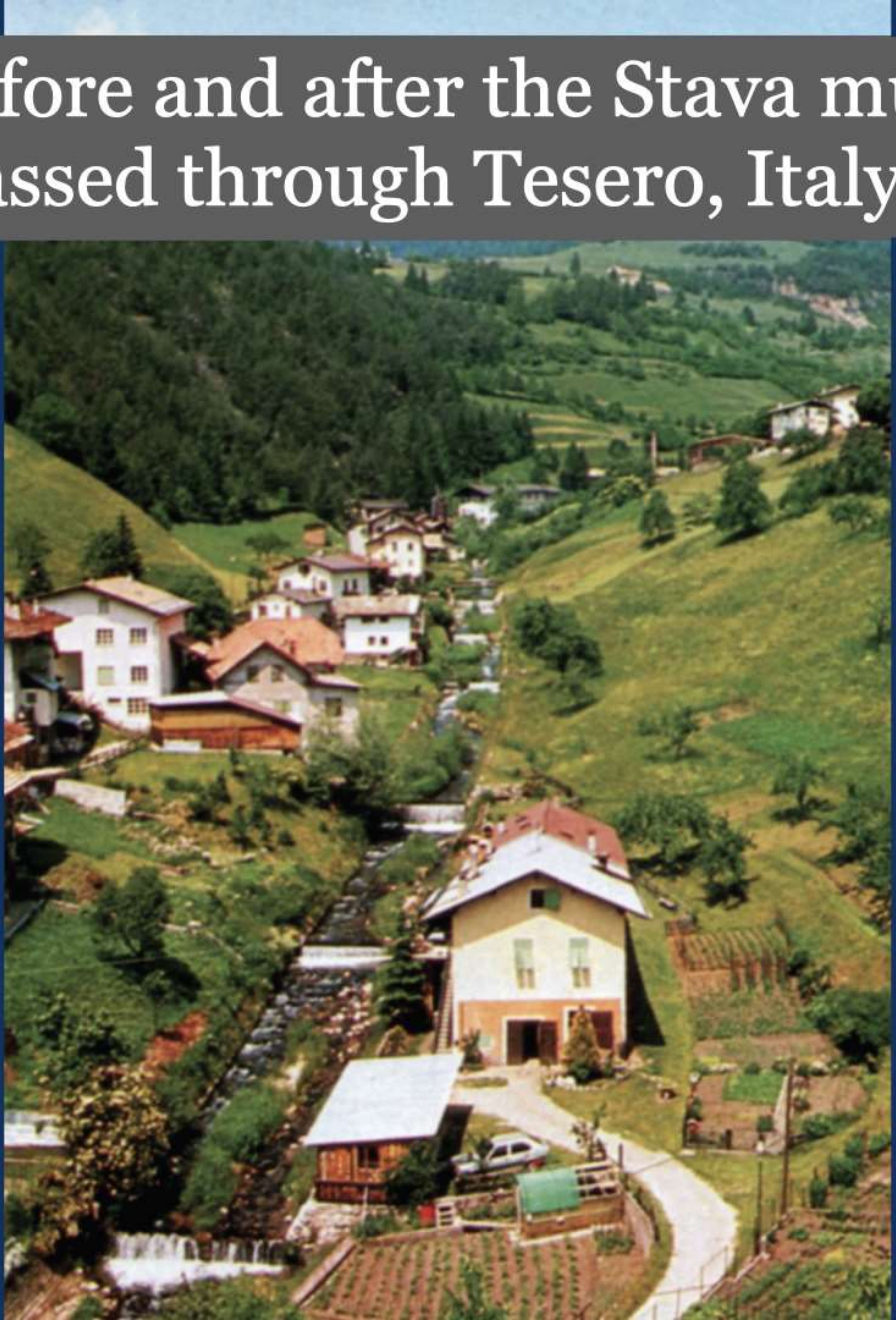
Sediment and debris can be stored in/along hillside swales and mobilized during high-intensity rain events

Debris-flow tracks can be avoided if they are recognized in pre-site investigations

There is no substitute for good geological characterization of building sites.

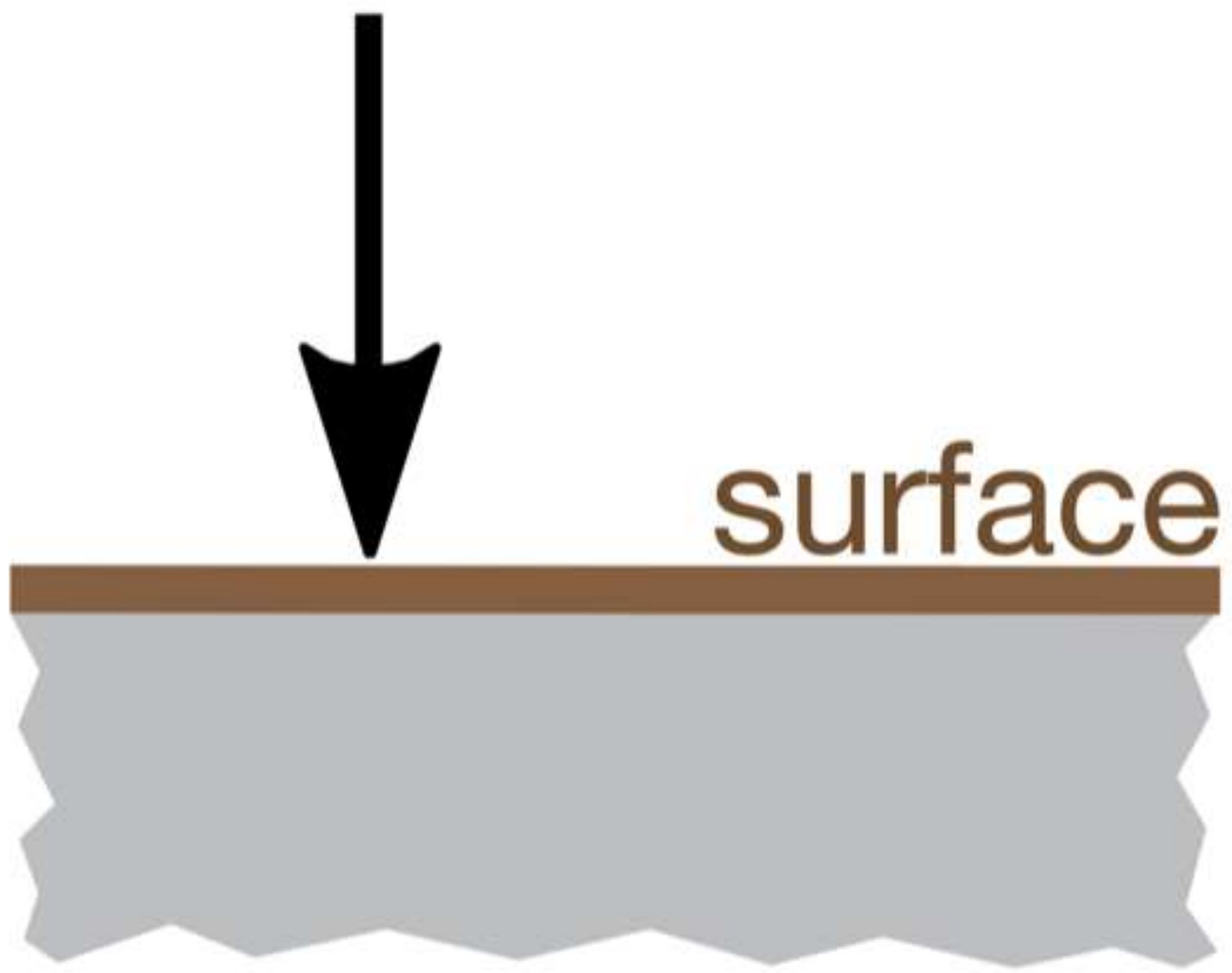
Engineers need geologists.

Before and after the Stava mudflow passed through Tesero, Italy, 1985

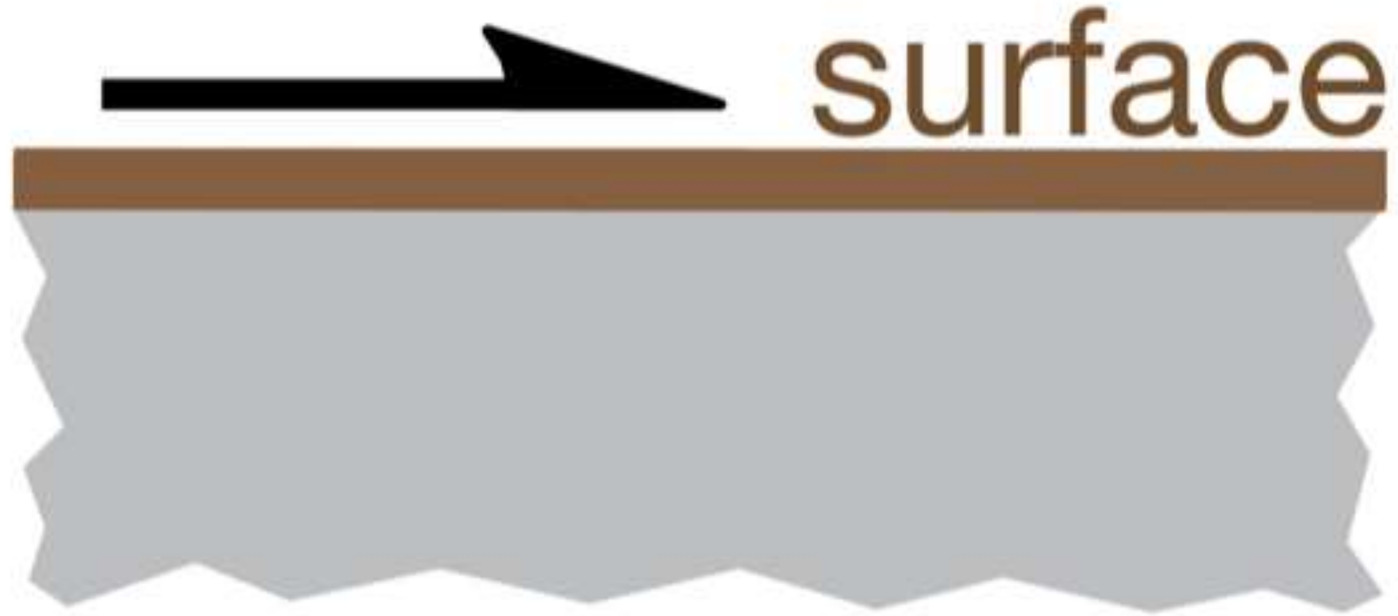


Luino and De Graff (2012)

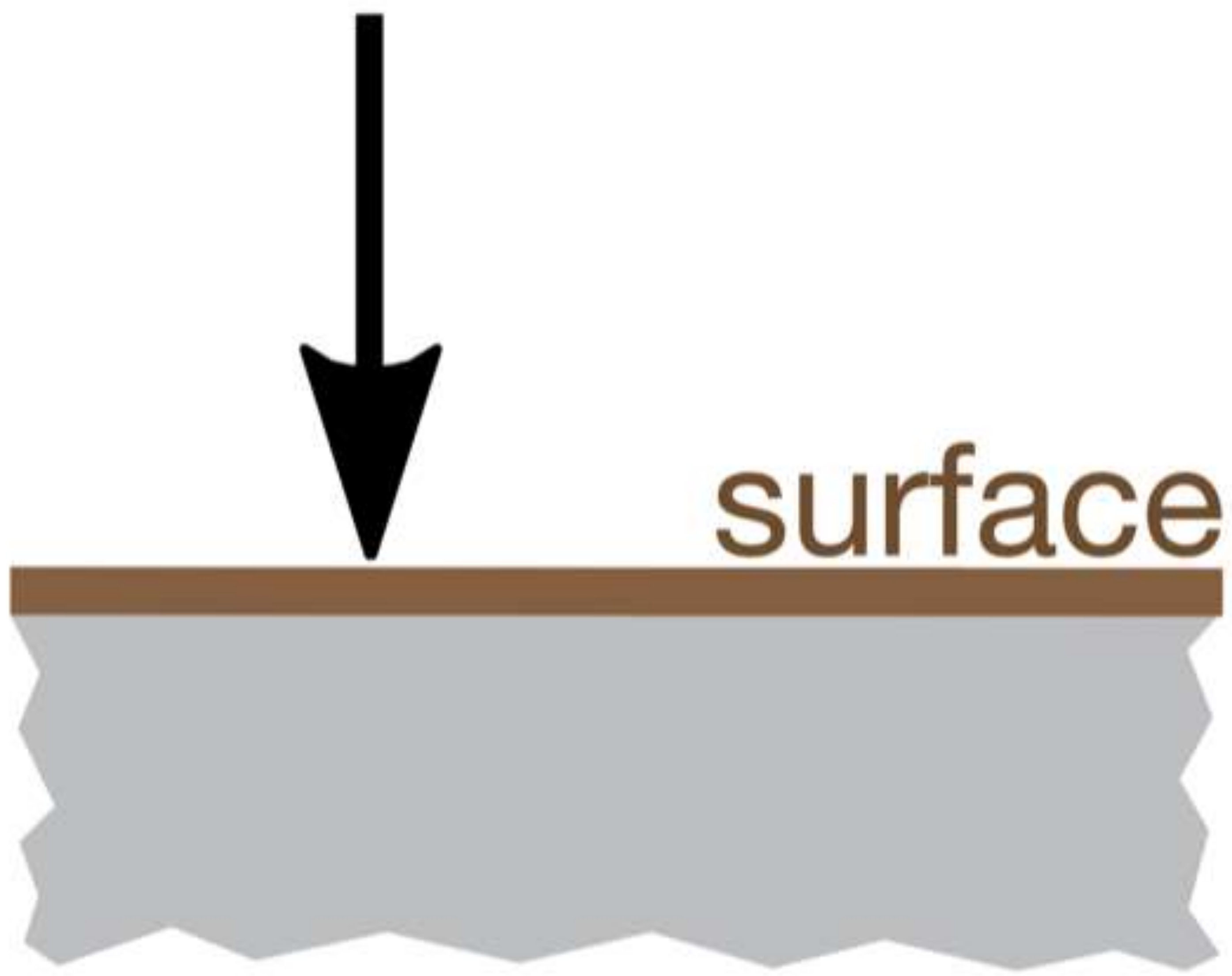
stress component oriented perpendicular to a surface = ***normal*** stress



stress component oriented parallel to a surface = ***shear*** stress



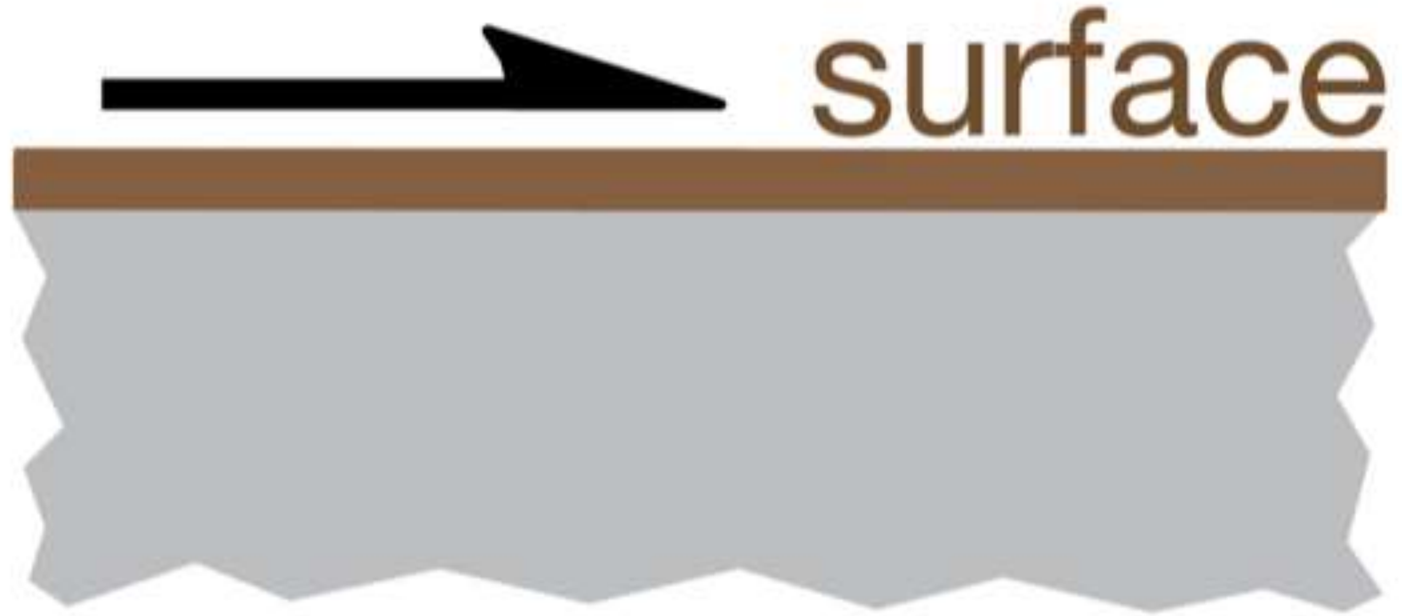
stress component oriented perpendicular to a surface = ***normal*** stress

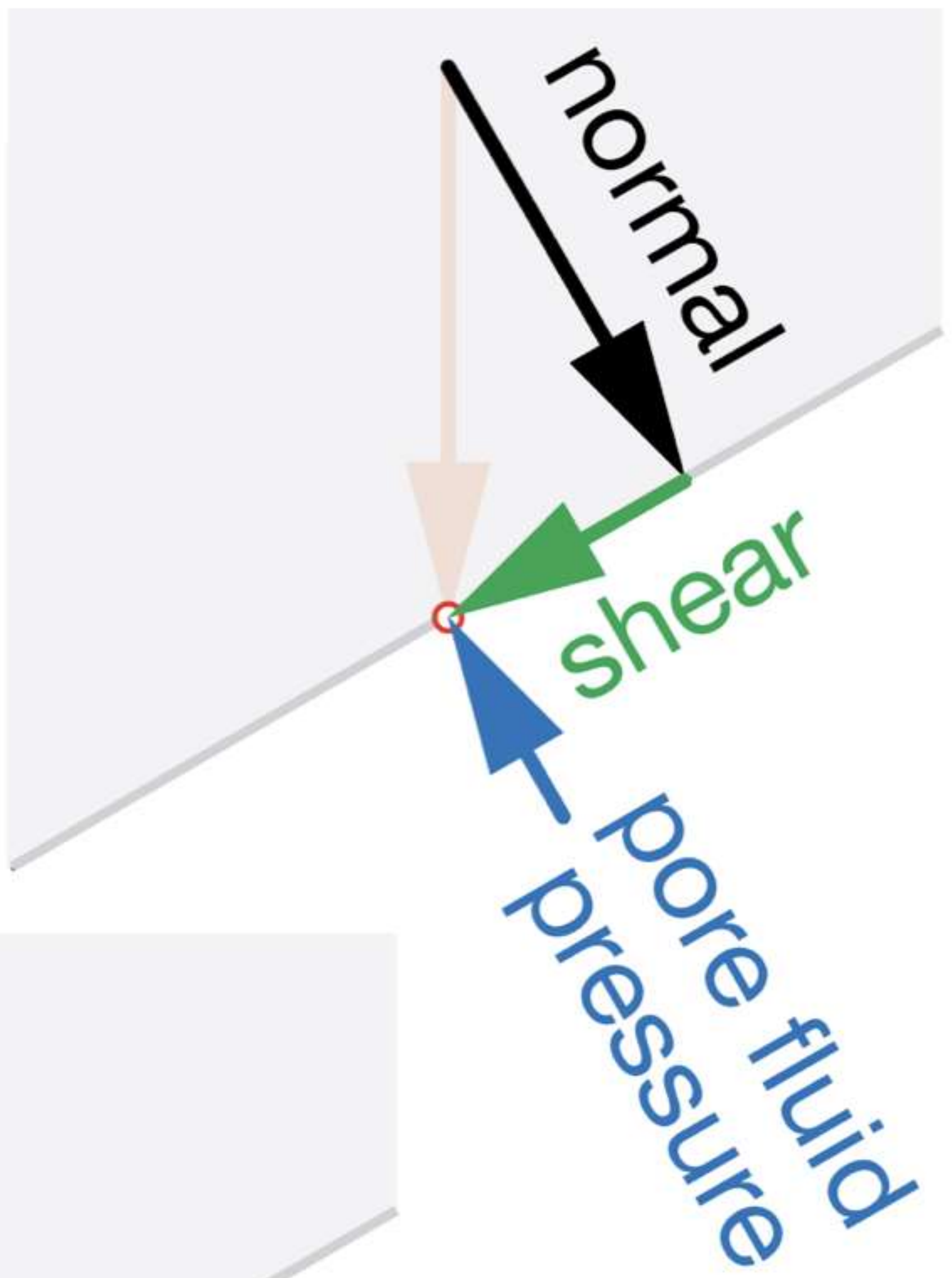


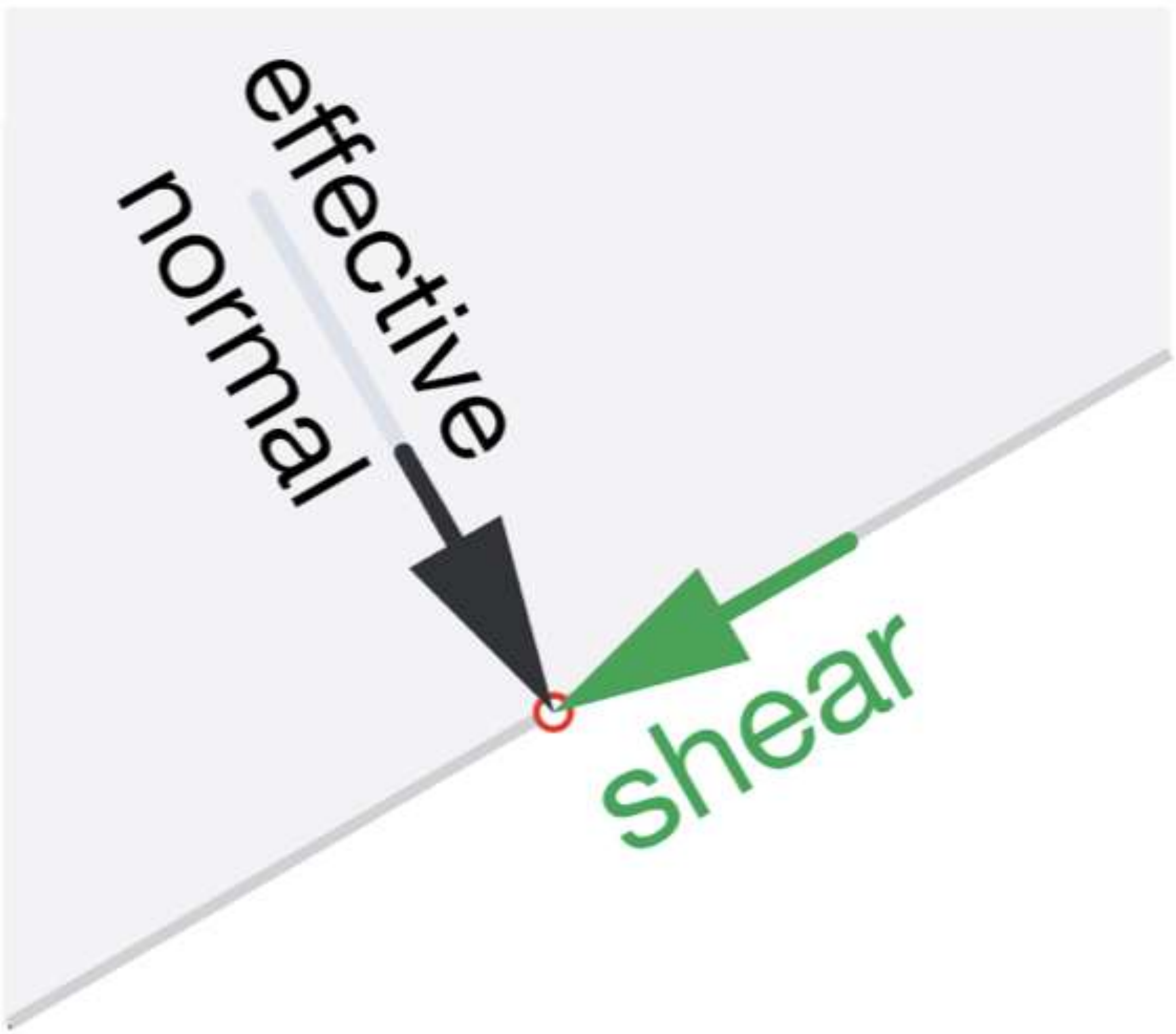
normal stress inhibits sliding along the surface and so is a "resisting stress"

shear stress promotes sliding along the surface and so is a “driving stress”

stress component oriented parallel to a surface = ***shear*** stress

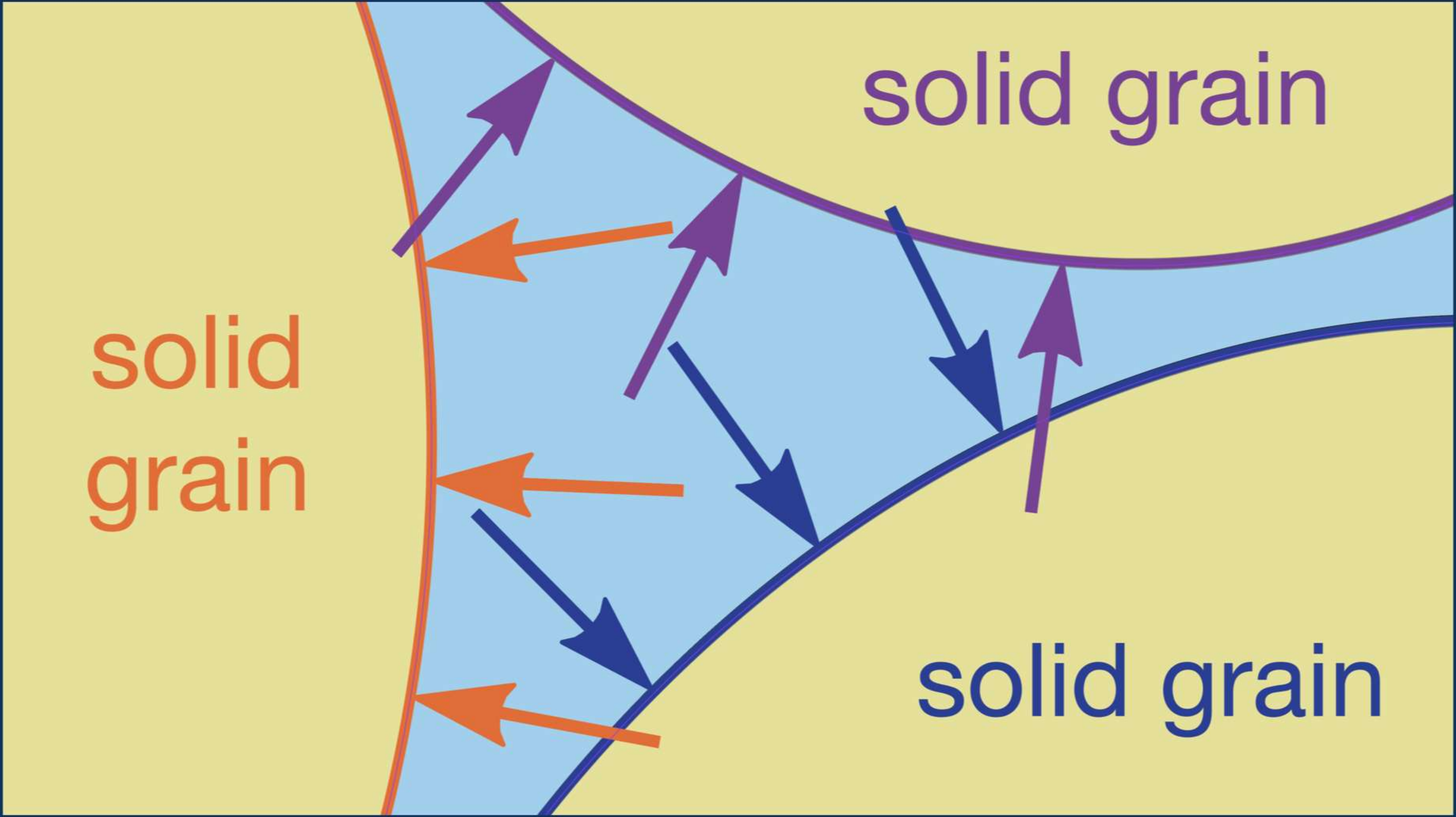






The effective normal stress is equal to the normal stress component minus the pore-fluid pressure


solid grain
solid grain
solid grain
solid grain
solid grain
solid grain

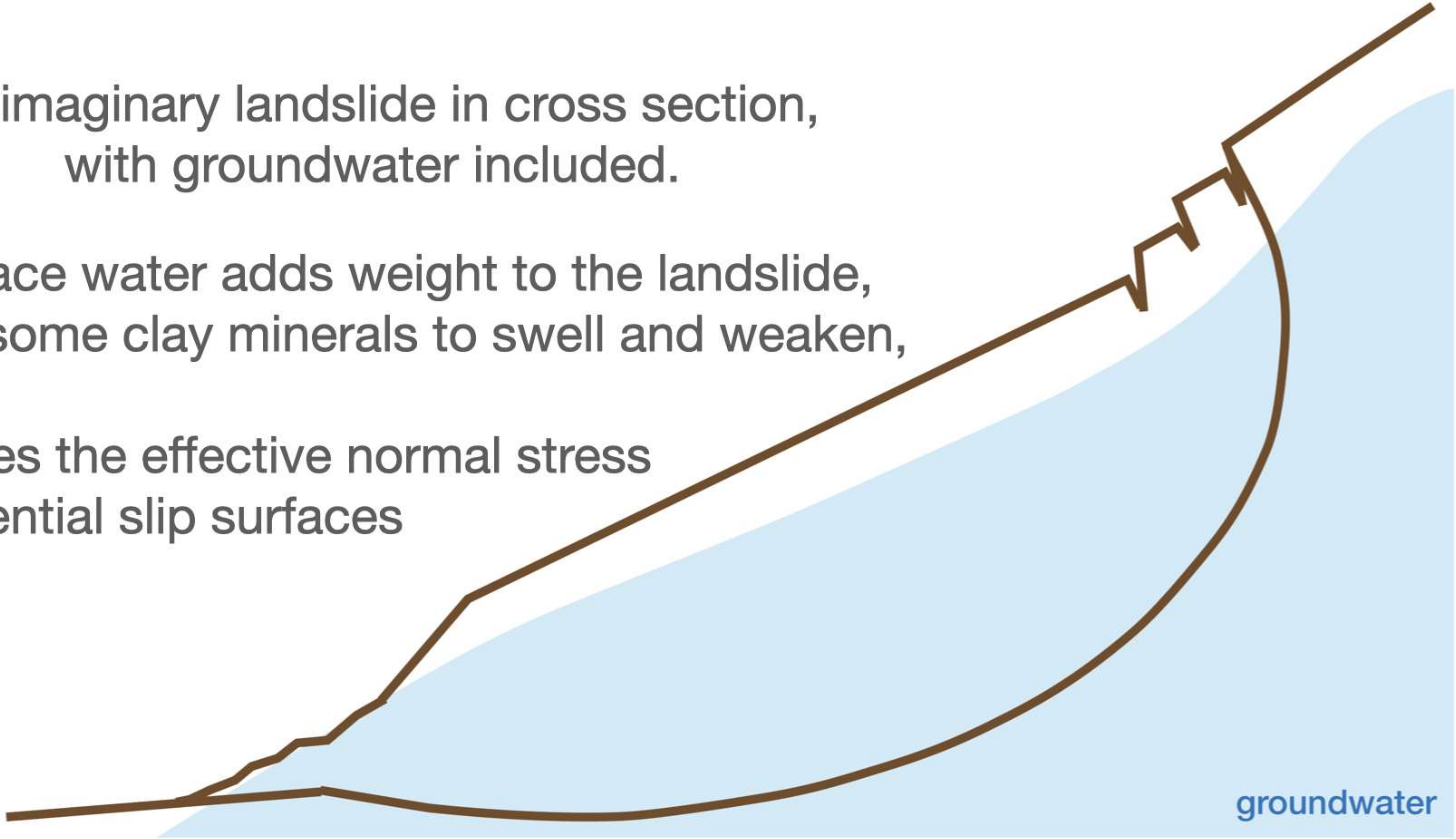

solid grain
solid grain
solid grain

Increasing the pore fluid pressure has the effect of decreasing the normal stress on any potential landslide slip surface.

Increasing pore pressure makes it easier for the landslide to move.

An imaginary landslide in cross section,
with groundwater included.

Subsurface water adds weight to the landslide,
causes some clay minerals to swell and weaken,
and
decreases the effective normal stress
on potential slip surfaces



Some Typical Strategies for Mitigating a Landslide

Some Typical Strategies for Mitigating a Landslide

Drain groundwater in and behind slide mass:
- reduces pore fluid pressure
- reduces weight of slide mass
- reduces driving stress

Regrade/unload landslide top:
- reduces weight of slide mass
- reduces driving stress

Construct a buttress at landslide base:
- increases resisting stress

Excavate landslide & regrade slope

A buffet of big landslides

LA Times

Portuguese Bend and Abalone Cove landslides, Palos Verdes Peninsula, California

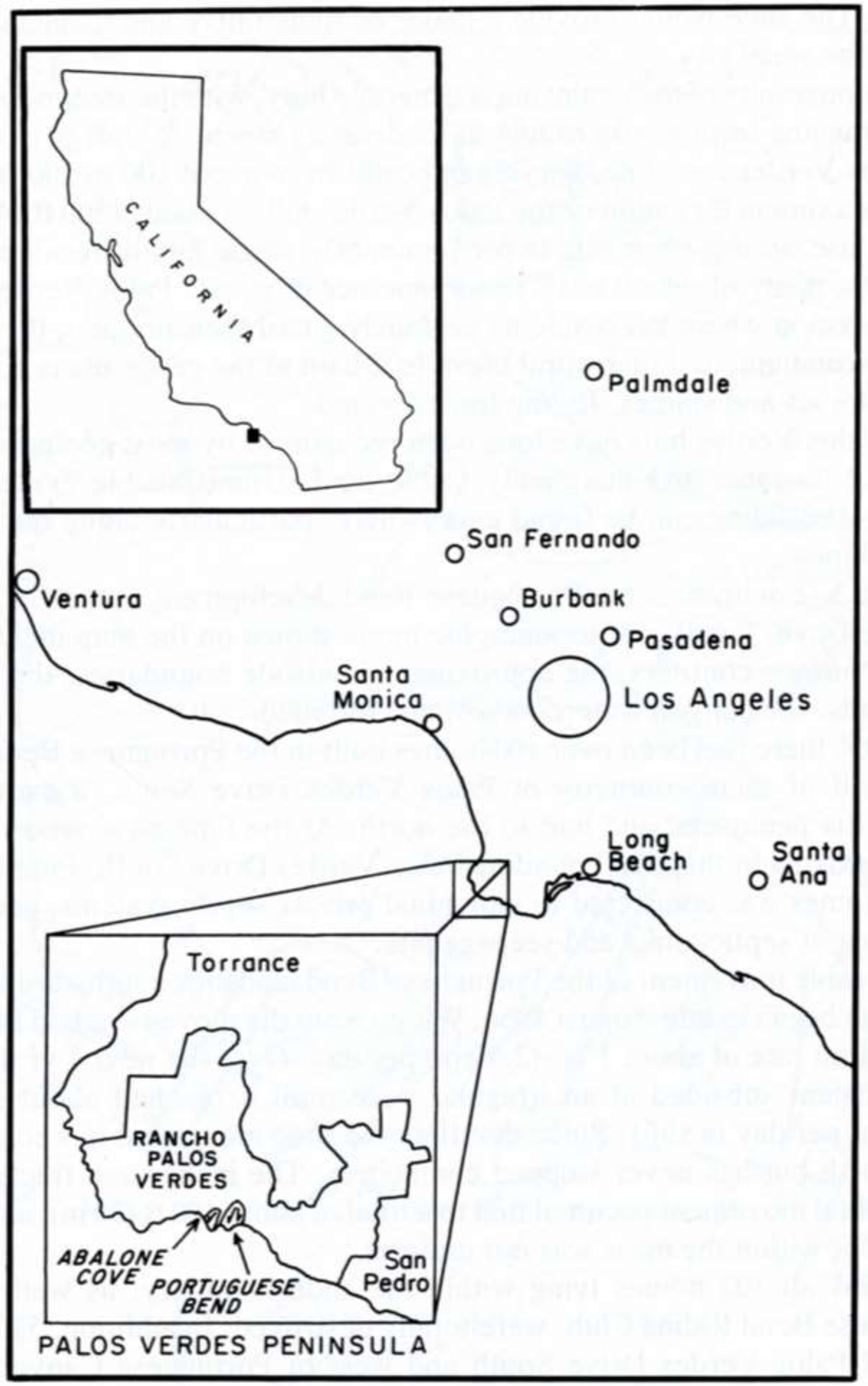
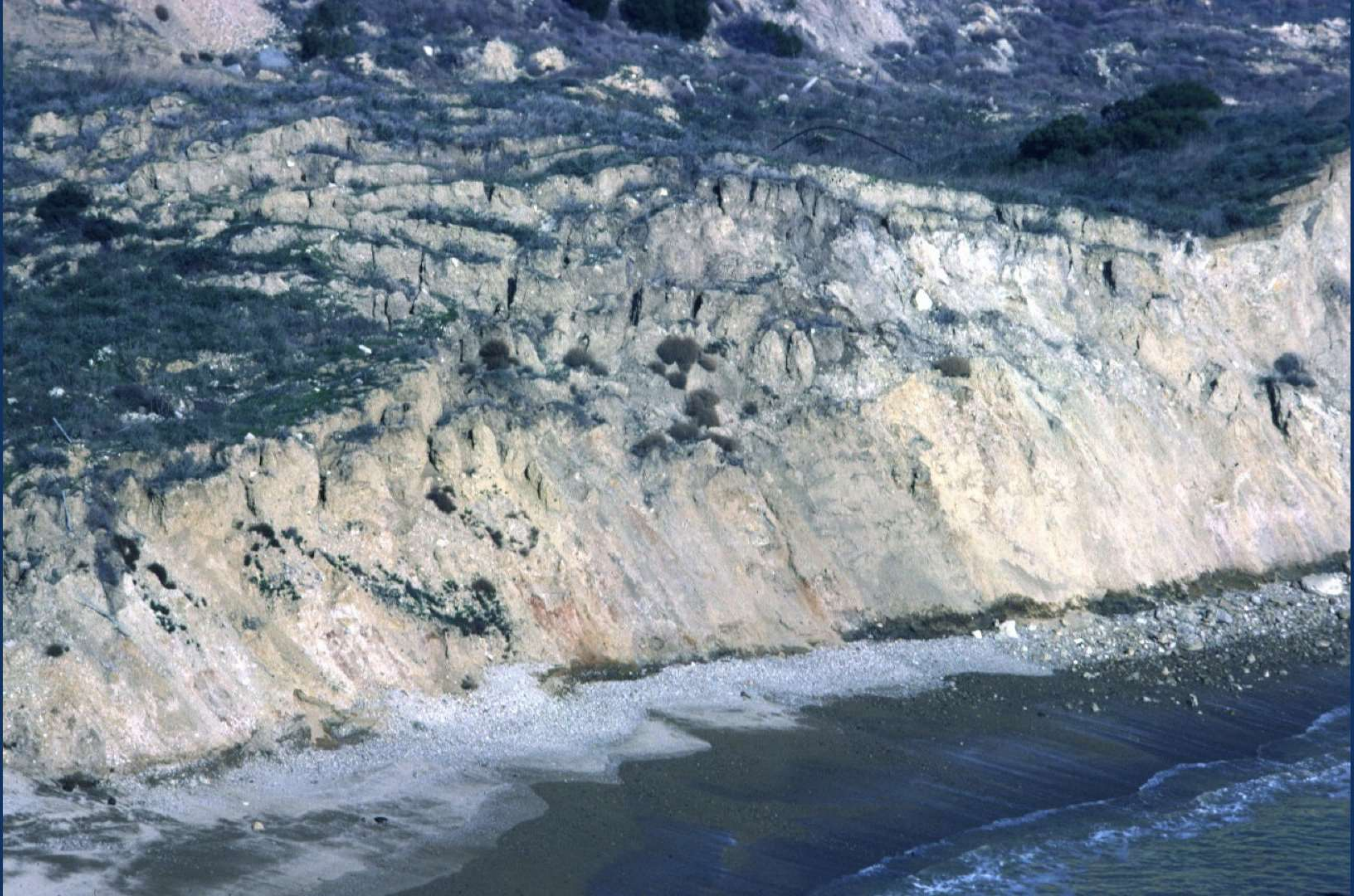


FIGURE 5–1
Vicinity map of the Portuguese Bend and Abalone Cove landslides.


N
100 m
50 m
Sea
Level
PVDS
Segment of landslide
in photograph
S



Lessons Learned

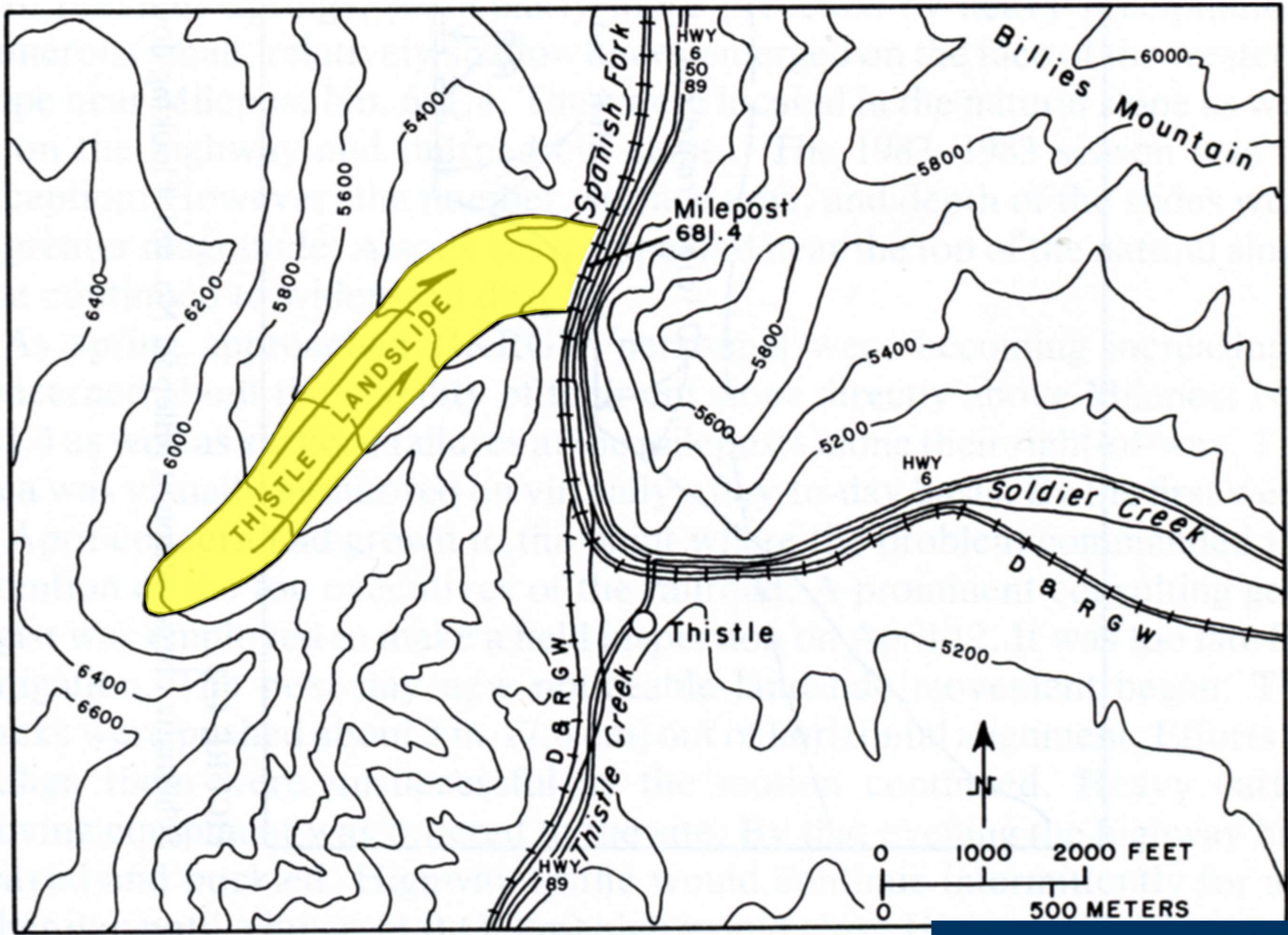
Water is an essential ingredient for (most) landslides.

Many (most) landslides do not move as a rigid block.

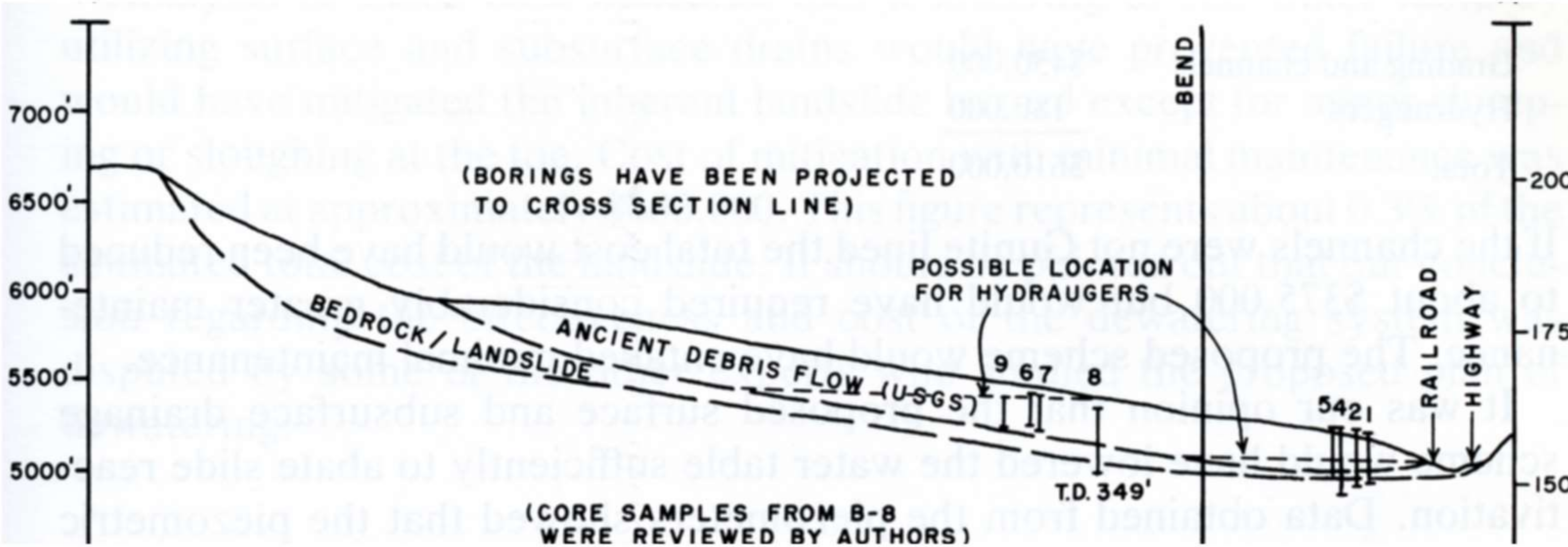
Uncompacted fill is a disaster waiting to happen, ***especially*** in buttresses.

Engineers need geologists.

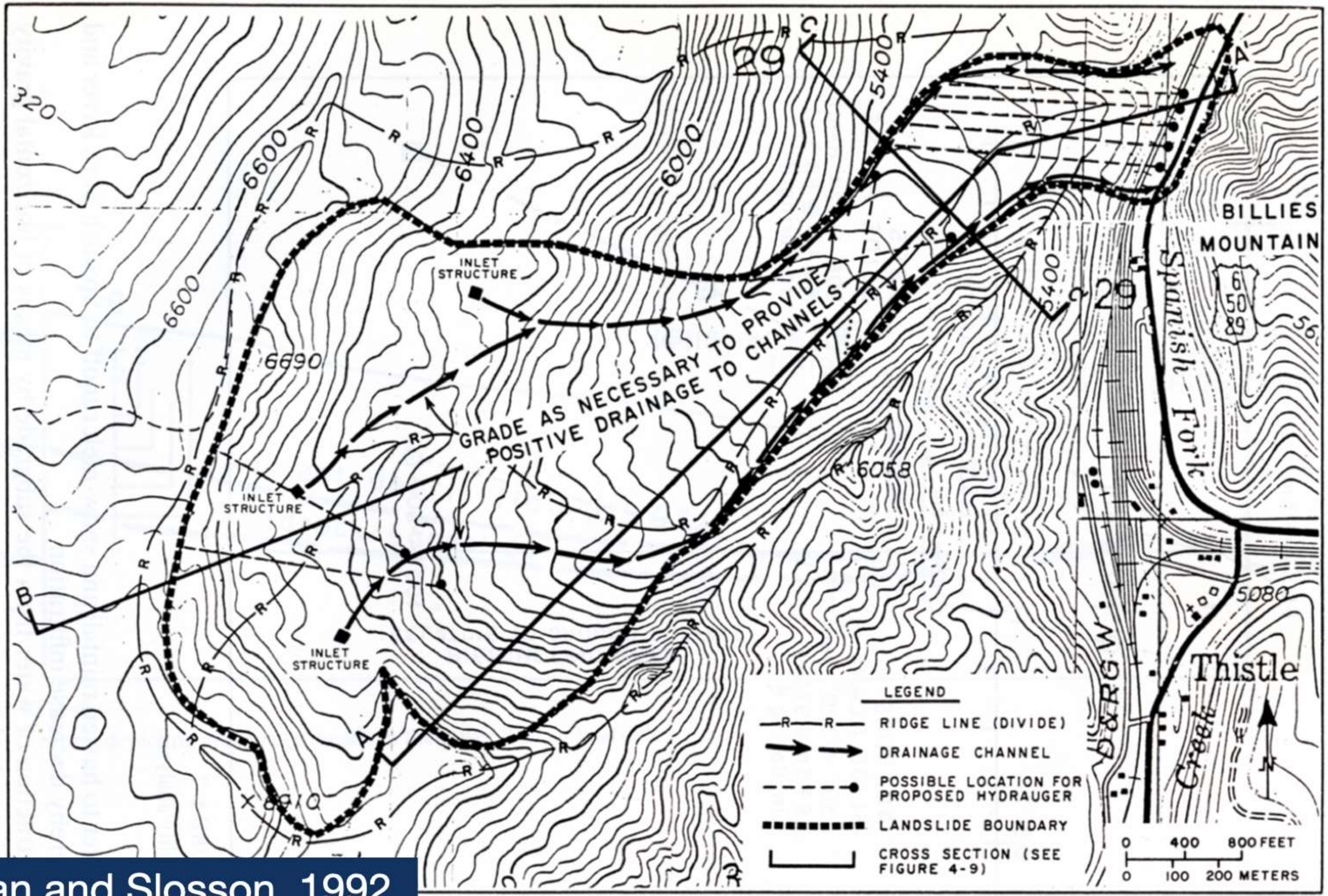

Thistle landslide and
landslide lake, Utah



Shuirman and Slosson, 1992



Shuirman and Slosson, 1992



Shuirman and Slosson, 1992

Lessons Learned

There is no substitute for good geological reconnaissance along critical transportation and energy-transmission corridors, with the purpose of identifying potential hazards.

Dewatering and routine monitoring of the Thistle landslide are essential to hazard mitigation.

Engineers need geologists.

Big Rock Mesa, Malibu

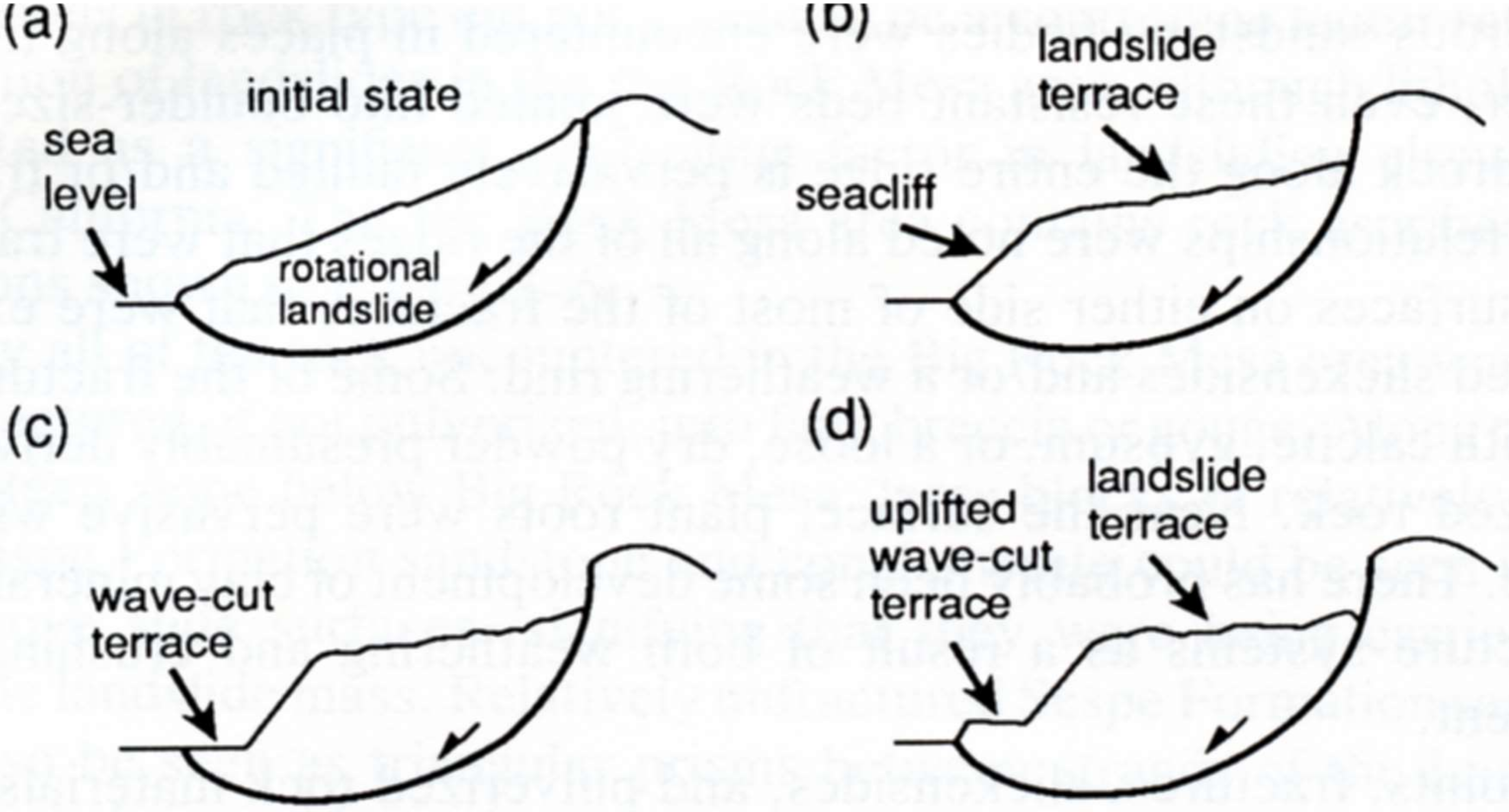
Aerial photo by Woody Higdon;
supplied by Jim Slosson

Big Rock Mesa, Malibu, circa 1927

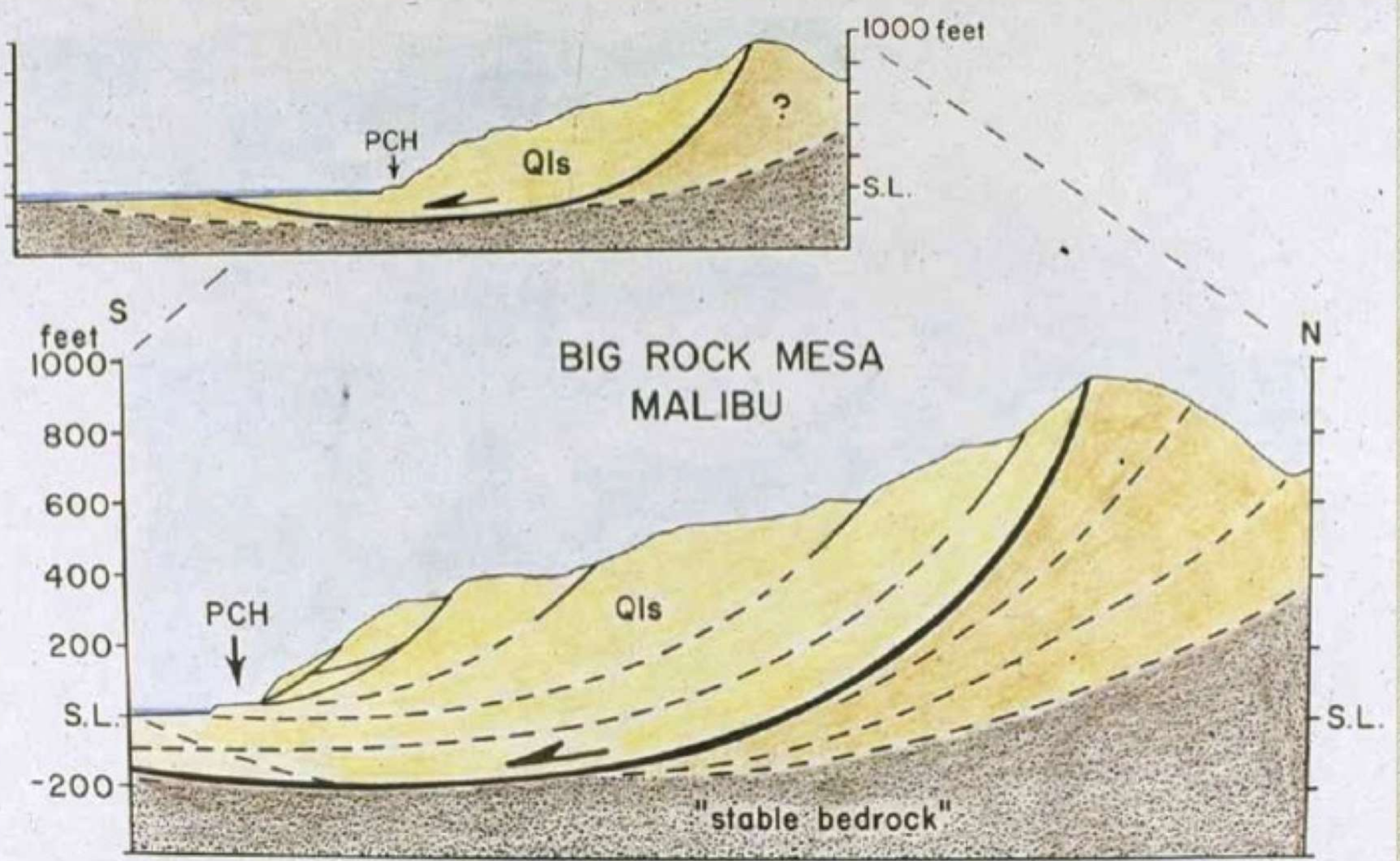

Big Rock Mesa, Malibu
Inactive
extended
slide
Active
landslide
0
500 meters
0
2000 feet
circa 1974


Assumptions:
100 gal/da. septic discharge per person
15-20 in. annual rainfall
1/4 acre lot
5% soil infiltration
septic discharge system
It would take the infiltration from
roughly 200 inches of rain on a bare 1/4 acre lot
to equal the saturation resulting from a year's septic discharge
beneath a typical 2-person house--
10 to 15 times the normal precipitation

Aerial photo by Woody Higdon;
supplied by Jim Slosson



Shuirman and Slosson, 1992



1000 feet
PCH
Qls
?
S.L.
S
N
feet
1000
800
600
400
200
S.L.
-200
BIG ROCK MESA
MALIBU
PCH
Qls
S.L.
"stable bedrock"

Pacific Coast Hwy uplifted across the front of the Big Rock Mesa landslide

Unstable cliff above Pacific Coast Hwy


UNSAFE

Extension cracks in the surface of the landslide, covered in plastic held in place with sandbags

Exposed water supply pipes along a road on Big Rock Mesa landslide

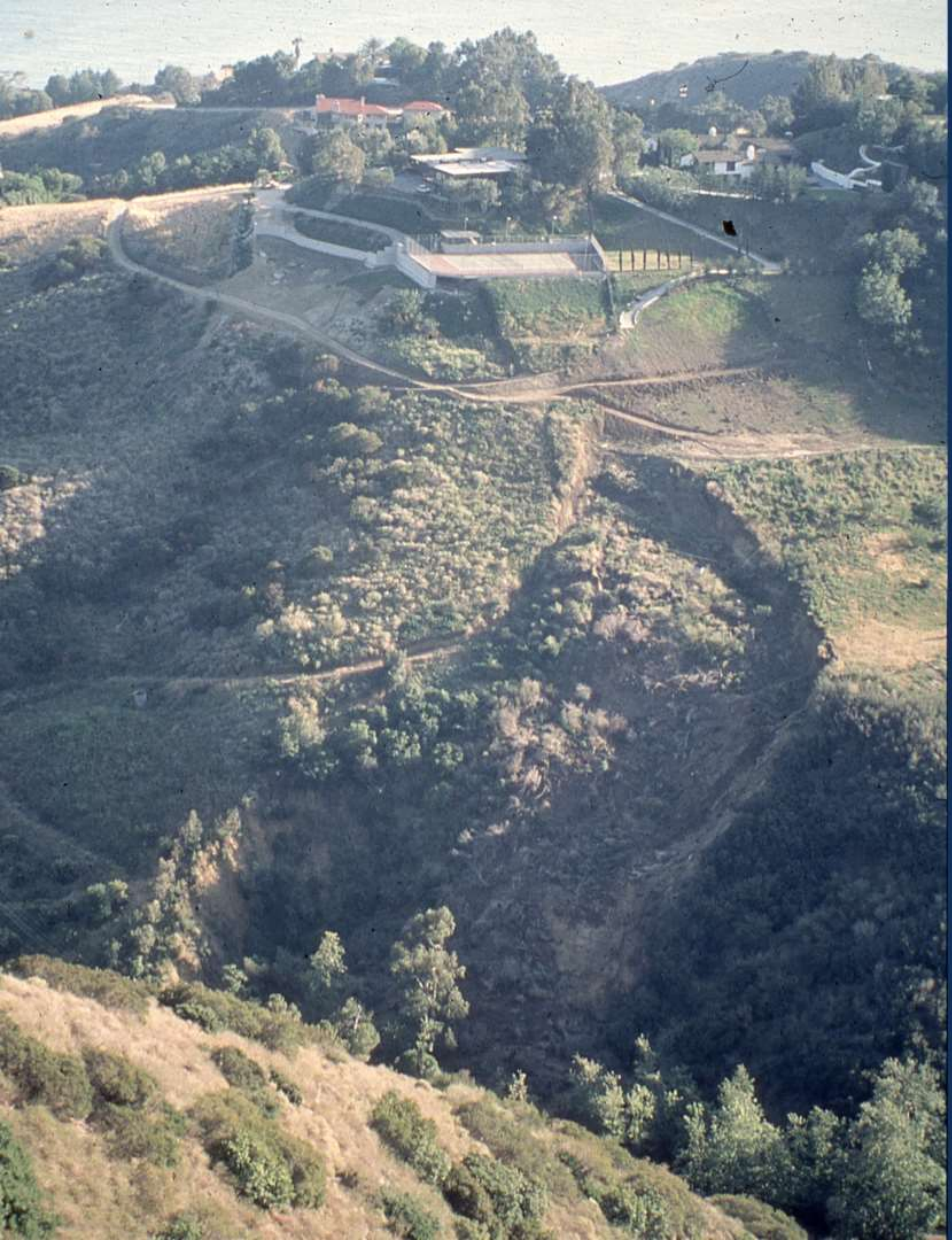
Exposed water supply pipe with strain release loop along a road on Big Rock Mesa landslide

Dewatering well along a road on Big Rock Mesa landslide, discharging into a storm sewer

Headscarp above Hansch property, Big Rock Mesa landslide


Nikon

Nikon



One of Olivia Newton-John’s landslide-damaged homes in Malibu

The reason engineering geology exists as a profession is to recognize and usefully characterize potential geologic hazards so that they can be mitigated or avoided.

Protection of public health and safety is a fundamental goal of our profession.

We are not hired guns who generate reports whose conclusions are pre-determined by clients.

We are scientists, not client advocates.

The ultimate client of
any engineering geologist
is society

Business decisions do not outweigh our professional obligation to protect the public.