

# Why did the 2014 Oso Landslide happen?



PHOTO BY TED S. WARREN / THE ASSOCIATED PRESS; GRAPHIC BY THE SEATTLE TIMES

Image credit: Seattle Times <http://old.seattletimes.com/flatpages/local/interactivebeforeandafterthehighway530mudslide.html>



# Where did the 2014 Oso Landslide happen?

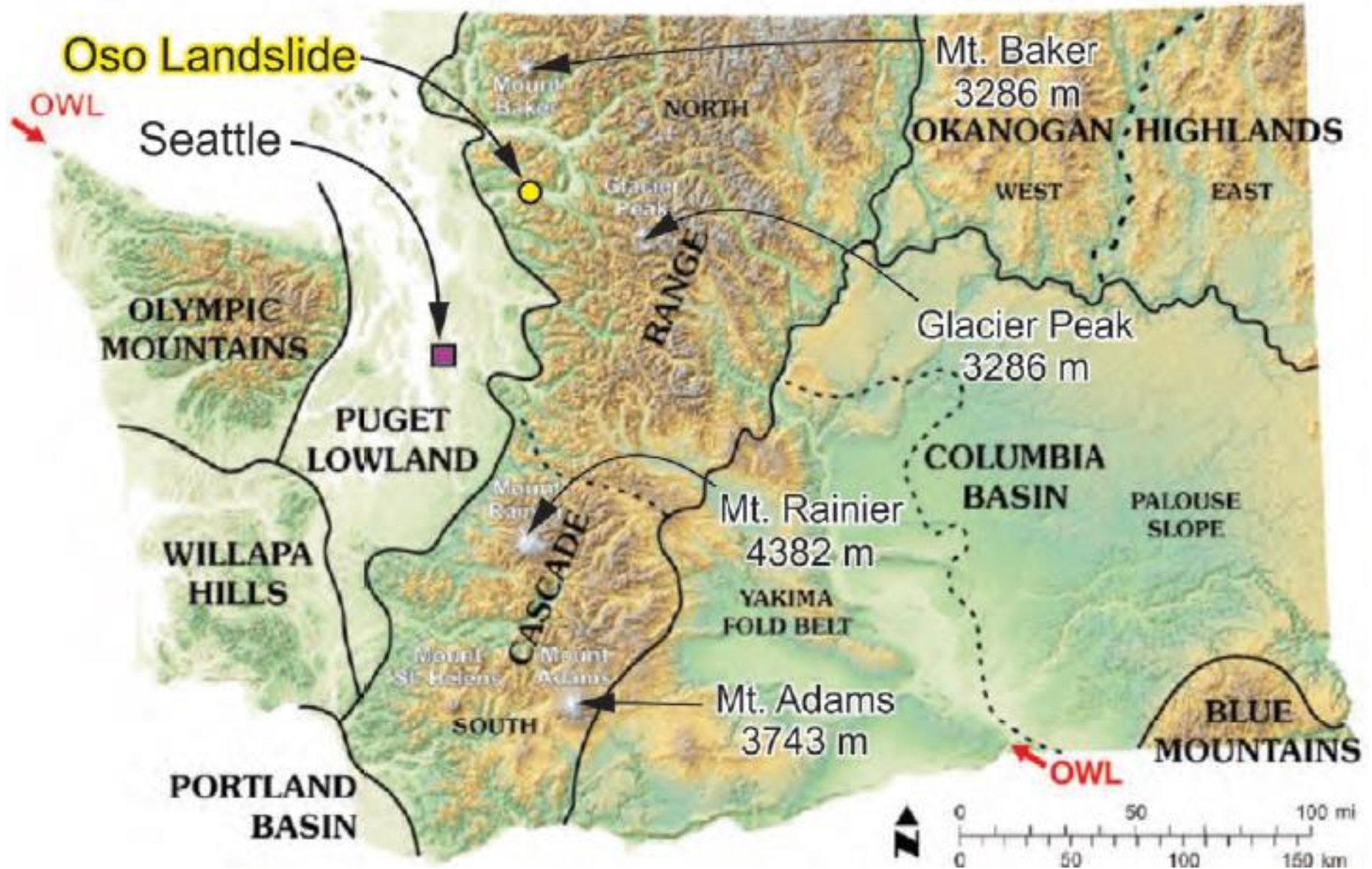


Image source: [http://www.dnr.wa.gov/Publications/ger\\_geol\\_map\\_washington\\_pagesize.pdf](http://www.dnr.wa.gov/Publications/ger_geol_map_washington_pagesize.pdf)



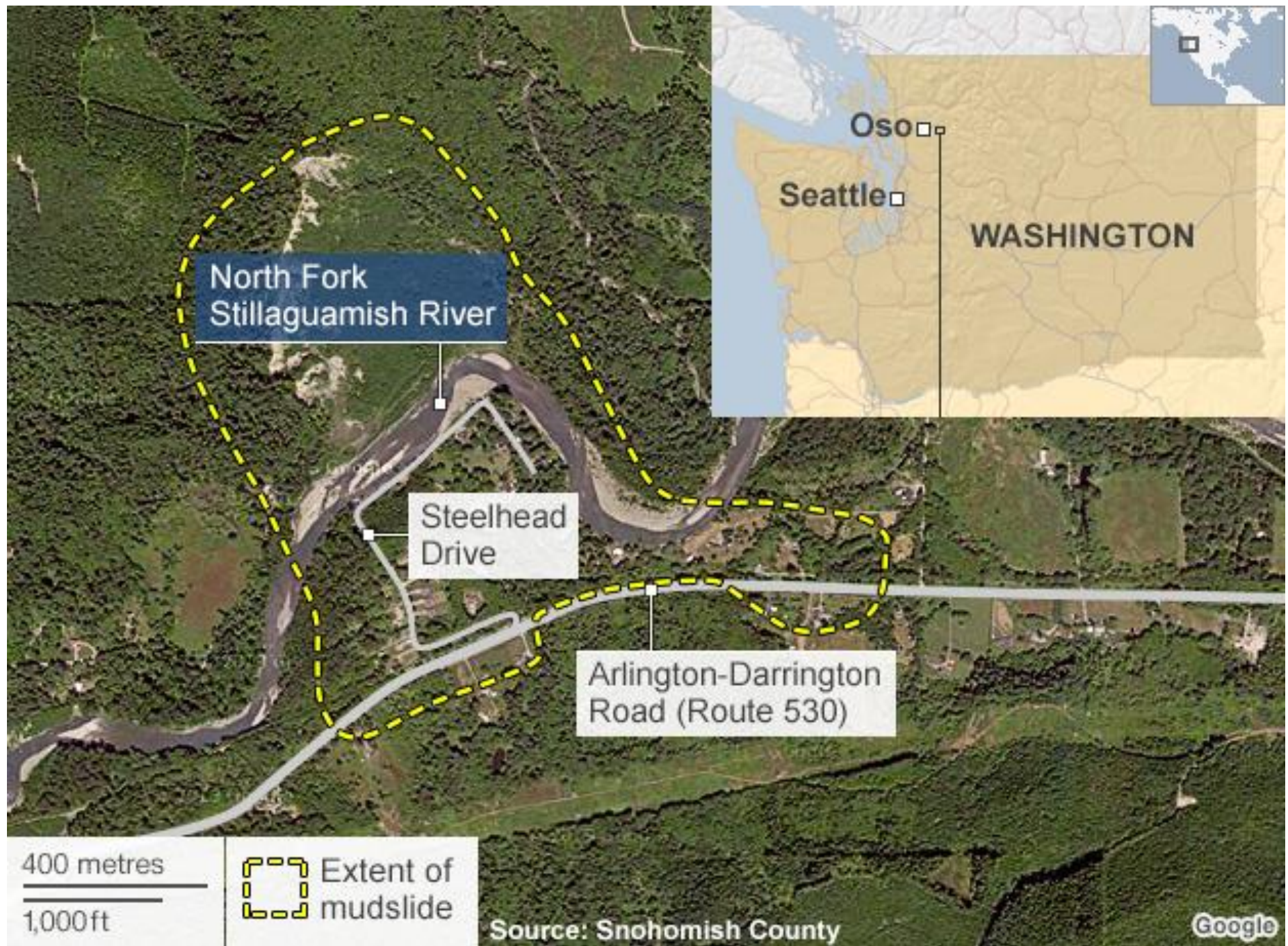


Image source: <http://ttnewsflash.com/wp-content/uploads/2014/03/Snohomish-County-landslide.jpg>



# Topographic Map of Oso Landslide Area and surrounding Geography

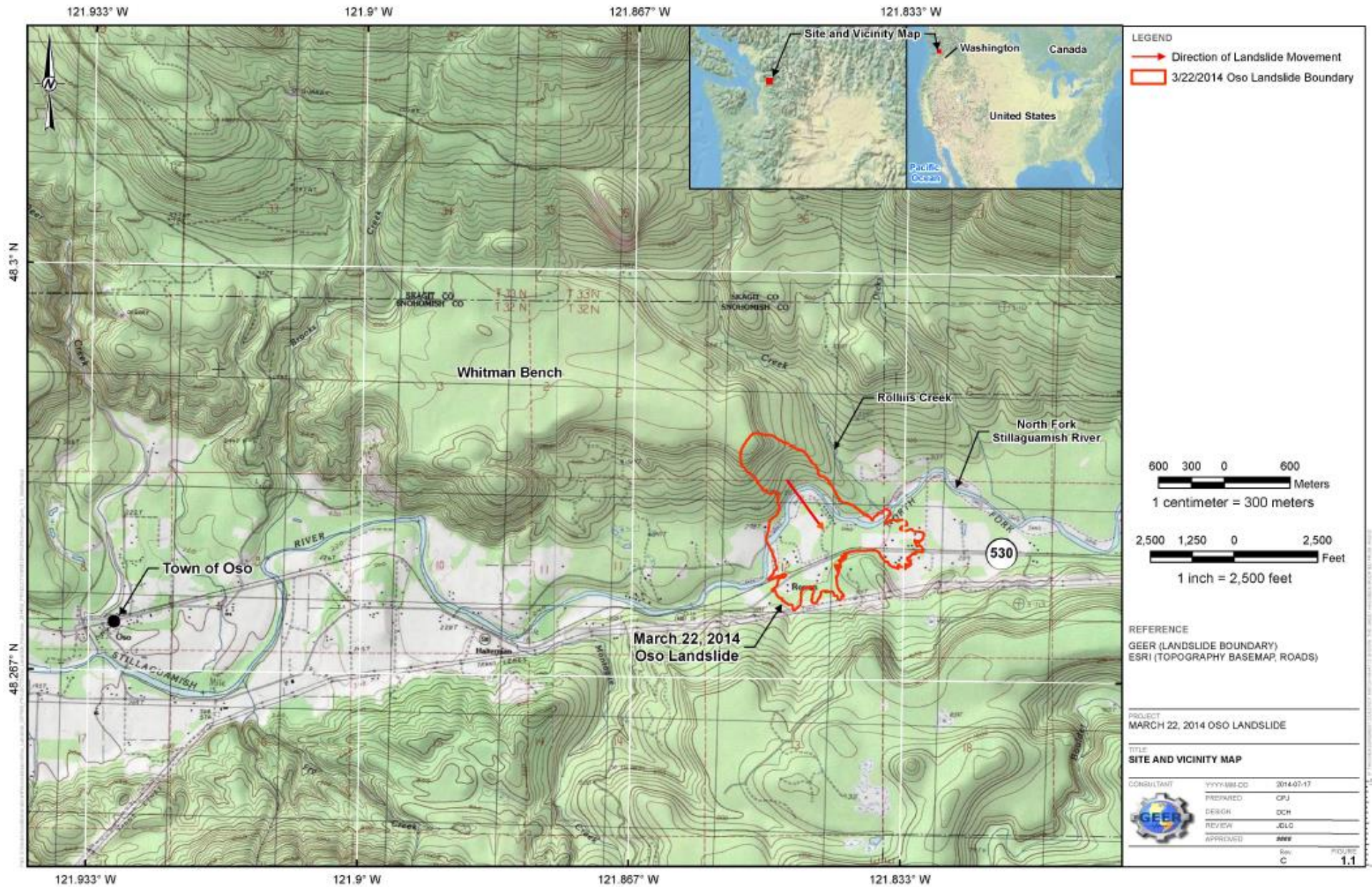


Image source: <http://snohomishcountywa.gov/DocumentCenter/View/18180>



# Aerial photos over Steelhead Haven near Oso, WA



**Landslide January 25, 2006:** After heavy rain, a big slide of about 900 feet of soil crashes into the river, creating flooding that threatens homes. Emergency workers scramble to create a new channel for the river, saving the neighborhood by walling it off with 400 feet of heavy rocks.

**Landslide March 22, 2014:** The hill falls away after heavy rain, releasing millions of cubic yards of earth. Waves of mud, described as 25 feet high, roll for nearly a mile — across the river, through the Steelhead Haven neighborhood and onto Highway 530.



Image and information credits:

Seattle Times <http://old.seattletimes.com/flatpages/local/interactivebeforeandafterthehighway530mudslide.html>

Seattle Times <http://projects.seattletimes.com/2014/building-toward-disaster/>



# Average Precipitation for March: 1981 - 2010

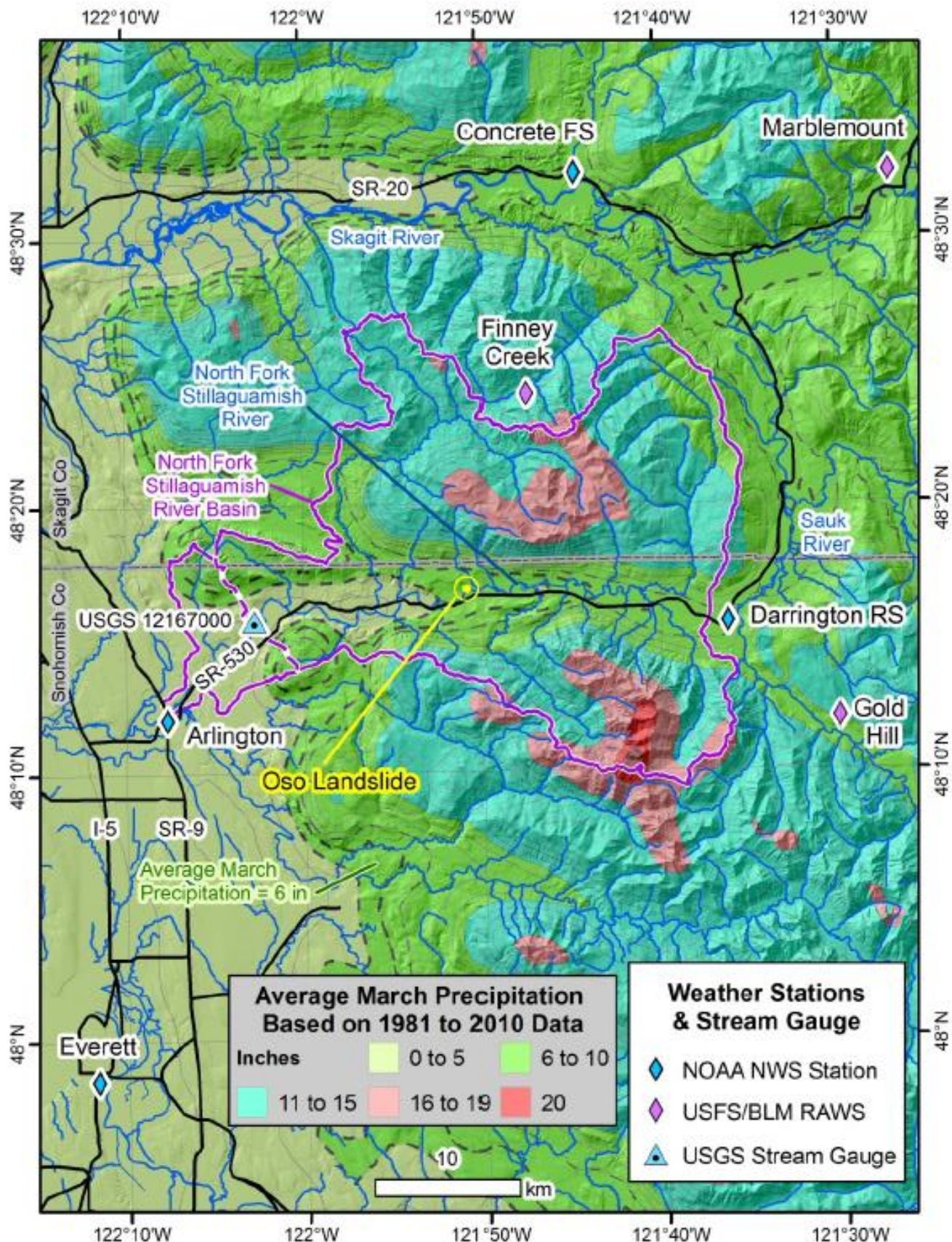
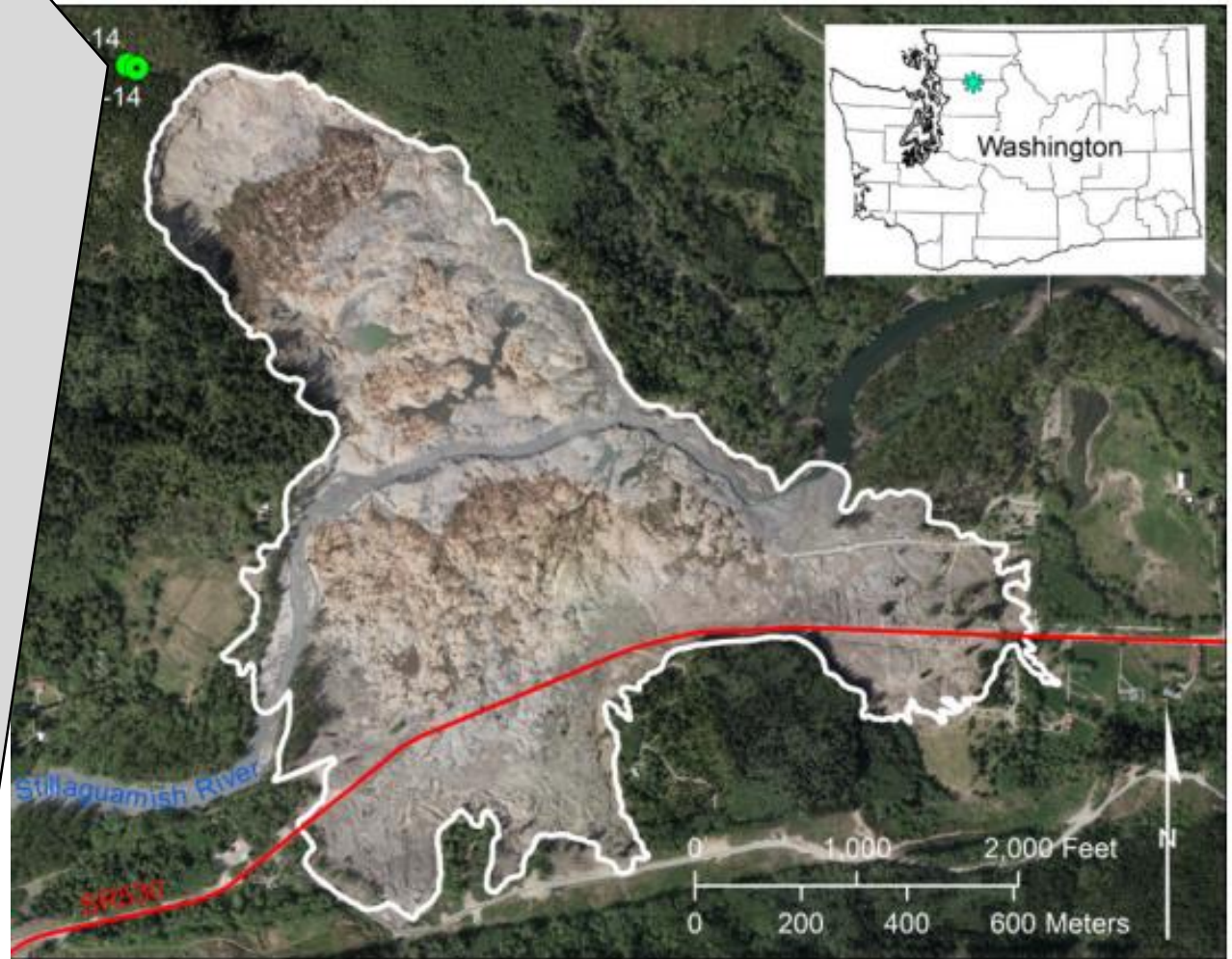
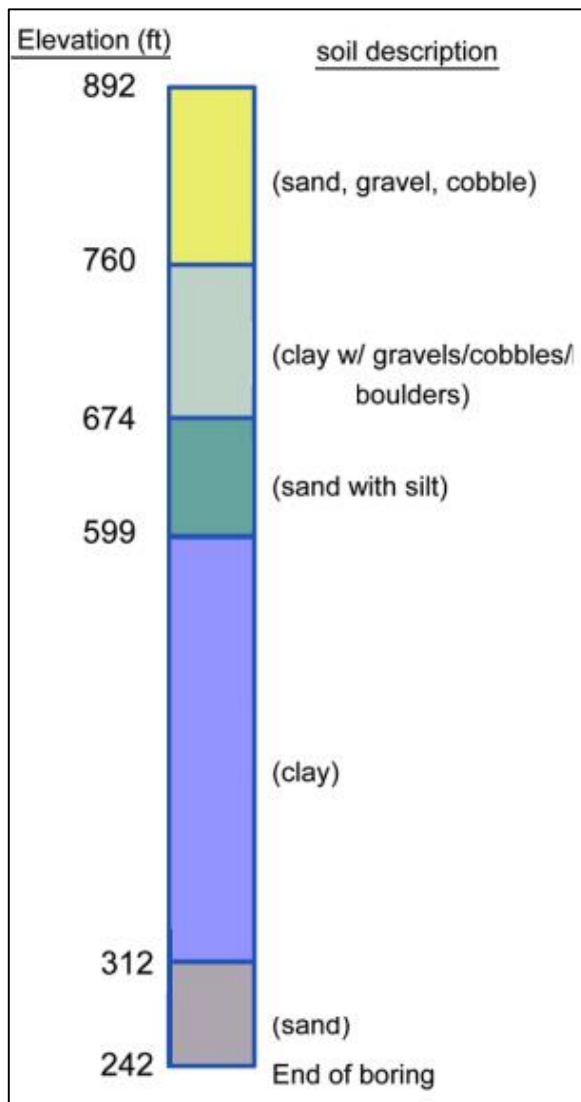


Image source: <http://snohomishcountywa.gov/DocumentCenter/View/18180>



## Soil Profile near the 2014 Oso Landslide

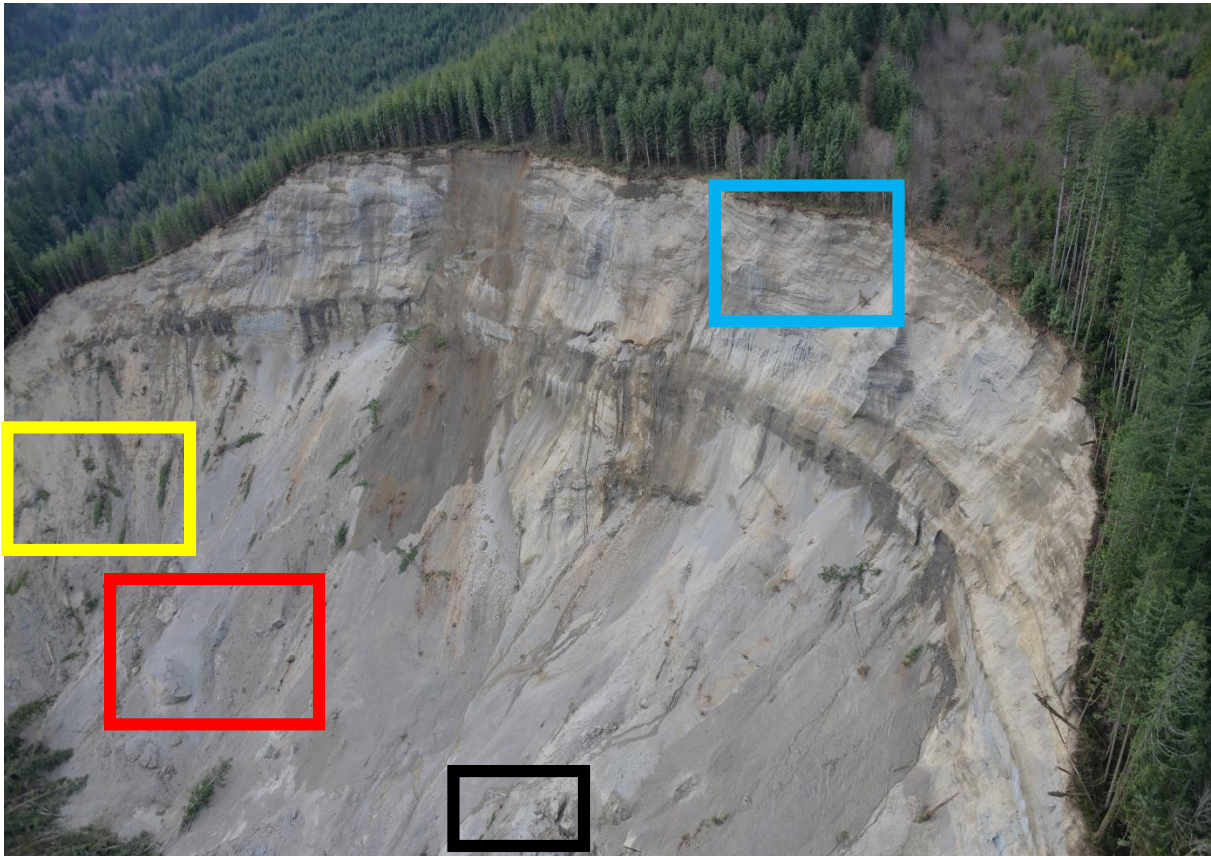


The diagram, left, shows layers of soil in the hill. The photo, right, shows a map with an outline of the 2014 Oso landslide and the dots to the north show where scientists took the sample. Scientists bored a deep hole using special machines to gather a core sample. This sample has layers of soil. This diagram shows the thickness of each layer and describes the kinds of soil they found.

Modified from source: <http://pubs.usgs.gov/of/2015/1089/pdf/ofr20151089.pdf>



# USGS Aerial Photo of Oso Landslide with Zoom-ins



**How would you describe the soil?**

**Do you see any gravel, sand, humus, or clay?**



## *No slope (flat)*



Image source: <http://sevenhillslake.com/construction%20stormwater%20runoff%20041003%202.jpg>

**flat**

## *Shallow slope*



Image source: <http://bit.ly/1pHuW9H>

**shallow**

## *Steep slope*

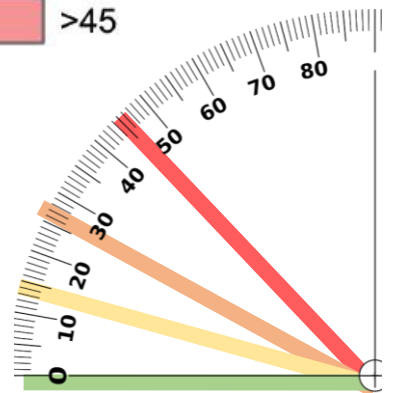
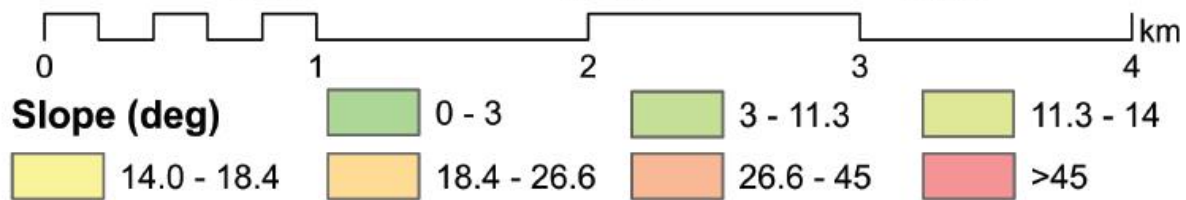
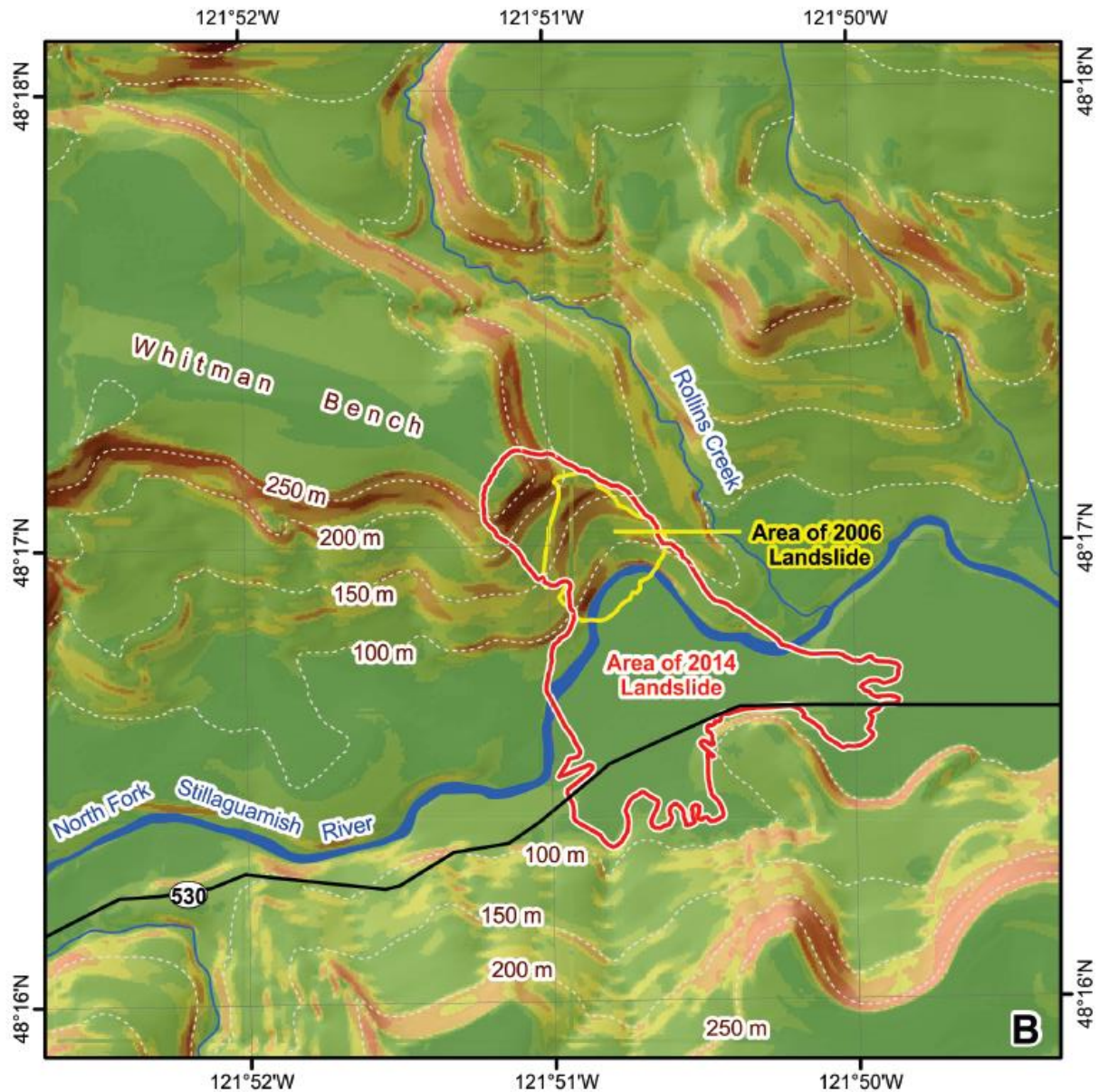


Image source: [http://farm7.staticflickr.com/6196/6090477852\\_d3e0416b10\\_z.jpg](http://farm7.staticflickr.com/6196/6090477852_d3e0416b10_z.jpg)

**steep**



# Slopes in Areas around Oso Landslide





## Looking at landslides with high-tech eyes

RELATIVE AGE  
OF LANDSLIDE DEPOSITS\*

Newest Oldest

A USGS analysis of lidar images reveals more than a dozen previous landslides along the North Fork of the Stillaguamish, one more than twice as big as Saturday's. Lidar can reveal previously unknown slides, and geologists say use of the mapping technique should be expanded.

Approximate position  
of the headscarp of  
Saturday's slide

Approximate  
extent of  
deposits  
from  
Saturday's  
slide

North fork Stillaguamish River

0 0.5  
MILE

\*Slides that are the same color did not necessarily happen simultaneously. All struck within the past 14,000 years, the most recent in 2011.

Sources: USGS, Snohomish County Information Services THE SEATTLE TIMES

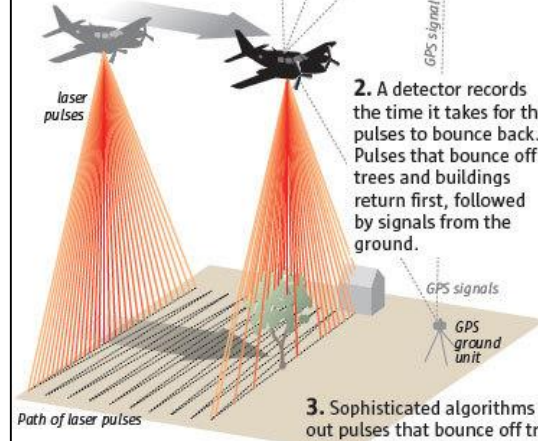
Teacher note: This map is not referenced in the lesson guide; however, it does show how this region has had landslides over time and how scientists collected this data. Include this map in a lesson if it makes sense to do so.

## How lidar works

Lidar (light detection and ranging) uses an aircraft equipped with a scanning laser rangefinder to "peer" through forests and construct a topographic map accurate to within a few inches.

1. The laser fires up to 150,000 harmless, invisible pulses per second at the ground while the aircraft flies a precise grid guided by GPS and an inertial navigation system.

GPS satellites  
GPS signal  
GPS signal  
GPS signal



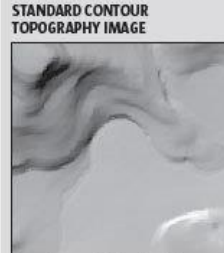
2. A detector records the time it takes for the pulses to bounce back. Pulses that bounce off trees and buildings return first, followed by signals from the ground.

3. Sophisticated algorithms weed out pulses that bounce off trees and structures, and create a topographic map that essentially strips away vegetation. The lidar image (to the right) is of the Oso slide area in 2013.

COST: \$500-\$1,000 per square mile.

Sources: USGS, Snohomish County Information Services, idar-uk.com, NASA's Goddard Space Flight Center, pugetsoundlidar.ess.washington.edu/About\_LIDAR.htm

A sharper view  
These three images  
of the Oso slide  
area (taken before  
Saturday's slide)  
illustrate lidar's  
superiority over  
aerial photos or  
contour maps.



MARK NOWLIN / THE SEATTLE TIMES

Source of Images: [http://old.seattletimes.com/html/localnews/2023244512\\_mudslidelidarxml.html](http://old.seattletimes.com/html/localnews/2023244512_mudslidelidarxml.html)