

Losses from landsliding in Oregon range from \$10M to hundreds of millions a year, making landslides one of the most common and destructive natural hazards in the state. DOGAMI uses lidar, a technology that uses laser light, to create very accurate landslide inventory maps for Oregon.

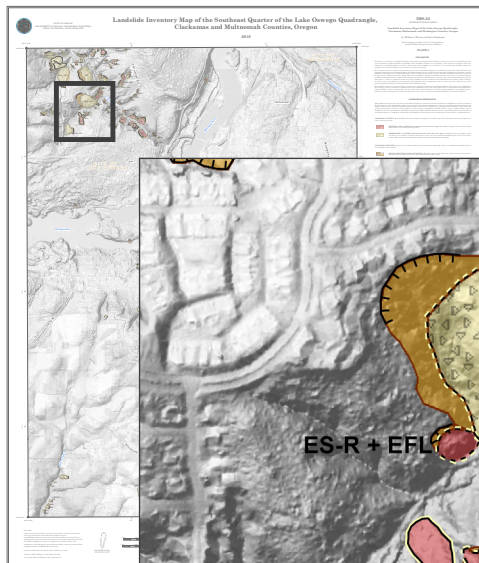
WHAT IS A LANDSLIDE DEPOSIT INVENTORY MAP?

A landslide deposit inventory map shows the locations of all identified landslide deposits for an area along with the characteristics for each landslide. One characteristic is the type of landslide movement: slide, flow, fall, topple, and spread. (See DOGAMI's *Landslides in Oregon Fact Sheet*.) Landslides are also classified according to the general age of the last movement. Older landslide features may be eroded and/or covered with deposits, which can decrease the confidence that a landslide happened in that area. Other characteristics of landslide deposits include depth of failure, slope, direction of movement, area, and volume.

A landslide deposit map is *not* a map of locations of all past landslides. For example, many very small landslide deposits cannot be located. In other cases, deposits are removed immediately and are not included on inventory maps.

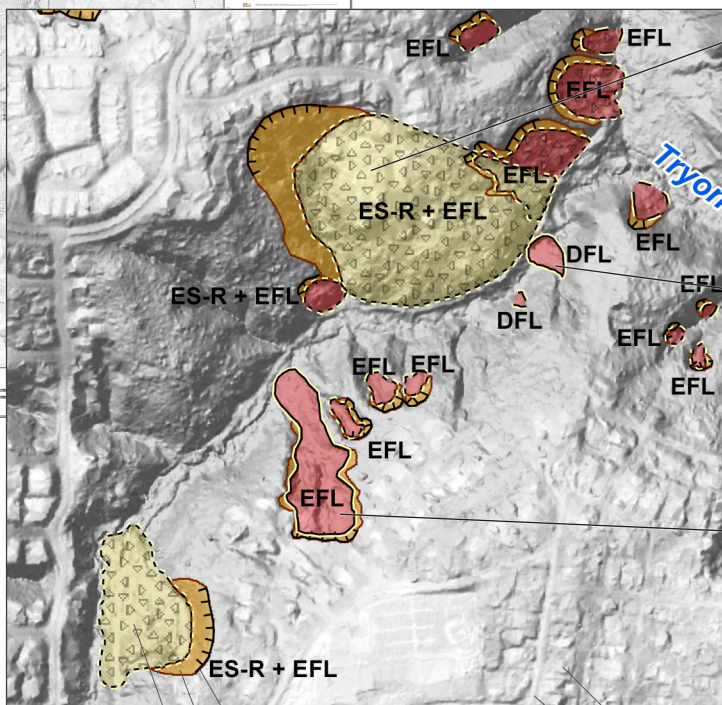
HOW CAN THESE MAPS REDUCE LANDSLIDE RISK?

Landslide inventory maps provide basic information for identifying areas of higher and lower hazards, which is the first step in risk reduction. If a site is within a mapped landslide deposit, or even in an area with many adjacent or surrounding landslides, additional investigation might be the next step. It is important to note that although areas with mapped landslide deposits are likely to be at *higher risk* than other areas, areas mapped as landslide deposits will not automatically have problems in the future. We can prepare by performing risk reduction; that is, by taking steps to reduce the landslide hazard and/or the vulnerability. Landslide inventory maps can be used in comprehensive land use plans, the development of hazard ordinances, and in updating building code regulations.



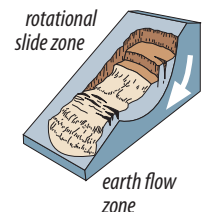
Landslide inventory map (left) and detail (below). Each landslide is classified according to type of movement (text label), activity of landsliding (red is active/historic [less than 150 years]; yellow is prehistoric/ancient [greater than 150 years]), failure plane depth: shallow (less than 4.5 m [15 ft]; no pattern) or deep (patterned), and confidence of interpretation. Landslide features such as head scarp line and zone are also shown.

SE quarter of the Lake Oswego quadrangle, mapped at 1:8,000 scale; DOGAMI map IMS-32). Actual map size is 36 by 42 inches.



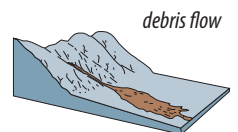
Example 1

Deep seated (patterned) combination earth slide - rotational + earth flow (ES-R + EFL) with prehistoric/ancient movement (yellow color); mapper assigned a moderate confidence of interpretation (dashed outline).



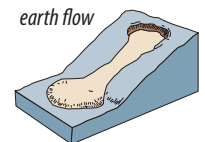
Example 2

Shallow seated (no pattern) debris flow (DFL) with historic/active movement (red color); mapper assigned a high confidence of interpretation (solid outline).



Example 3

Shallow seated (no pattern) earth flow (EFL) with historic/active movement (red color); mapper assigned a high confidence of interpretation (solid outline).



High-resolution, lidar-derived landslide and man-made features:

Head scarp line
Head scarp zone
Slide extent

Buildings
Roads



HOW IS A LANDSLIDE INVENTORY MAP CREATED?

The first step is to collect any previous landslide studies. These data are reviewed and corrected. The second step is visualization of lidar data with a geographic information system. A geotechnical professional who is trained and has experience mapping landslides interprets the lidar data into a landslide deposit geodatabase. These data are used to create one-quarter quadrangle maps at 1:8,000 scale. The maps are reviewed by qualified professionals to ensure that the maps are as accurate as possible.

DOGAMI selects areas for landslide inventory mapping on the basis of three criteria: 1) existence of lidar data, 2) funding, and 3) risk. Contact DOGAMI for more information. Mappers follow the DOGAMI landslide deposit inventory mapping protocol (Burns, W. J., and Madin, I. P., 2009, Protocol for inventory mapping of landslide deposits from light detection and ranging (lidar) imagery: Oregon Department of Geology and Mineral Industries Special Paper 42), which is included with all DOGAMI landslide inventory IMS publications.

Signs of possible landslide problems:

- Structural deformation such as large foundation cracks, misaligned doors and windows, tilted floors, or sagging decks
- Large, open cracks in driveways, curbs, and roads
- Failing retaining walls
- Arc-shaped cracks in the ground

What can I do to reduce landslide risk around my home?

- If you are looking for or are building a home, avoid siting the structure in a hazardous location.
- Consult a certified engineering geologist or a licensed geotechnical engineer if you are considering building or buying on a location with high-risk characteristics.
- Control stormwater so it flows away from steep slopes and into storm drains or natural drainages where it will not harm you or your neighbors.



Who should I consult if I have questions about a specific site?

Contact the Oregon Board of Geologist Examiners (<http://www.osbge.org/>; phone 503-566-2837) or the Oregon State Board of Examiners for Engineering and Land Surveying (<http://osbeels.org/>; phone 503-362-2666) for lists of registered professional consultants available for site-specific evaluations.

RESOURCES

Nature of the Northwest Information Center

(<http://www.naturenw.org>) is operated by the Oregon Department of Geology and Mineral Industries and carries earthquake and landslide hazard maps. 800 NE Oregon St., #28, Ste. 965, Portland, OR 97232, phone 971-673-2331.

Landslide Loss Reduction: A Guide for State and Local Government

Planning, FEMA 182 (<http://www.fema.gov/library/viewRecord.do?id=1417>) Colorado Geological Survey, Department of Natural Resources, Denver, CO, 1989.

Homeowner's Guide to Landslides: Recognition, Prevention, Control, and Mitigation

(<http://www.oregongeology.org/sub/Landslide/homeowners-landslide-guide.pdf>), Federal Emergency Management Agency, Region Ten, and Oregon State Police, December 1996.

Forestry, Landslides and Public Safety

(<http://www.oregon.gov/ODF/privateforests/docs/LandslidesPublicSafety.pdf>)

Oregon Department of Forestry Issue Paper, Salem, Oregon, April 1998.

Agencies

Oregon Department of Geology and Mineral Industries

(<http://www.OregonGeology.org>) maps landslides and issues reports and maps.

Oregon Department of Forestry

(http://www.oregon.gov/ODF/PRIVATE_FORESTS/PCFPubIndex.shtml) publishes technical papers on landslides.

Oregon Department of Transportation

(<http://www.oregon.gov/ODOT/>) maintains highways and issues 24-hour information about road conditions and road closures. For current conditions, call 1-800-977-6368 or visit <http://www.tripcheck.com>.

Oregon Department of Land Conservation and Development

maintains policies that guide local planning for development away from hazardous areas including landslide-prone areas (<http://www.oregon.gov/LCD/HAZ/landslides.shtml>) and also maintains the Oregon Coast Management Program — Coastal Atlas Hazards Map (<http://www.coastalatlases.net/learn/topics/hazards/landslides/>).

USGS National Landslide Information Center

(<http://landslides.usgs.gov/>) has educational information and publications.

Local city or county emergency managers or planners

may have landslide mitigation information.

