

STATE OF OREGON
DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES
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Landslide Inventory Map of the Upper Camp Creek, Lower Camp Creek, Loon Lake-Mill Creek, and a Portion of Lower Lake Creek Watersheds, Douglas County, Oregon

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Landslide Inventory of Portions of Northwest Douglas County, Oregon

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PLATE 4

CONFIDENCE OF INTERPRETATION: Each landslide was classified according to the confidence that the mapper assigned based on the likelihood that the landslide actually exists. Landslides are mapped on the basis of characteristic morphology, and the confidence of the interpretation is based on how clearly visible that morphology is. As a landslide ages, weathering (primarily through erosion) degrades the characteristic morphologies produced by landsliding. With time, landslide morphologies may become so subtle that they resemble morphologies produced by geologic processes and conditions unrelated to landsliding.

Landslides may have several different types of fan morphologies associated with them, and we define confidence through a simple point system (see table below) associated with these features. The point system is based on a ranking of four primary landslide features with a ranking of 0 to 10 points per feature. For example, if during mapping, the head scarp and toe of a landslide were identifiable and clearly visible, the mapper would supply 10 points for the head scarp and 10 points for the toe, equating 20 points, which would be associated with a moderate confidence of identification.

The visual display of this landslide characteristic is through the use of different line styles as shown below.

Confidence	Points
HIGH CONFIDENCE (≥30 points)	
MODERATE CONFIDENCE (1-19 points)	
LOW CONFIDENCE (<10 points)	

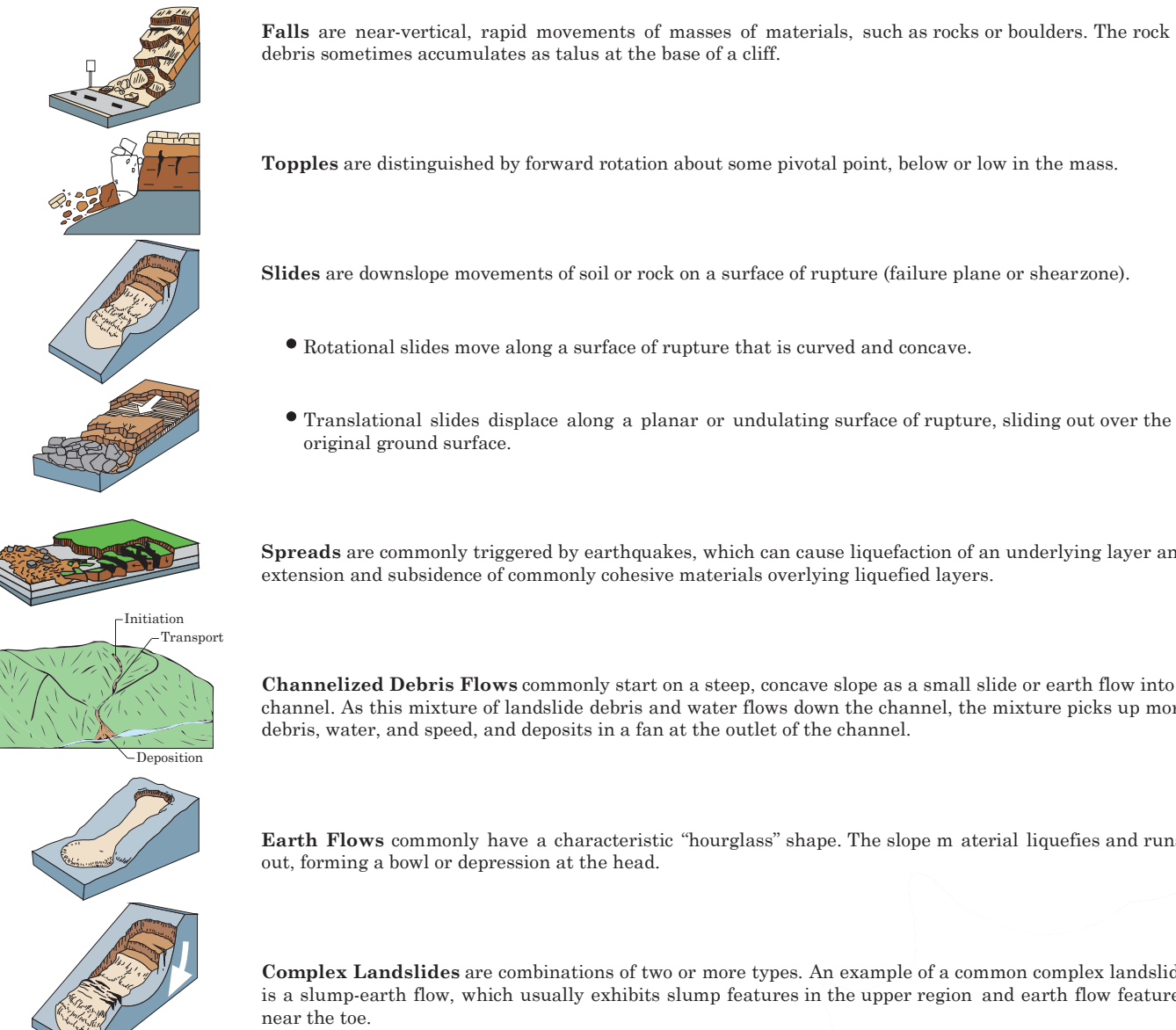
Landslide Feature	Points
Head scarp	0-10
Flanks	0-10
Toe	0-10
Internal scarps, sag ponds, compression ridges, etc.	0-10*

*Applies only areas of fan topography in our dataset.

CLASSIFICATION OF MOVEMENT: Each landslide was classified with the type of landslide movement. There are five types of landslide movement: slide, flow, fall, topple, and spread. These movement types are combined with material types to form the landslide classification. Not all combinations are common in nature, and not all are present in the quadrangle.

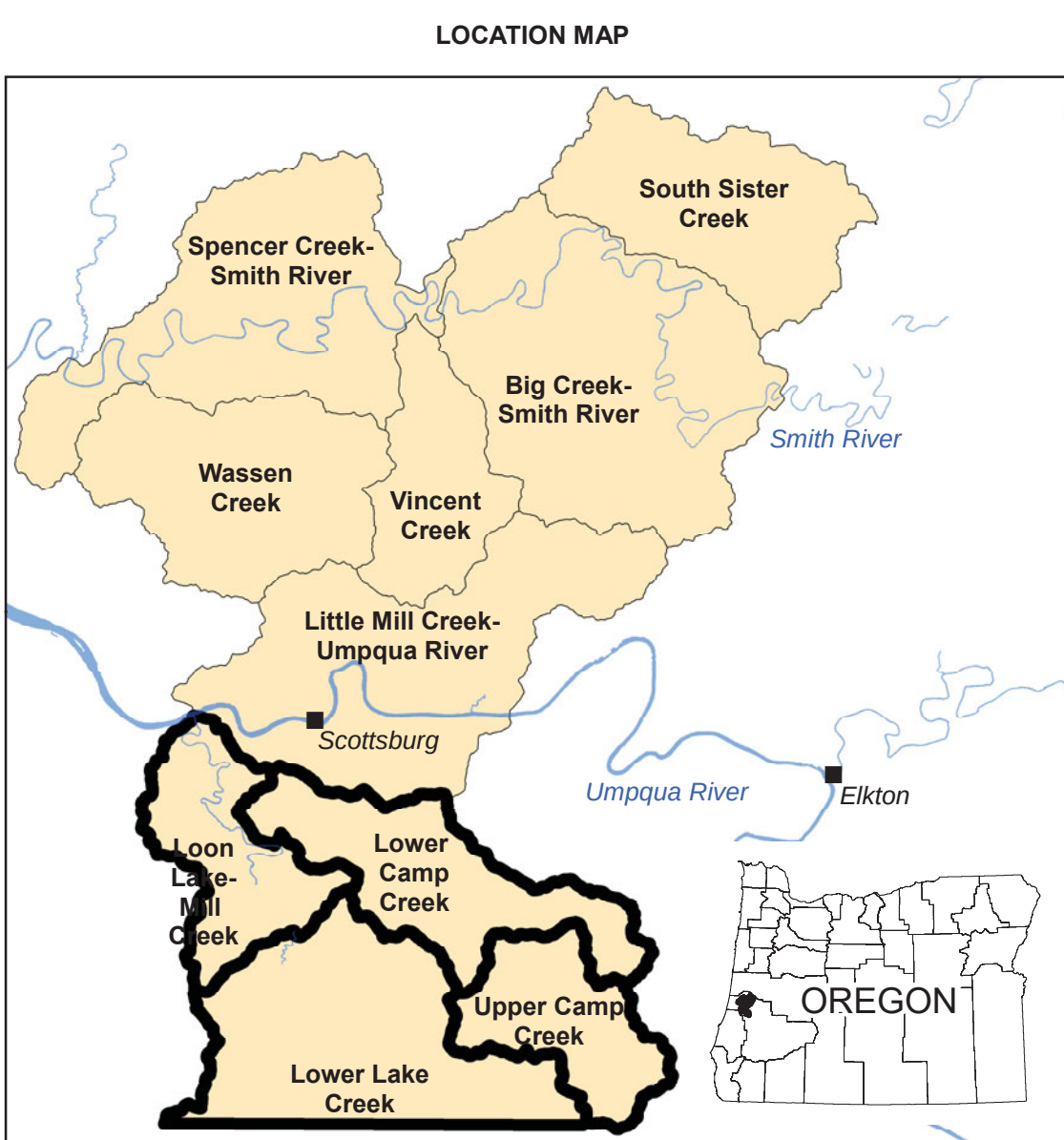
EFL - Earth Flow - Abbreviation for class of slope movement. The table below displays the types (Varma, 1978).

Type of Movement	Rock	Debris	Soil
Fall	RF - rock fall	DF - debris fall	EF - earth fall
Topple	RT - rock topple	DT - debris topple	ET - earth topple
Slide-rotational	RS-R - rock slide-rotational	DS-R - debris slide-rotational	ES-R - earth slide-rotational
Slide-translational	RS-T - rock slide-translational	DS-T - debris slide-translational	ES-T - earth slide-translational
Lateral spread	RSP - rock spread	DSP - debris spread	ESP - earth spread
Flow	RFL - rock flow	DFL - debris flow	EFL - earth flow
Complex	C - complex or combinations of two or more types (for example, ES-R + EF)		



REFERENCES

- Burns, W.J., 2014. Statewide Landslide Information Database for Oregon, release 3.2. Oregon Department of Geology and Mineral Industries. Web: <http://www.oregon.gov/ogm/databases/>
- Burns, W. J., and Maden, L. 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 62, 20 p., available online at <http://www.oregon.gov/ogm/publications/>
- Highland, L., compiler, 2004. Landslide types and processes. U.S. Geological Survey Fact Sheet 2004-3072 (rev. 1), 1 p.
- Varma, D.J., 1976. Slope movement types and processes. In Schuster, R. L., and Krizek, R. J., eds., Landslides—analysis and control. Washington, D. C.: Transportation Research Board Special Report 176, p. 11-33.



INTRODUCTION

The Oregon Department of Geology and Mineral Industries (DOGAMI) partnered with the Bureau of Land Management (BLM) to better understand the landslide hazards on the Big River (BLM) land within the study area. The goal of the partnership was to create detailed landslide inventories. The text below explains how this was done.

EXPLANATION

This map is an inventory of existing landslides in the study area. The landslide inventory is one of the essential data layers used to delineate regional landslide susceptibility. This landslide inventory is not regulatory, and reviewers can expect when new information regarding landslides is found or when future (two) landslides occur. Therefore, it is possible that landslides within the mapped areas were not identified or occurred after the map was prepared.

This inventory map was prepared by following the Protocol for Inventory Mapping of Landslide Deposits from Light Detection and Ranging (Lidar) Imagery developed by Burns and Maden (2009). The three primary tasks included compilation of previously mapped landslides (including review of the Statewide Landslide Information Layer for Oregon, release 3 (Burns and others, 2010)), lidar-based morphologic mapping of landslide features, and review of aerial photographs. Landslides identified by these methods were digitally compiled into a GIS database at varying scales. While the protocol recommends data use at a map scale of 1:50,000, and the geodatabase contains data at 1:50,000 or better, for representation purposes the data have been visualized on the map plate at 1:20,000. Each landslide was also attributed with classifications for activity, depth of failure, movement type, and confidence of interpretation. The landslide data are displayed on top of a base map that consists of an aerial photograph (orthorectified) overlaid on the lidar-derived hillshade image.

This landslide inventory map is intended to provide users with basic information regarding landslides within the study area. The geologic, terrain, and climatic conditions that led to landslides in the past may provide clues to the location and conditions of future landslides, and it is intended that this map will provide useful information to develop regional landslide susceptibility maps, to guide site-specific investigations for future developments, and to assist in regional planning and mitigation of existing landslides.

LANDSLIDE CLASSIFICATION

Each landslide shown on this map has been classified according to a number of specific characteristics identified at the time the data were recorded in the GIS database. The classification scheme was developed by the Oregon Department of Geology and Mineral Industries (Burns and Maden, 2009). Several significant landslide characteristics recorded in the data base are portrayed with symbology on this map. The specific characteristics shown for each landslide are the activity of landsliding, landslide features, deep or shallow failure, confidence of landslide interpretation, and type of landslide movement. These landslide characteristics are determined primarily on the basis of geomorphic features, or landforms, observed for each landslide. The symbology used to display these characteristics is explained below.



HISTORIC LANDSLIDE POINTS: These are the locations of known landslides that were recorded and included in previous versions of BLIM or captured during this project from review of historical air photos from 1980 to 2011 or from other historical records.

LANDSLIDE ACTIVITY: Each landslide has been classified according to the relative age of last movement. This map display uses color to show the relative age of activity.



HISTORIC and/or ACTIVE (movement less than 160 years ago): The landslide appears to have moved within historic time or is currently moving (active).



PRE-HISTORIC or ANCIENT (movement greater than 160 years ago): Landslide features are slightly eroded and there is no evidence of historic movement. In some cases, the observed landslide features have been greatly eroded and/or covered with deposits that result in modified and subdued morphology.



HEAD SCARP ZONE and FLANK ZONE: The head scarp or upper most scarp, which in many cases exposes the primary failure plane (surface of rupture), and flanks or shear zones.



HEAD SCARP LINE and INTERNAL SCARP LINES: Upper most extent of the head scarp and internal scarps within the body of the landslide. Hatching is in the down-slope direction.

DEPTH OF FAILURE: The depth of landslide failure was estimated from scarp height. Failures less than 4.5 m (15 ft) deep are classified as shallow-seated and failures greater than 4.5 m (15 ft) deep are classified as deep-seated.



SHALLOW-SEATED LANDSLIDE: Estimated failure plane depth is less than 4.5 m (15 ft).



DEEP-SEATED LANDSLIDE: Estimated failure plane depth is greater than 4.5 m (15 ft).

Base Map:

Lidar data for this publication are from DOGAMI Lidar Data Quadrangles LIDQ 43123-G5 through -G8, LIDQ 43123-P5 through -P8, and LIDQ 43123-B6 through -B8.

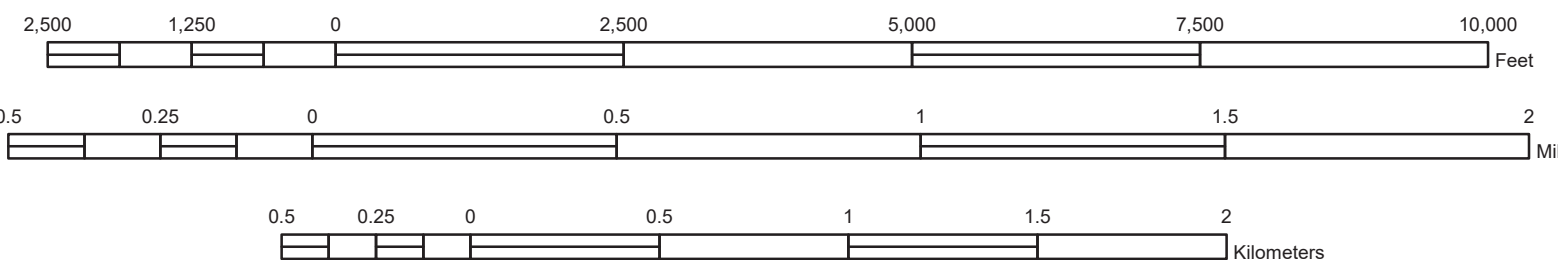
Digital elevation model (DEM) consists of a 2-foot-square elevation grid that was converted into a hillshade image with sun angle at 315 degrees at a 60-degree angle from horizontal. The DEM was multiplied by 2 (vertical exaggeration) to enhance slope areas.

2009 orthophoto imagery is from Oregon Geospatial Enterprise Office and is draped over the hillshade image with transparency.

Projection: North American Datum 1983, UTM zone 10.
Software: Esri ArcMap 10.5.1, Adobe Illustrator CS2.
Source File: Project VLM Oregon Landslides

IMPORTANT NOTICE:

This product is for informational purposes and may not have been prepared for or be suitable for legal, engineering, or surveying purposes. Users of this information should review or consult the primary data and information sources to ascertain the usability of the information. This publication cannot substitute for site-specific investigations by qualified practitioners. Site-specific data may give results that differ from the results shown in this publication.



APPROXIMATE MEAN DECLINATION, 2009

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