STATE OF OREGON
DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES
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# Landslide Inventory Map of Mosier, Oregon

2023

**Open File Report O-23-02**

**Landslide Inventory and Risk Reduction of the North and Central Portions of Wasco County, Oregon**

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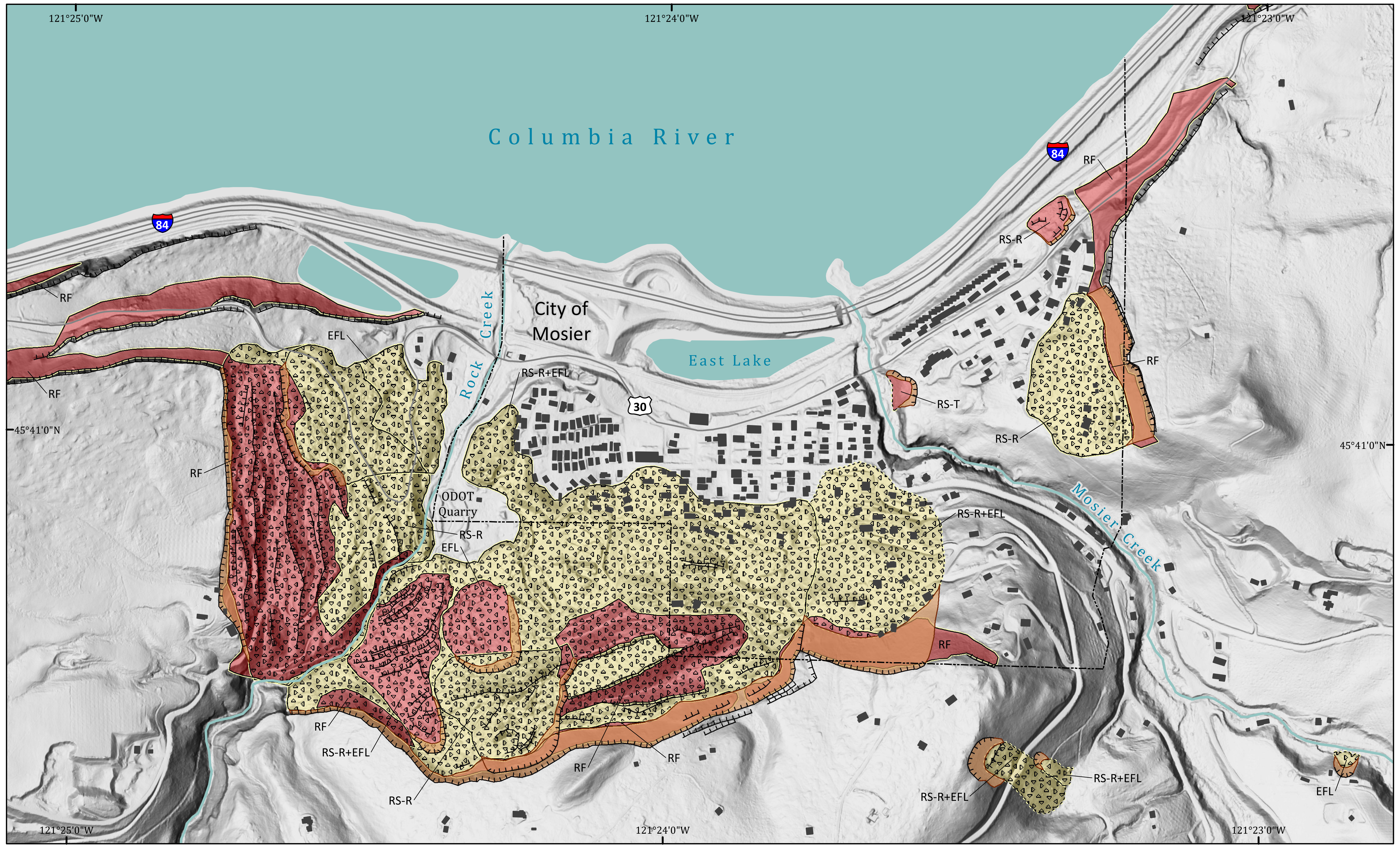
## PLATE 2

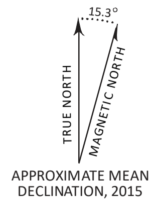



**Source Data:**
Oregon Lidar Consortium, 2015 and US Army Corp Engineers, 2010 for White Salmon (45121-F4) and Lyle (45121-F3) quadrangles. Water features from the National Hydrology Dataset (NHD), 2017 and transportation from Oregon Department of Transportation (ODOT), 2015.

**Projection:**
Oregon Statewide Lambert Conformal Conic, Unit: International Feet, Horizontal Datum: NAD 1983 2011.

**Software:**
Esri® ArcMap® 10.7.1

**Digital Cartography:**
Jon J. Franczyk




SCALE 1:8,000

0 — 0.25 — 0.5 Miles

0 — 0.25 — 0.5 Kilometers

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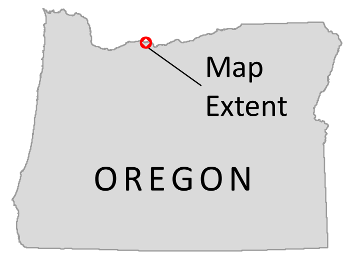
This product is for informational purposes and may not have been prepared for or be suitable for legal, engineering, or surveying purposes. Users of this information should review or consult the primary data and information sources to ascertain the usability of the information. This publication cannot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

- City Boundary
- Highway
- Stream
- Building
- Waterbody




## INTRODUCTION

The Oregon Department of Geology and Mineral Industries (DOGAMI) partnered with Federal Emergency Management Agency (FEMA) to better understand the landslide hazards in the Wasco County, Oregon 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 revisions can happen when new information regarding landslides is found or when new landslides occur. Therefore, it is possible that landslides within the mapped area 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 Madin (2009). The three primary tasks included compilation of previously mapped landslides (including review of the Statewide Landslide Information Layer for Oregon Release 4 [Franczyk and others, 2019]), 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 1:8,000, and the geodatabase contains data at 1:8,000 or better, for representation the data have been visualized on the map plate at 1:32,000. 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 locations and conditions of future landslides.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

We have classified each landslide shown on this map 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 Madin, 2009). Several significant landslide characteristics recorded in the database 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 we use to display these characteristics on the map is explained below.

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

**HISTORIC and/or ACTIVE (movement less than 150 years ago):** The landslide appears to have moved within historic time or is currently moving (active).

**PRE-HISTORIC or ANCIENT (movement greater than 150 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 smoothed and subdued morphology.

**LANDSLIDE FEATURES:** Because of the high resolution of the lidar-derived topographic data, some additional landslide features were identified. These include:

**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-dropped 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, and failures greater than 4.5 m (15 ft) deep are classified as deep.

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

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

## CONFIDENCE OF INTERPRETATION

**HIGH CONFIDENCE** (≥ 30 points)

**MODERATE CONFIDENCE** (20 – 30 points)

**LOW CONFIDENCE** (≤ 20 points)

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

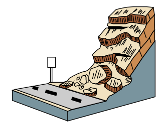
* Applied only once so that total points do not exceed 40.

**EFL** — EFL - Earth Flow - Abbreviation for type of slope movement. The table below displays movement types (Varnes, 1978). Generalized diagrams (some modeled from Highland, 2004) showing types of movement are shown in the next column.

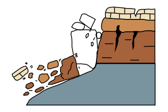
## CLASSIFICATION OF MOVEMENT

We classified each landslide with the type of landslide movement. There are five types of landslide movement: slide, flow, fall, topple, and spread (Varnes, 1978). These movement types are combined with material type to form the landslide classification. Not all combinations are common in nature, and not all are present in this study area.

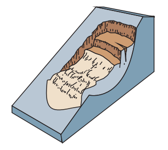
| Type of Movement | Type of Material | | |
|---|---|---|---|
| | Rock | Debris | Soil |
| Fall | **RF** rock fall | **DF** debris fall | **EF** earth fall |
| Topple | **RT** rock topple | **DT** debris topple | **ET** earth topple |
| Slide-rotational | **RS-R** rock slide-rotational | **DS-R** debris 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 + EFL) | | |



**Falls** are near-vertical rapid movements of masses of materials, such as rocks or boulders. The rock debris sometimes accumulates as talus at the base of a cliff.

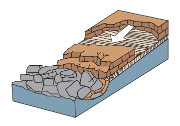


**Topples** are distinguished by forward rotation about some pivotal point, below or low in the mass.

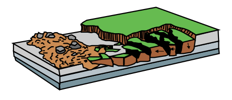


**Slides** are downslope movements of soil or rock on a surface of rupture (failure

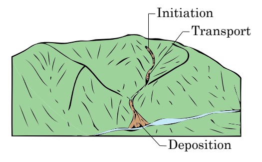
- Rotational slides move along a surface of rupture that is curved and concave.



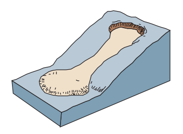
- Translational slides displace along a planar or undulating surface of rupture, sliding out over the original ground surface.



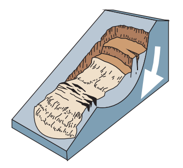
**Spreads** are commonly triggered by earthquakes, which can cause liquefaction of an underlying layer and extension and subsidence of otherwise cohesive materials overlying liquefied layers.




**Channelized Debris Flows** commonly start on steep, concave slopes as small slides or earth flows into channels. As this mixture of landslide debris and water flows down the channel, the mixture picks up more debris, water, and speed, and deposits in a fan at the outlet of the channel.



**Earth Flows** commonly have a characteristic "hourglass" shape. The slope material liquefies and runs out, forming a bowl or depression at the head.



**Complex Landslides** are combinations of two or more types. An example of a common complex landslide is a rotational slide + earth flow, which usually exhibits rotational slide features in the upper region and earth flow features near the toe.

(Block Diagrams from Highland, 2004)

## REFERENCES

Franczyk, J.J., Burns, W.J., Calhoun, N.C., 2019. Statewide Landslide Information Database for Oregon, release 4 (SLIDO-4.0), Oregon Department of Geology and Mineral Industries, Digital Data Series, https://www.oregongeology.org/slido/index.htm

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