

METADATA

Tags

Colorado Geological Survey, Landslides, Landslide inventory

Summary

Jefferson County is located to the west of Denver County and is experiencing urban growth and development, some into landslide prone areas in the county. The county extends from the Rocky Flats area, north of Golden, to south of Buffalo Creek. It contains North Table Mountain, South Table Mountain, Green Mountain, and a section of the hogbacks. Much of the western part of the Denver Metro area lies within the county, as well as mountain towns like Evergreen, Conifer, and Pine. This is a geodatabase of landslide deposits, landslide headscarps, and potential landslide points mapped in Jefferson County using 1-m resolution lidar. This dataset update was funded by the U.S. Geological Survey Intergovernmental Personnel Act Mobility Program from 2022 to 2023. [County boundaries](#) were acquired in 2025 from the Colorado Department of Public Health and Environment (CDPHE).

CGS has developed a 3-level schema for lidar-based landslide inventories. This inventory falls into the CGS's third and highest inventory mapping level. Level 3 inventories include more detailed mapping, including nested deposits, and attribution that includes details like type of movement, material, and source area geology, among some other additional attributes. Please see the description for a complete list of attributes.

Description

Landslides are mapped using 1-m resolution, lidar-derived slope maps. Lidar was examined and landslide deposits were mapped at varying scales, generally 1:5,000 or smaller, but may be as great as 1:2,000. Five- to ten-foot contours derived from lidar DEM's were used to assist in mapping deposit boundaries. The Jefferson County dataset includes mapped alluvial- and debris-fan, identified as DFL in the Move_Code attribute.

Mapping detail is comparable to Level 2 mapping and much more detailed than Level 1. Level 3 mapping includes additional mapping of:

Nested landslide deposits: Polygons mapped within and overlapping with older landslide deposit polygons. These polygons are included in the counties “Deposits” feature class.

Headscarps and scarp flanks: Polygons identifying headscarp and flank extents and boundaries above landslide deposits. These polygons are included in the counties “Scarp_Flanks” feature class.

Scarps: Lines indicating sections of the headscarp or lengths of internal scarps. Segments of the headscarp mapped with this line indicate areas where the deposit detached and moved mostly downward relative to the headscarp polygon. Areas of the headscarp not mapped with this line indicate segments of the headscarp polygon where the deposit moved laterally relative to the headscarp, indicating scarp flank zones. Internal scarps are mapped inside landslide polygons. These lines are included in the counties “Scarps” feature class.

Potential landslide points: Point file with potential, relatively small landslides that are not map-scale for polygon features.

Each dataset includes the following attributes:

Type_Move: Movement type, after Varnes (1978). Fall, topple, slide, spread, flow, complex (a combination of movement types).

Move_Class: Movement classification using movement type (Type_Move), material type (earth, debris, rock), and geometry of movement (rotational, translational).

Move_Code: A combination of letters correlative with Type_Move and Move_Class.

Confidence: A mapping confidence assigned by the mapper(s). Considerations are listed for each confidence interval. Confidence can be re-assed after field review.

Low: Landslide features are difficult to distinguish, boundaries are not clear, and/or the lidar is distorted (tinning) and difficult to interpret. Even though none are mapped, headscarps and flanks are difficult to distinguish, and general landslide morphology (hummocky topography, internal scarps) is muted, weathered, or eroded.

Moderate: Most landslide features are distinguishable in lidar, but some deposit features may not be well-defined. Headscarps may be present and easy to identify, or they may be more eroded but are generally still defined. Deposit boundaries may be difficult to distinguish in places, but the general shape and distribution of the landslide deposit is still distinguishable in the lidar. Hummocky topography is present but may not be as well-defined as a high confidence landslides.

High: Most or all landslide boundaries are easy to identify and map. The landslide deposit shows clear hummocky topography and, though none are mapped, if internal scarps are present, they are clearly defined in lidar. Headscarps and flanks, though none are mapped, are clear and easy to identify.

Age: Estimated relative age. Historic <150 years, Prehistoric >150 years

Geol: Source area geology, the units that are susceptible to landslide initiation.

Slope: Pre-failure slope, estimated from slopes adjacent to the headscarp. Value is in degrees.

HS_Height: Headscarp height in ft. Average distance between the top of the headscarp and bottom of the headscarp.

Fan_Height: The difference between the top of the fan deposit and bottom of the fan deposit, below the toe.

Fail_Depth: Depth of failure plane, estimated from HS_Height and slope.
 $\text{Fail_Depth} = \text{HS_Height} * \cos(\text{Slope})$.

Deep_Shallow: Assigns designation based on Fail_Depth. ≤15 ft is shallow, > 15 ft is deep.

Direction: Average direction of movement, using a 360° circle with North as 337.5° to 22.5°.

Quadname: The quadrangle that was used to identify source area geology. If no scale is indicated, the maps are 7.5 minute/1:24,000 scale quadrangles. Others are indicated by name and scale (ex. Bailey 100k)

Area_sqft: Measured in square-feet. Calculated using “Calculate Geometry” tool from the attribute table.

Volume_cubft: Measured in cubic feet. For landslides, it is the area * Fail_Depth. For alluvial- and debris-flow fans, volume is half the volume of a cone. $\text{Volume} = \text{area} * (1/3 * \text{Fan_Height})$

Unique_ID: A unique identified assigned using a combination of the county name and OBJECTID.

Notes: Mapper notes for landslide deposits. Some earlier datasets may not include mapper notes until the dataset is reevaluated and published.

FieldCheck: An attribute to identify landslides confirmed during fieldwork, with a “Yes”. This field is left blank for landslides that are not field confirmed. Any mapped landslides that the mapper confirmed were not present in the field were removed from the dataset.

County: The county the landslide deposit exists within.

Shape_Length: Default geodatabase measurement in meters.

Shape_Area: Default geodatabase measurement in square-meters.

Attributes were not assigned for headscarp polygons and scarp lines.

The lidar data used to map this landslide dataset were collected in two parts: the first in 2013 by Photo Science and the second in 2016 by Merrick and Co. The first set lacked coverage of the southern portion of the county. The second set was acquired to complete coverage of the county. Lidar can be accessed [here](#).

Map Use Limitations

This landslide inventory dataset should supersede the inventory dataset published in [OF-18-06](#) (Lindsey: Landslide Inventory and Susceptibility Map for Jefferson County, Colorado). Landslide susceptibility mapping remains the same. This is not a complete dataset of existing landslides, debris-flow fans, or alluvial fans. Where these processes have occurred before, it is possible for them to occur in the future if appropriate assessment and mitigation are not developed. In many places, streams and rivers can and have eroded away debris-flow and alluvial-fan deposits. This inventory mapping does not show any assessment of susceptibility or risk. This map is intended for use at a 1:24,000 scale and should not be used for site-specific analysis; rather, this mapping should be used to advise on how much and what type of site-specific analysis may be necessary. To assess landslide initiation susceptibility or debris-flow/alluvial-fan occurrence, a qualified geotechnical engineer or engineering geologist should be enlisted to evaluate each site or

drainage individually. There are a few places along the northern border of Jefferson County with Boulder County where the majority of the landslide deposit is in Boulder County. Some metrics were not collected for these landslides, since they are split between counties with the majority lying outside Jefferson County. This database will continue to be updated iteratively when new data becomes available.

Credits

Colorado Geological Survey. U.S. Geological Survey.