SLOPE MOVEMENTS AND SLOPE MOVEMENT DEPOSITS MAP OF WATAUGA COUNTY, NORTH CAROLINA

By
Richard M. Wooten, Anne C. Witt, Kenneth A. Gillon, Thomas J. Douglas, Rebecca S. Latham, Stephen J. Fuemmeler, and Jennifer B. Bauer

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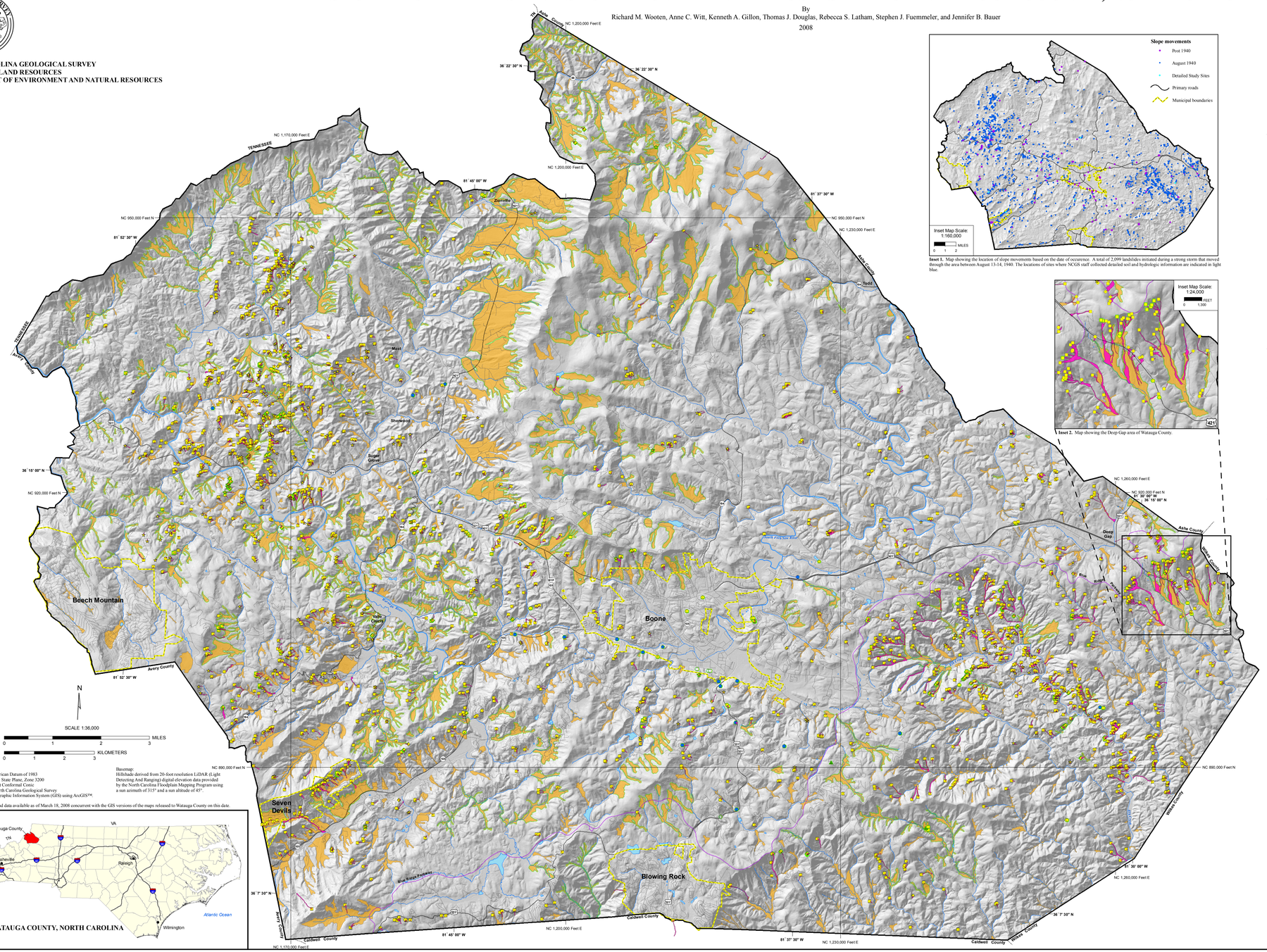
GEOLOGIC HAZARDS MAP SERIES 3
SLOPE MOVEMENT HAZARD MAPS OF WATAUGA COUNTY, NC
SHEET 1 of 4, VERSION: MARCH 18, 2008



Inset 1. Map showing the location of slope movements based on the date of occurence. A total of 2,099 landslides initiated during a strong storm that moved through the area between August 13-14, 1940. The locations of sites where NCGS staff collected detailed soil and hydrologic information are indicated in light blue.

Inset 2. Map showing the Deep Gap area of Watauga County.

Map Information:
Datum: North American Datum of 1983
Coordinate System: State Plane, Zone 3200
Projection: Lambert Conformal Conic
Cartography by North Carolina Geological Survey
Produced in a Geographic Information System (GIS) using ArcGIS™.

Basemap:
Hillshade derived from 20-foot resolution LiDAR (Light Detecting and Ranging) digital elevation data provided by the North Carolina Floodplain Mapping Program using a sun azimuth of 315° and a sun altitude of 45°.

Based on information and data available as of March 18, 2008 concurrent with the GIS versions of the maps released to Watauga County on this date.

LOCATION OF WATAUGA COUNTY, NORTH CAROLINA

EXPLANATION

MAP FEATURES

Slope movements
- Debris flow track

Initiation zones
- Crveep
- Debris or earth flow
- Debris or earth slide and flow
- Debris or earth slide-general
- Debris or earth slide-rotational
- Debris or earth blowout
- Debris or earth slide-translational
- Rock fall
- Rock slide-general
- Rock slide-translational
- Weathered rock slide-general
- Weathered rock slide-rotational
- Weathered rock slide-translational

Slope movement deposits
- Slope movement deposit
- Slope movement deposit - field verified

Modifiers
- Dot indicates slope movement initiated on modified ground
- Green halo indicates slope movement was field verified

Roads
- Primary Roads
- Secondary Roads
- Blue Ridge Parkway

Rivers
- Major Rivers
- Minor Rivers/Streams
- Municipal boundaries
- Watauga County boundary

Material definitions:

debris - Soil that contains a significant proportion of coarse material in which 20% to 80% of the particles are greater than sand sized in the range of 0.08 inches (2 mm).

earth - Soil in which about 80% or more of the particles are smaller than 0.08 inches (2 mm).

rock - An aggregate of one or more minerals or undifferentiated mineral matter.

weathered rock - Rock that is partly- to completely-decomposed (in accordance with Williamson (1984) from physical and chemical weathering processes.

Mechanism definitions:

blowout - A type of slope failure in which water and soil bursts forth from the ground and then proceeds downslope as overland flow. These are possibly caused by excessive pore water pressure.

creep - The slow, more or less continuous downslope movement of mineral, rock, and soil particles by gravity.

fall - A type of slope movement in which material is detached from a steep slope or cliff along a surface on which little or no shear displacement occurs. The detached material descends mostly through the air by free fall, bounding, or rolling.

flow - A type of slope movement in which the water content in the displaced mass is sufficient for the material to liquefy and resemble a viscous fluid.

slide-general - A slope movement initiated by slippage along a well-defined failure surface that is usually planar or curvi-planar. Slides can be divided into two classes, rotational and translational.

slide-rotational - A slide in which the displaced material has moved along a curved, concave upward, failure surface.

slide-translational - A slide in which the displaced material has moved along a generally planar failure surface.

Note: Definition of blowout from Hack and Goodlett (1960); All other definitions are in general accordance with Cruden and Varnes (1996) and Jackson (1997).

SLOPE MOVEMENT STATISTICS

Slope Movement Type	Modified	Unmodified	Unknown	Total	% of Total
Debris or Earth flow	61	1682	0	**1743**	77.4%
Debris or Earth blowout	5	294	0	**299**	13.3%
Debris and Earth slide and flow	25	107	0	**132**	5.9%
Debris or Earth slide-general	21	20	0	**41**	1.8%
Debris or Earth slide-translational	11	0	0	**11**	0.5%
Weathered rock slide-general	9	0	0	**9**	0.4%
Weathered rock slide-translational	6	0	0	**6**	0.3%
Rock slide-translational	4	0	0	**4**	0.2%
Weathered rock slide-rotational	2	1	0	**3**	0.1%
Debris or Earth slide-rotational	2	0	0	**2**	0.1%
Debris creep	0	1	0	**1**	0.0%
Rock fall	1	0	0	**1**	0.0%
Weathered Rock creep	0	1	0	**1**	0.0%
Total	**147**	**2106**	**0**	**2253**	100.0%
% of Total	6.5%	93.5%	0.0%	100.0%	

Table 1. Slope movement type versus modified or unmodified slope configuration at the initiation zone. Modified slopes are slopes that have been subjected to earth work activities by humans. Unmodified slopes are slopes that have not been altered by human activity.

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OVERVIEW OF THE SLOPE MOVEMENTS AND SLOPE MOVEMENT DEPOSITS MAP

Introduction

In response to the number of slope movements (landslides) and the destruction caused by the remnants of Hurricanes Frances and Ivan in western North Carolina in September 2004, the North Carolina General Assembly authorized the North Carolina Geological Survey (NCGS) to produce landslide hazard maps for 19 western counties. Watauga County was selected as the second county to be mapped after Macon County because of the large number of landslides and the 14 landslide deaths associated with the August 13-14, 1940 storm, and the fast-growing population primarily at risk from other slope movements. The intent of the landslide hazard mapping program is to provide the public, local government, and local and state emergency agencies with a descript ion and location of areas where slope movements have occurred, or are likely to occur, and the general areas at risk from these slope movements. The locations of previous slope movements are important because they often reoccur in the same general areas. This mapping is not intended to be a substitute for a detailed, onsite analysis by a qualified geologist or engineer.

The slope movement hazard map series for Watauga County consists of four maps (Geologic Hazards Map Series 3 (GHMS-2), Sheets 1, 2, 3, and 4) designed to be used in conjunction with each other. This map is Sheet 1. The accompanying maps are: Sheet 2, Stability Index Map of Watauga County, North Carolina; Sheet 3, Map of Known and Potential Debris Flow Pathways in Watauga County, North Carolina; and Sheet 4, Map Showing the Zone of Potential Rock Slope Instability with the Generalized Bedrock Geologic Compilation.

Slope Movements and Slope Movement Deposits Map (Geologic Map Series 3, Sheet 1)

This map consists of point and polygon dat a derived from the North Carolina slope movement -slope movement deposit (SM-SMD) database, and is color-coded by entry type (slope movement or slope movement deposit). Slope movements are classified in accordance with Cruden and Varnes (1996), with the exception of the term "blowout" which is classified according to Hack and Goodlett (1960). Definitions and descriptions of slope movements and slope movement deposits are given in the explanation section of the map. Individual point and polygon data types in cluded on the map are described below. New information or future mapping may identify slope movements and slope movement deposits not currently shown on this map.

1. **Slope Movement Initiation Zones.** These locations identify the initiation points of slope movements derived from the SM-SMD database. Data points are color-coded by type of slope movement (process) or slope movement deposit (deposit). NCGS staff conducted detailed studies at six debris flow initiation zones identified on the map.

2. **Recent Debris Flow Tracks.** These polygons outline the areal extent of relatively recent individual slope movements. NCGS staff delineated the outlines from field investigations, and features visible in 1940, 1993, 1998 aerial imagery, and 2005 orthophotography. Approximately 3% of the mapped tracks are from debris flows triggered by the remnants of Hurricanes Frances and Ivan in September 2004. NCGS staff delineated tracks from the August 13-14, 1940 storm primarily from 1940 aerial photographs.

3. **Slope Movement Deposits.** These polygons outline the areal extent of slope movement deposits (e.g., debris fans, block fields, talus, etc.). NCGS staff delineated the approximate outlines of deposits primarily from the LiDAR (Light Detecting And Ranging)-digital elevation model (DEM), field investigations, other published geologic maps (listed in the "Sources of Information" section), and, to a limited extent, aerial photography. The resulting map shows where significant volumes of composite deposits have accumulated in the area from multiple processes such as debris flows, debris slides, and rock falls. Most mapped deposits are likely prehistoric, but this is yet to be verified by modern age-dating techniques. Field verified deposits indicate where slope movement deposit m aterial was confirmed at one or more locations within the delineated polygon.

4. **Slow Moving Debris-Weathered Rock Slides.** These polygons delineate the areal extent of known, active, slow- to very slow-moving translational and/or rotational slides that have developed in deep (usually >10 ft or 3 m thick) debris deposits, and/or highly weathered bedrock (partly- to completely-decomposed bedrock as defined by Williamson (1984). NCGS staff delineated these features from field investigations, GPS mapping techn iques, the LiDAR DEM, and aerial and satellite imagery. Designation of these slides as active was made using field criteria such as the presence of leaning and curved trees, unvegetated scarps, and reported and observed damage to man–made structures. Movement rates of these slides appear to be on the order of inches to feet (i.e., centimeters to meters) per year or less, but may vary considerably depending on a number of factors including seasonal rainfall patterns and ground disturbing activities such as excavations. The slow to very slow moving velocity classifications used here are in accordance with Cruden and Varnes (1996).

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