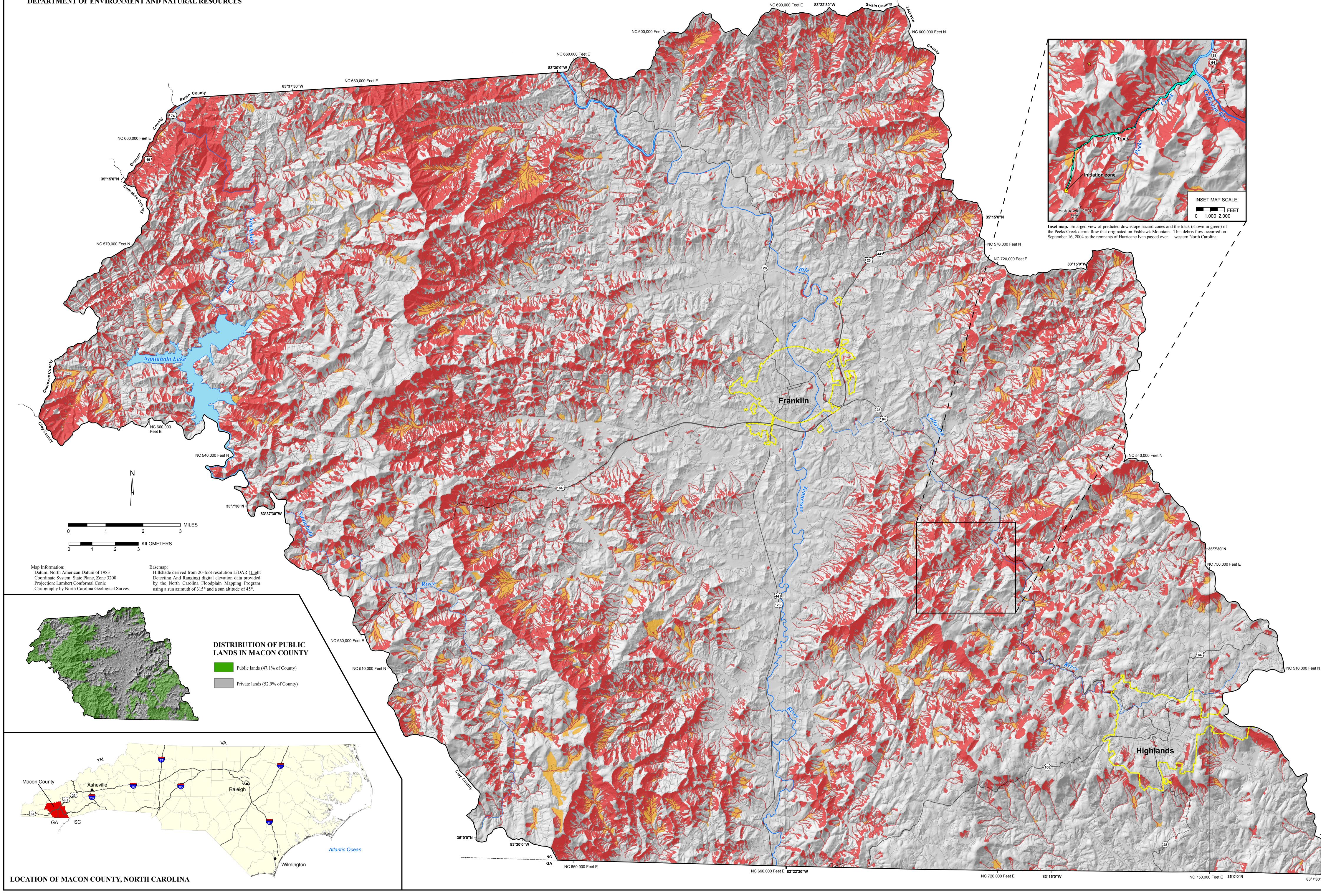


NORTH CAROLINA GEOLOGICAL SURVEY **DIVISION OF LAND RESOURCES** DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES



DOWNSLOPE HAZARD MAP OF MACON COUNTY, NORTH CAROLINA

FOR SHALLOW TRANSLATIONAL SLOPE MOVEMENTS

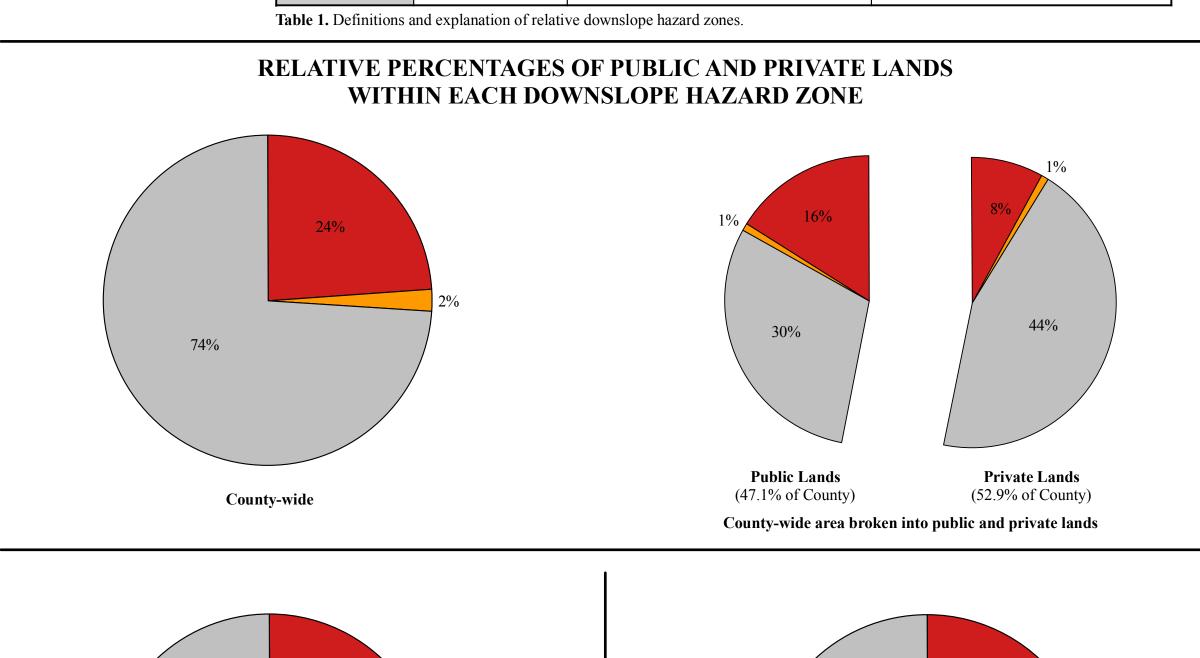
Richard M. Wooten, Rebecca S. Latham, Anne C. Witt, Stephen J. Fuemmeler, Kenneth A. Gillon, Thomas J. Douglas, and Jennifer B. Bauer

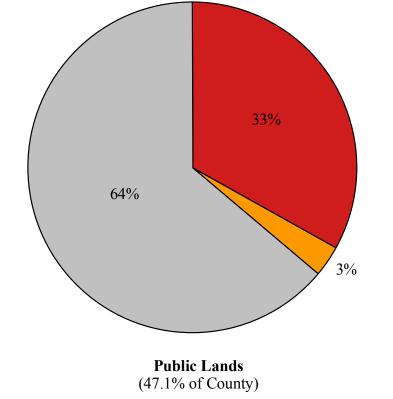


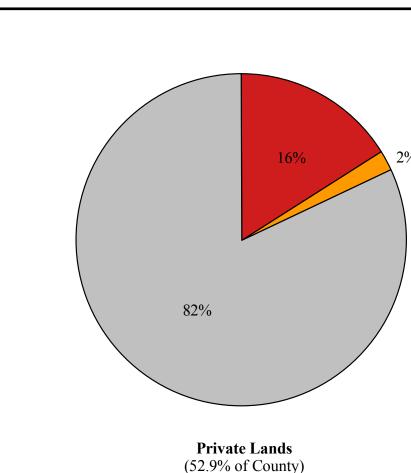
GEOLOGIC HAZARDS MAP SERIES 1

SLOPE MOVEMENT HAZARD MAPS OF MACON COUNTY, NORTH CAROLINA SHEET 3 OF 3

EXPLANATION MAP FEATURES Relative Downslope Map Color Code Description Comments Hazard MAP SYMBOLS Areas in the predicted flow paths of possible Slope movements that initiate on modified Roads debris or earth slides and flows that intiate in slopes within these high hazard zones may the unstable and upper threshold stability Primary Roads so follow similar flow paths. zones of the Stability Index Map (Sheet 2). Secondary Roads reas within the boundaries of mapped slope Unconsolidated slope movement deposits Rivers Moderate movement deposits that are not included in can be unstable when over-steepened by Major Rivers the high hazard zones. excavations or stream erosion. Minor Rivers he hazard in these areas is considered low Municipal boundaries Areas outside of the predicted flow paths of unmodified slopes, however slope \sim Low debris or earth slides and flows or mapped movements may result from slope slope movement deposits.







exists for slope movement deposits because they typically consist of deep, unconsolidated

Low Hazard Zones. Low hazard downslope zones are those areas outside of the

predicted flow paths of potential debris/earth slides and flows, and mapped slope movement deposits. There is a low likelihood of damage in this area from slope

movements that originate from outside of this area. Slope movements may result from the

2. high hazard areas of the Stability Index Map (GHMS-1, Sheet 2).

following step in the process computationally feasible.

. outlines of slope movements (debris flow tracks) and slope movement deposits

from the Slope Movement and Slope Movement Deposit Map (GHMS-1, Sheet 1);

The following sequential steps outline the method used to produce the Downslope Hazard

Map on a 20-ft (6-m) LiDAR (Light Detecting And Ranging)-derived elevation model

1. All high hazard areas from the Stability index Map (GHMS-1, Sheet 2) were

2. These high hazard zones were reduced to include only those with contiguous areas ≥ 0.25 acres (10,893 ft² or 1,012 m²). This reduction was needed to make the

3. Hydrologic flow paths based on topographic gradients were then created in

. Flow paths were terminated once they encountered slope gradients less than three

degrees. Three degrees was selected as a nominal gradient consistent with the

lowermost downslope extent of most slope movement deposits and tracks

delineated in the accompanying Slope Movement and Slope Movement Deposit

. These flow path widths were then buffered to 33 ft (10 m) on each side to delineate

6. Known slope movement outlines (e.g., recent debris flow tracks) were added to these downslope hazard zones to produce the high downslope hazard class.

Extensive manual map editing was required to adjust the downstream extents of the high hazard zones in order to preserve flow path continuity and terminate unrealistic flow paths

1. Flow paths with gaps occurring within the areal extent of mapped slope movement

4. Flow paths were arbitrarily terminated at lake boundaries (where LiDAR elevation

5. Flow paths that originated at the toes of slopes were limited in their downstream

3. Flow paths that traveled along a floodplain or along a road were terminated.

where warranted. These adjustment procedures are outlined as follows.

2. Flow paths with gaps of 98 ft (30 m) or less were connected.

the downslope hazard zones. This buffer approximates the average track width of

hazard areas (using a 20-ft or 6-m grid was not computationally feasible).

ArcGISTM from points placed on a 39.4-ft (12-m) grid constructed from these high

designated as the most likely slope movement source areas for the downslope

excavations, and in areas over-steepened by stream erosion.

The Downslope Hazard Map is derived from two sources:

modification of slopes in low hazard zones.

Map Production

hazard zones.

Map (GHMS-1, Sheet 1).

deposits were connected.

data are absent).

extent.

mapped debris flows in Macon County.

accumulations of clay- to boulder-sized material that can be unstable in high, steep-sided

OVERVIEW OF THE DOWNSLOPE HAZARD 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. Macon County was selected as the first county to be mapped because of the fatalities caused by a debris flow and the fast-growing population potentially 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 description 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 predictive 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 Macon County consists of three maps, Geologic Hazards Map Series 1 (GHMS-1) Sheets 1, 2 and 3, designed to be used in conjunction with each other. This map is GHMS-1, Sheet 3. The accompanying maps are: GHMS-1, Sheet 1, Slope Movement and Slope Movement Deposit Map of Macon County, North Carolina; and, GHMS-1, Sheet 2, Stability Index Map of Macon County North Carolina.

Downslope Hazard Map (Geologic Hazards Map Series 1, Sheet 3).

This color-coded map, the Downslope Hazard Map (GHMS-1, Sheet 3), portrays areas designated as high, moderate, or low hazard zones that could potentially be affected by shallow, translational slope movements (i.e., debris/earth slides and flows). Definitions of all slope movement types mapped are given on GHMS-1, Sheet 1. The Stability Index Map (GHMS-1, Sheet 2) shows areas where shallow translational slope movements are more likely to originate in response to a 5-inch (125-mm) or greater recharge event within a 24-hour period. A 5-inch (125-mm) recharge event is approximately equivalent to a 5-6inch (125-154-mm) rainfall event. The Downslope Hazard Map delineates areas likely to be in the path of these slope movements, including areas significantly further downslope from where the slope movements originate. Table 1 shows the color codes used on the map with explanations that correspond to the high, moderate and low hazard zones. The Downslope Hazard Map is intended to indicate the distribution of high and moderate

downslope hazard areas where further slope stability analysis, including field verification, is recommended prior to siting facilities or undertaking ground disturbing activities in these locations.

Relative Hazard Rankings

High Hazard Zones. Areas that lie within the predicted flow paths of potential debris/earth slides and flows that initiate in the unstable and upper threshold predicted stability zones of the Stability Index Map (GHMS-1, Sheet 2). Slope movements that initiate on modified slopes within these high hazard zones may also follow similar flow naths

Moderate Hazard Zones. Areas mapped as slope movement deposits outside the predicted flow paths are designated as moderate downslope hazard zones. Debris/earth slides and flows are more likely to affect the topographically lower portions of these deposits that have been incised by streams rather than topographically higher portions of the deposits. Because slope movements have previously deposited material at these locations, future slope movements could also affect these areas. Another potential hazard

The North Carolina Geological Survey would like to thank Macon County Emergency

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Development. Special thanks go to the residents of Macon County for their willingness t o

provide information and property access. The North Carolina Department of Transportation - Geotechnical Engineering Unit; the North Carolina Floodplain Mapping

Program, and the U.S.D.A. Forest Service provided much useful data and assistance.

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DISCLAIMER OF LIABILITY

The Hurricane Recovery Act of 2005 (Section 6) directs the Department of Environment USE OF THESE MATERIALS CONSTITUTES ACCEPTANCE OF THIS and Natural Resources (DENR) to ensure that maps indicating areas vulnerable to DISCLAIMER OF LIABILITY. Therefore, the users must be aware of data conditions landslides be made available for the 19 counties included in the Major Disaster and bear responsibility for the appropriate use of the information with respect to possible Declarations for Hurricanes Frances and Ivan.

The North Carolina Geological Survey was tasked to prepare those maps and is committed to providing users with accurate, useful and current information. All electronic and/or hardcopy products (maps, data, text, etc.) produced by this landslide hazard mapping or profits; or business interruption) however caused and on any theory of liability, whether program are considered public information and may be redistributed and/or copied. These in contract, strict liability, or tort (including negligence or otherwise) arising in any way products, however, are intended to serve for general planning purposes only, and are out of the use of these data, even if advised of the possibility of such damage. provided on an "as is" basis. These maps and products do not substitute for an on-theground site assessment by a qualified geologist or engineer.

Analysis, DENR.

errors, original map scale, collection methodology, currency of data, and other conditions specific to certain data. In no event shall DENR or its employees be liable for any direct, indirect, incidental, special, exemplary, or consequential damages (including, but not limited to, injuries or death; procurement or substitute goods or services; loss of use, data,

