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**Coastal Plain Scarps of the  
Neuse River Basin, North Carolina  
as Delineated by R. B. Daniels**

**A New GIS Coverage**

**Ground Water Circular Number 18**

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SECTION 1

*Introduction*

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OCCURRENCE OF SCARPS

The Coastal Plain of North Carolina consists of a series of low-relief plains rising in elevation from east to west, each separated from the next by a relatively abrupt scarp 5 to 10 meters high and with slopes 0.5% to 2%. Each scarp represents the former position of a marine, estuarine, or riverine shoreline during a stillstand of sea level. Each plain locally represents either a former seafloor seaward of a scarp or a surface formed by deposition of sediments in rivers and estuaries.

MAPPING OF SCARPS

During the 1960s and 1970s a team of federal and state scientists mapped the topographic expressions of major scarps found in the Coastal Plain of the Neuse River Basin. Limited mapping was also done outside the basin. The results of this scarp mapping were never published as an inclusive document.

OUTLINE OF REPORT

Recently the Groundwater Section (Division of Water Quality, N.C. Department of Environment and Natural Resources) began developing a ground water vulnerability map for the Neuse River Basin under a federal EPA Section 319 Nonpoint Source grant. Recognizing the importance of geomorphology to ground water issues in the Coastal Plain, the Section contracted with Dr. Ray Daniels, the team member responsible for the original scarp mapping, to transfer his mapping to modern topographic maps for digitizing into the Section's geographical information system (GIS). This report summarizes the original scarp mapping effort, explains how the new GIS coverage was created, describes the new coverage, and discusses some features of the scarps and plains found in the Neuse River Basin.

*IMPORTANCE OF SCARPS*

Scarps and plains of the Coastal Plain are important to consider in environmental studies because the pattern of sediment deposition with respect to scarps during past sea level fluctuations influences patterns of soil properties and surficial aquifer materials. Additionally, because the plains have different histories, the degree of weathering and erosion of each plain is unique, resulting in unique geomorphologic and hydrologic characteristics.



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SECTION 2

## *Background*

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*HISTORICAL INVESTIGATIONS*

During the early part of the 1900s, Coastal Plain investigators in North Carolina established the presence of several gently sloping plains separated by seaward facing scarps. However, the exact ground location of the scarps was difficult to establish because the published maps of that period were generalized and usually did not show topographic contours. Despite the short time allowed for study and the lack of detailed topographic maps, the earlier workers (e.g., Shattuck 1901; Johnson 1907; Stephenson 1912; Cooke 1930) accurately identified the major scarps and their general toe altitudes. The accuracy of this early mapping is impressive, particularly the mapping by the earliest scientists who had little ground control and few reliable contour maps.

*USDA/NCSU STUDY*

In 1960 the U. S. Department of Agriculture (USDA), in cooperation with the North Carolina State University (NCSU) Soil Science Department, initiated a cooperative study of the soils and geomorphology of the North Carolina Coastal Plain, primarily in the Neuse River Basin. The study was active from 1960 to 1977. The study approach was to map the surficial stratigraphy, geomorphology, and soils in a few detailed areas and then extend the data through reconnaissance mapping of geomorphology. R.B. Daniels, E.E. Gamble, Walter H. Wheeler and W.D. Nettleton did the fieldwork, with support and consultation from Ralph McCracken and Stanley Buol of the NCSU Soil Science Department.

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BACKGROUND

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*HOW SCARPS WERE IDENTIFIED*

The scientists identified scarps in the field based on earlier investigations and on visible breaks in topographic slope that could be traced across the landscape at a relatively consistent elevation. Identification of scarps was difficult in the dissected upper and middle Coastal Plain.

*HOW SCARPS WERE MAPPED*

Several publications generated from the soil-geomorphic study (e.g., Daniels et al. 1966a, 1966b, Daniels and Gamble 1974) showed the general location of the seaward-facing scarps. These maps were developed from field reconnaissance, with the locations plotted on available 1-degree by 2-degree, 7.5-minute and 15-minute quadrangle sheets. Scarps were also plotted on uncontrolled county aerial photographic-mosaics used by the USDA in county soil surveys. These original materials are stored at the North Carolina Geological Survey Coastal Plain Office and Repository.

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SECTION 3

## *Creation and Release of New Coverage*

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TRANSFER TO NEW BASEMAPS

In 1998 the Groundwater Section, under an EPA Section 319 Nonpoint Source grant, funded the development of a new digital coverage of the original scarp mapping. The first author (Daniels), who performed the original mapping, transferred his original scarp delineations by hand to new 7.5-minute topographic maps. He classified the transferred scarp lines by level of confidence in scarp locations as high, low, or very low confidence, depending on clarity of the scarp in the field and on the topographic map. Jonathan Beck of the Groundwater Section then digitized the scarp lines from the 7.5-minute topographic maps and added attributes for each segment's scarp name, confidence level, location, and the 7.5-minute quadrangle in which each segment lies. Using GIS software, the digitized lines were overlaid on digital 7.5-minute topographic maps and edited on-screen for accuracy of location and attributes.

AVAILABILITY OF COVERAGE

This new digital coverage of Coastal Plain scarps in the Neuse River Basin and surrounding areas is available to government agencies, researchers, students, and interested members of the public. The new coverage is titled "Coastal Plain Scarps of the Neuse River Basin" and is distributed by the North Carolina Center for Geographic Information and Analysis (CGIA). To obtain this coverage, contact:

NC CGIA  
301 N. Wilmington St., Suite 700  
Raleigh, NC 27601-2825  
phone: (919) 733-2090  
E-mail: [dataq@cgia.state.nc.us](mailto:dataq@cgia.state.nc.us)  
Web: <http://cgia.cgia.state.nc.us:80/cgia/>



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SECTION 4

## *Description of New Coverage*

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IDENTIFICATION AND LOCATION  
OF SCARPS

Six Coastal Plain scarps were originally mapped in the Neuse Basin and are included in the coverage: the Suffolk, Walterboro, Surry, Kenly, Wilson Mills, and Coats\* (commonly called the Orangeburg). Figure 1 shows the distribution of these scarps. The entire extent of the Suffolk and Surry scarps in North Carolina, as mapped by Daniels, is reflected in the new coverage. Only those portions of the Walterboro, Kenly, Wilson Mills, and Coats Scarps that fall within or near the Neuse Basin are included in the coverage. The Suffolk Scarp was not extended south of the Neuse River because the slope breaks identifying the scarp were not sufficiently distinct in this area. However, an extension of this scarp south of the Neuse River is shown on the Geologic Map of North Carolina (NCGS 1985).

SCARP TOE MAPPED IN COVERAGE

Each line in the coverage represents the uneroded toe, or lower inflection point, of a scarp as determined by Daniels (Figure 2). The elevation of the scarp toe is relatively constant along the length of the scarp, usually varying by only 1 to 2 meters. The elevation of the Wilson Mills Scarp, however, ranges from about 73 meters (240 feet) just south of the Tar River to about 61 meters (200 feet) south of the Neuse River. In places where an inflection point marking the toe of the scarp is not apparent, the local elevation of the toe was traced and that segment of the scarp was assigned low or very low confidence. Each scarp's approximate toe elevation is shown in Table 1.

**Table 1. Approximate Toe Elevations of Scarps of the North Carolina Coastal Plain**

<i>Scarp:</i>	<i>Coats</i>	<i>Wilson Mills</i>	<i>Kenly</i>	<i>Surry</i>	<i>Walterboro</i>	<i>Suffolk</i>
Toe Elevation (MSL)	84 m (275 ft)	75 m (245 ft)	45 m (148 ft)	29 m (95 ft)	14 m (45 ft)	6 m (20 ft)

\* The Coats scarp was named by Daniels for the town of Coats, N. C., the locality where it was first identified. Although the suggestion by Daniels et al (1966b) that the Coats and the Orangeburg may be equivalent is generally accepted, later mapping of the Coats Scarp into South Carolina did not always agree with the toe elevation of the Orangeburg Scarp.

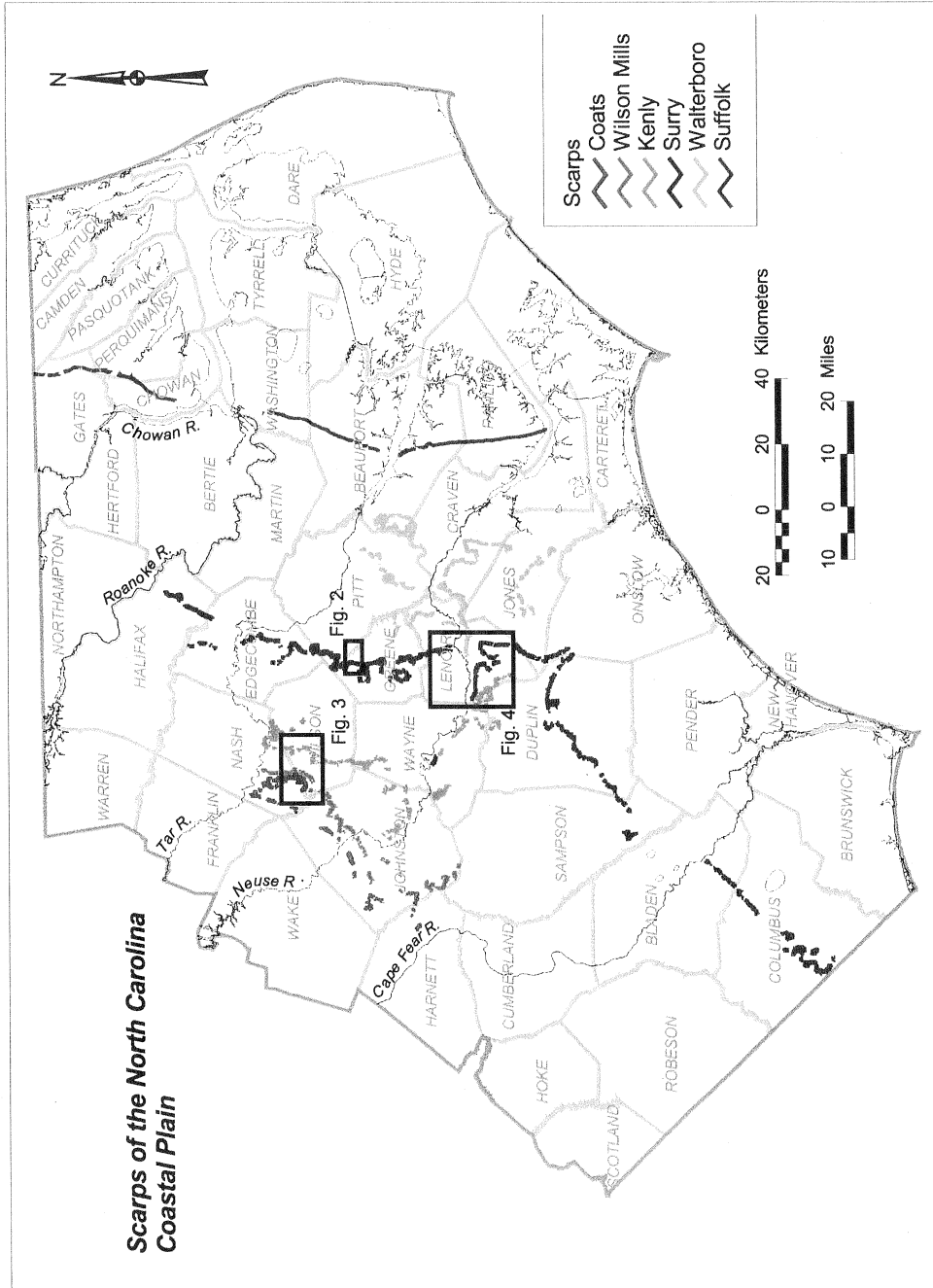


Figure 1. Distribution of scarps in the new GIS coverage. Areas shown in Figures 2 through 4 are indicated by labeled boxes.

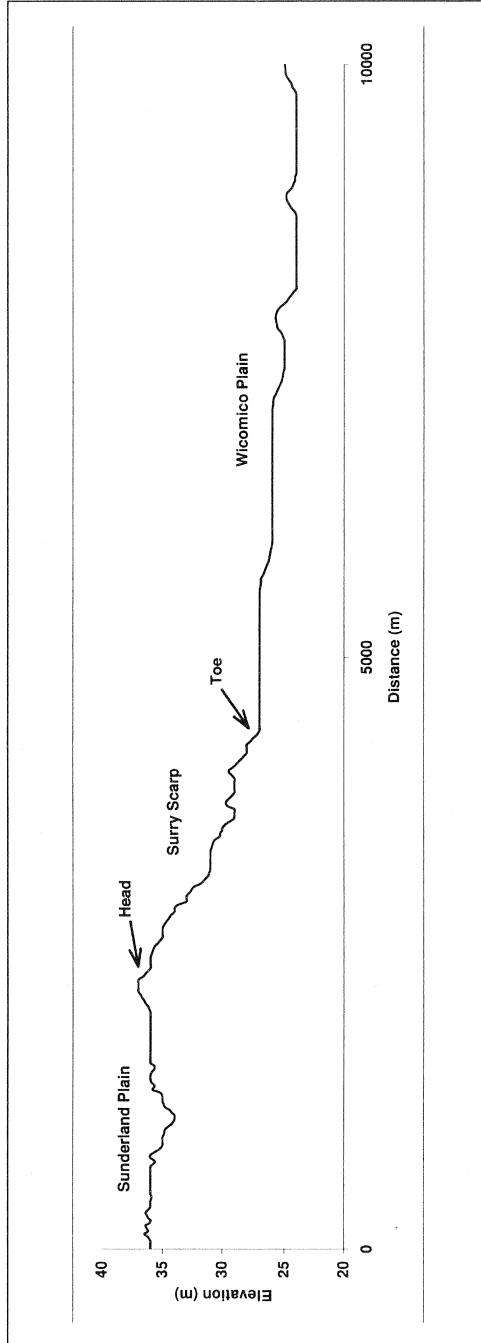


Figure 2. Topographic profile across the Surry Scarp near Snow Hill, NC showing scarp head and toe. Site location is shown in Figure 1.

## DISSECTION OF SCARPS

Each scarp has been eroded and dissected by drainage following the retreat of the sea from the scarp. Because scarps increase in elevation and age from east to west, the westernmost scarps are more dissected than the lower, easternmost scarps. Thus the Suffolk Scarp, the lowest, easternmost scarp, is nearly continuous throughout its length, interrupted only by major rivers, while the highest scarps, the Coats and Wilson Mills, are highly segmented, cut by both minor and major streams. Figure 3 illustrates the westward increase in dissection from the Kenly Scarp to the Wilson Mills and Coats scarps.

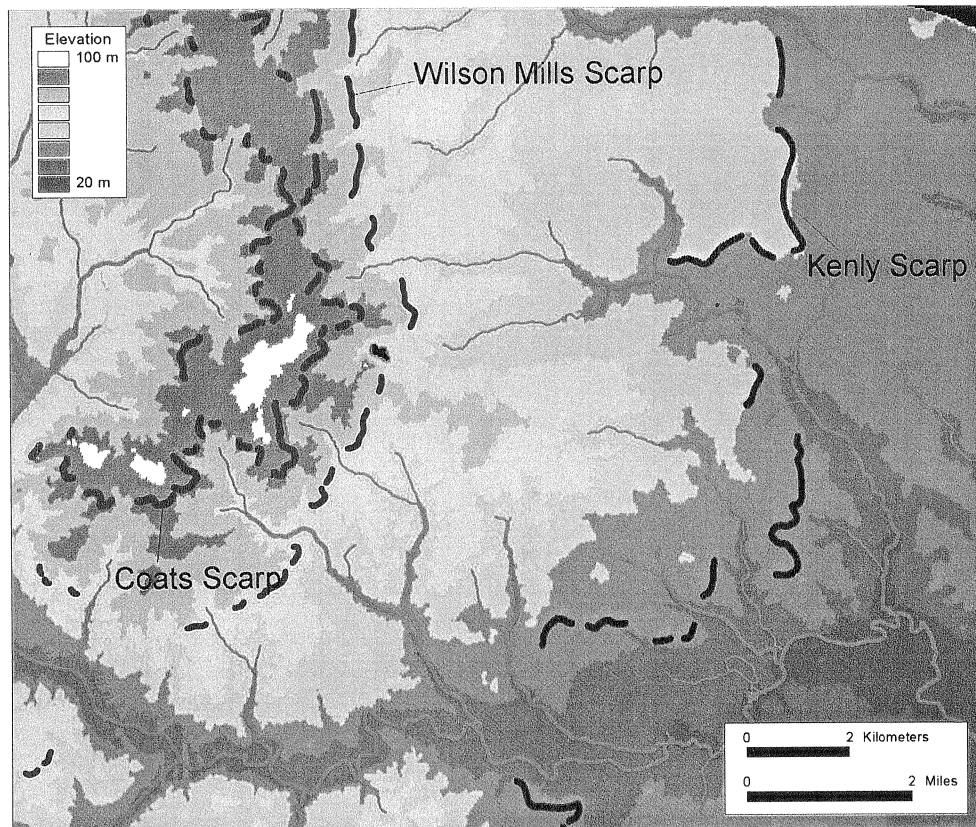
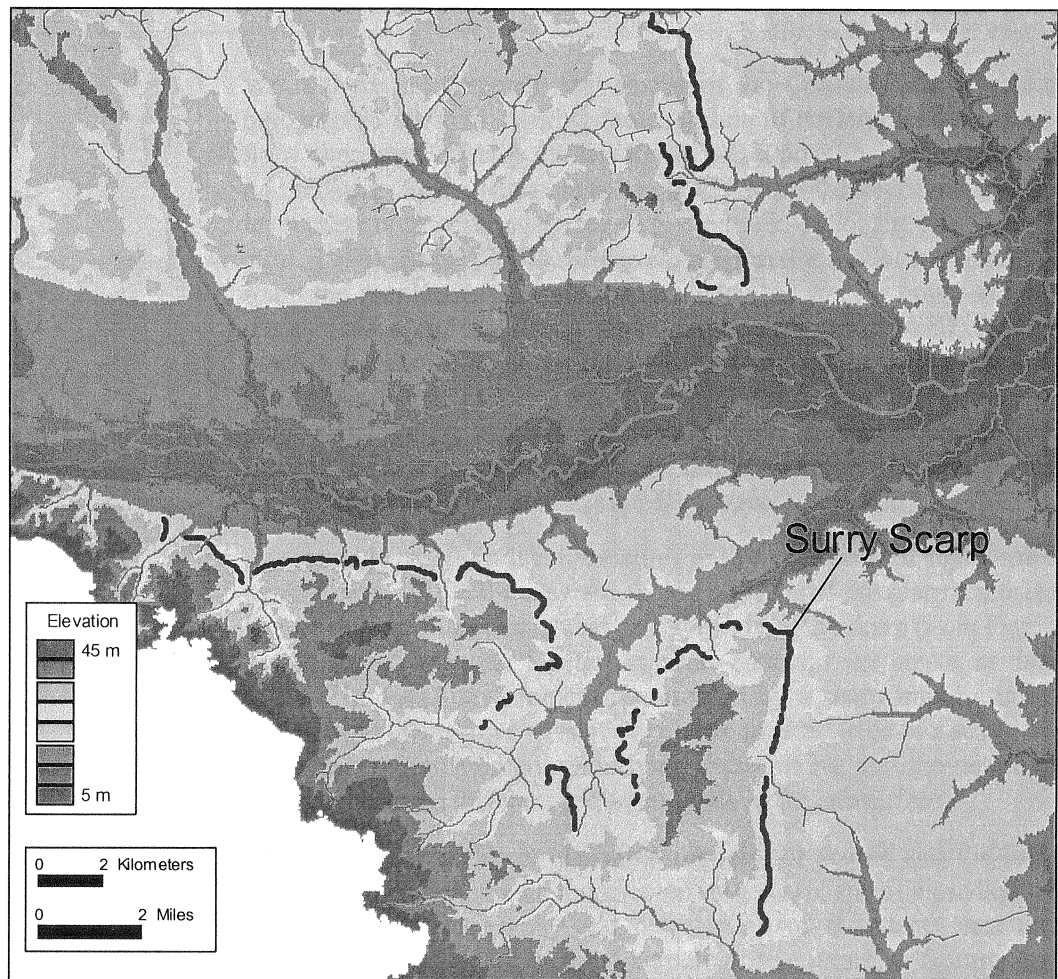


Figure 3. Detail of Coats, Wilson Mills, and Kenly Scarps along the Wilson/Nash county line showing increasing dissection. Site location shown in Figure 1.



*EMBAYMENTS OF SCARPS*

While each scarp is to some extent segmented by drainage dissection, it can also be traced up major river valleys. Figure 4 shows the Surry Scarp near Kinston, where the seaward facing scarp turns to parallel the Neuse River. The valley-parallel portion of the scarp can be traced several miles up the Neuse valley. Such valley-parallel embayments of a scarp represent former riverine or estuarine shorelines associated with the marine shoreline, represented by the seaward-facing portions of the scarp.



**Figure 4. Detail of Surry Scarp in Lenoir County, showing embayment of scarp up the Neuse River valley. Site location shown in Figure 1.**

al. (1966b), Daniels and Gamble (1974), Oaks and Coch (1963), and Kane (2001) for more information on the stratigraphic significance of scarps and plains.

*USE OF THE COVERAGE*

The Groundwater Section is using the new scarp coverage, in conjunction with GIS coverages of soils, digital elevation models, and other coverages, at basin-wide and local scales to better understand the distribution of hydrologic and hydrogeologic properties of the Coastal Plain portion of the Neuse River Basin. Outside of the Groundwater Section, it is anticipated that this coverage will serve as a reference for geologic and geomorphologic mapping and will help to increase the awareness of the importance of geomorphology of the Coastal Plain among researchers, agencies, and the general public.

*UNRESOLVED ISSUES*

The creation and release of this data should stimulate new interest and scientific discussion of the geomorphology of the Coastal Plain. Users of the new coverage should be aware that the extent and locations of Coastal Plain scarps in this coverage were determined by Daniels, not by the Groundwater Section. Daniels is recognized as a leading authority on geomorphology and soils of the Atlantic Coastal Plain, especially for his work on scarps, and it is for this reason that he was contracted to provide the source data for this coverage. However, the locations, extent, and interpretations of the scarps depicted in this coverage may still be debated among geomorphologists and coastal plain stratigraphers. In fact, it is hoped that the release of this coverage will re-invigorate such discussion.

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APPENDIX

## *Index of USGS 7.5 Minute Quadrangles Covering Scarps*

OVERVIEW

This Appendix identifies the USGS 7.5 minute topographic maps that were used by Daniels in mapping the Coastal Plain scarps included in the coverage. Table 2 lists these maps by scarp and county. Figure 5 plots the geographic distribution of these maps.

**Table 2. USGS 7.5 Minute Quadrangles Used in Compiling New Coastal Plain Scarp Coverage**

<i>Scarp Name</i>	<i>Counties</i>	<i>USGS 7.5 Minute Quadrangles</i>
Coats	Hamnett, Johnston, Nash, Wilson	Bailey, Benson, Bunn E, Coats, Edmondson, Flowers, Lucama Middlesex, Powhatan, Stancils Chapel
Wilson Mills	Johnson, Nash, Wilson	Bailey, Dunn, Edmondson, Flowers, Four Oaks, Lucama, Peacocks Crossroads, Powhatan, Selma, Stancils Chapel
Kenly	Duplin, Johnston, Lenoir, Nash, Wayne, Wilson	Bailey, Deep Run, Four Oaks NE, Grantham, Kenly E, Lucama, NW Goldsboro, Princeton, Selma, SE Goldsboro, Williams, Wilson, Winstead Crossroads
Surry	Bladen, Columbus, Duplin, Edgecombe, Greene, Halifax, Jones, Lenoir, Onslow, Pitt, Sampson, Wayne	Beulaville, Chadbourn, Comfort, Council, Deep Run, Delway, Draughn, Emerson, Falkland, Falling Creek, Fountain, Goretown, Harrells, Hobgood, Kenansville, Kinston, Lake Waccamaw W, Nakina, Old Sparta, Pinetops, Pink Hill, Potters Hill, Rivermont, Rose Hill, Scotland Neck, Seven Springs, Snow Hill, SW Goldsboro, Tabor City E, Tarboro, Tomahawk, Walstonburg, Warsaw S, Whiteville
Walterboro	Beaufort, Craven, Greene, Jones, Lenoir, Pitt	Ayden, Comfort, Cove City, Deep Run, Dover, Ft. Barnwell, Gardnerville, Greenville SE, Grifton, Grimesland, Hackney, Hookerton, Jacksonville NE, Jasper, Kinston, Phillips Crossroads, Pollocksville, Rivermont, Trenton, Wilmar
Suffolk	Beaufort, Chowan, Gates, Pamlico, Perquimans, Washington	Arapahoe, Aurora, Bath, Bayboro, Blounts Bay, Center Hill, Cherry Point, Corapeake, Edenhouse, Hobbsville, Hoke, Pike Road, Pinetown, Plymouth, East, Sunbury, Valhalla

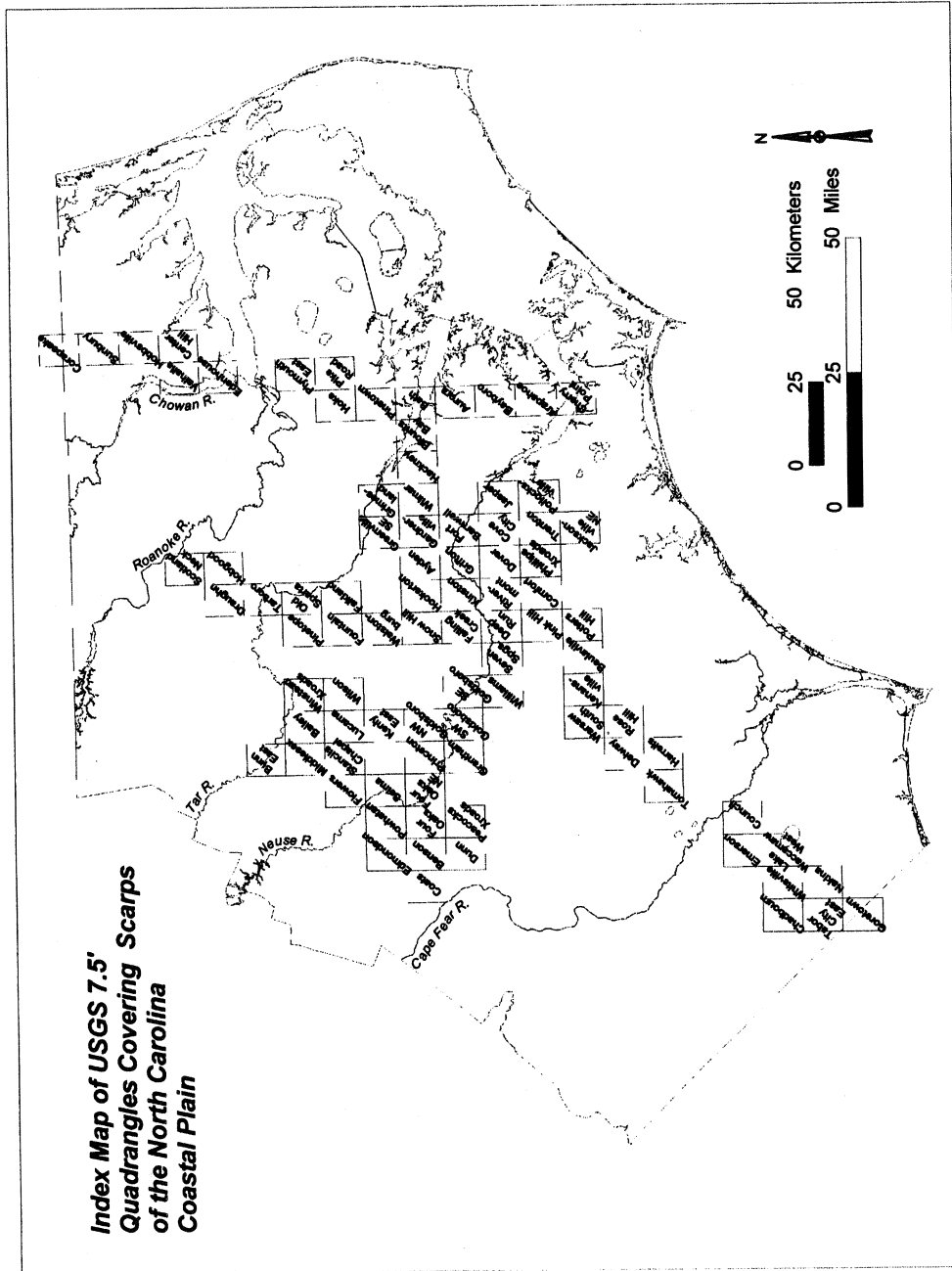


Figure 5. Index map showing location of USGS 7.5 minute quadrangles used in mapping scarps.