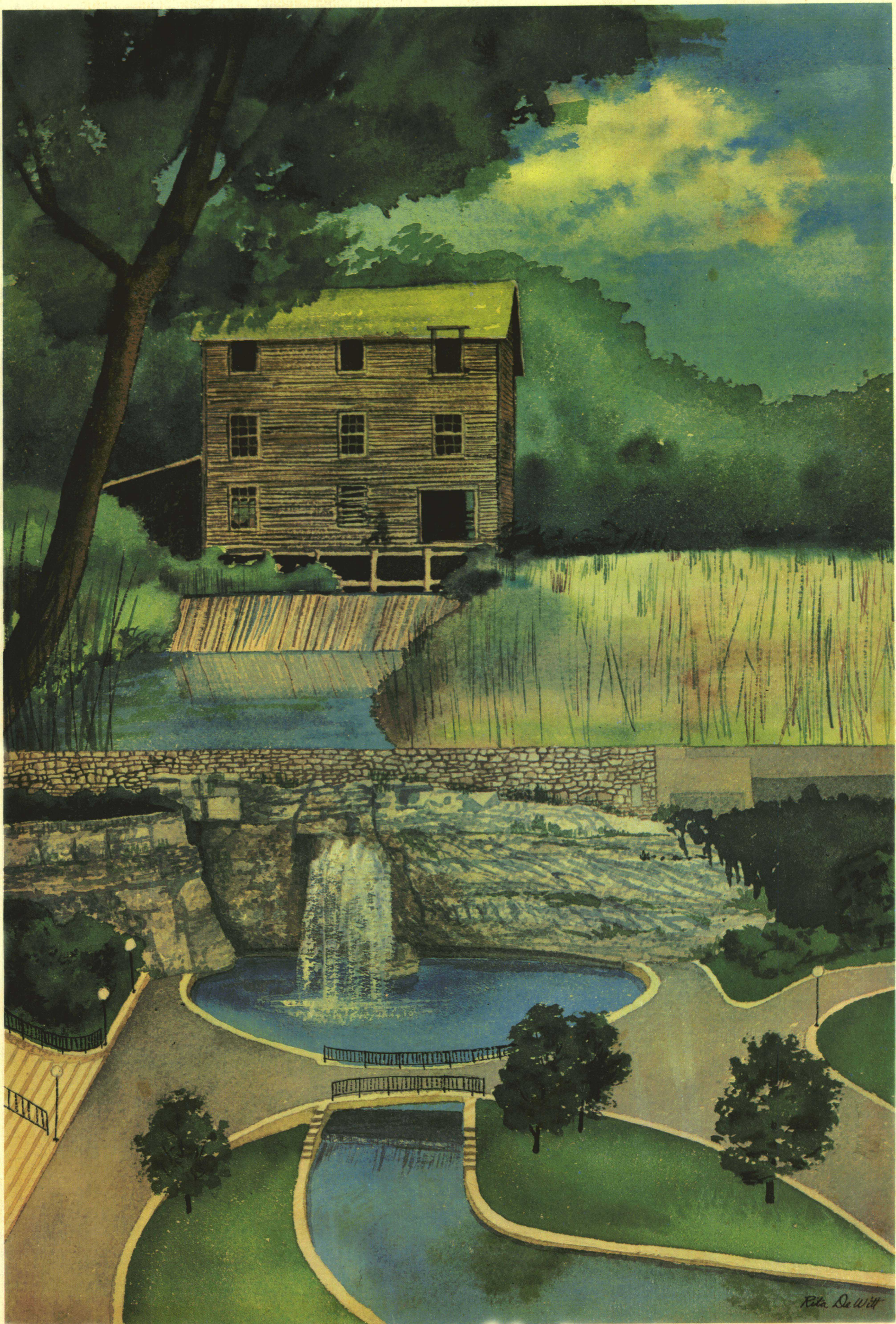
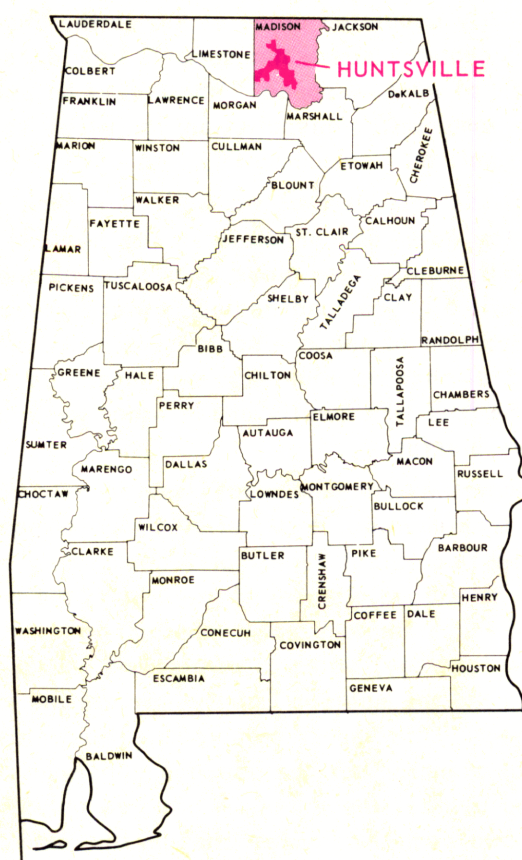


ENVIRONMENTAL GEOLOGY AND HYDROLOGY HUNTSVILLE AND MADISON COUNTY, ALABAMA



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GEOLOGICAL SURVEY OF ALABAMA
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ATLAS SERIES 8
UNIVERSITY, ALABAMA
1975



INTRODUCTION

The Huntsville and Madison County area is in north Alabama, in the rapidly developing Tennessee Valley. Its continued growth will require orderly planning and development to maintain a desirable environment for all its residents.

An understanding of the physical environment is a necessary basis for such planning. An expanding population uses the land and its natural resources at an increasing rate, and as a consequence the earth's natural systems may become overloaded and may be unable to accommodate the stresses imposed on them by man's actions. If use of the land is based on knowledge of its natural constraints, resources, and analyses of the effects of man's activities on it, measures can be taken to offset any potentially adverse effects. The geologic and hydrologic environment of Huntsville and Madison County are presented in this atlas clearly and graphically taking into consideration the land's resources, natural constraints, and areas where certain activities could have impact on the environment. By becoming informed of their natural environment all citizens are better equipped for grass-roots participation with their elected representatives in guiding the development of their community.

This report deals first with fundamental aspects of the natural environment—topography, climate, geology. Succeeding parts cover the applied fields of mineral and energy resources. Basic and applied aspects of hydrology are presented in the water resources section. The land use section includes illustrations of specific ways that geology and hydrology can be applied in development and planning.

This study was made in cooperation with, and supported by, funds from the city of Huntsville, Madison County, the University of Alabama in Huntsville, the U.S. Geological Survey, and the Geological Survey of Alabama. Over the 5-year period of operations, several technical divisions of the Geological Survey of Alabama and the Water Resources Division of the U.S. Geological Survey worked together in providing technical expertise. During the last 3 years the project was directed from the North Alabama Region office of the Geological Survey of Alabama in Huntsville, allowing for better recognition of the community's needs and for immediate application of the results of the study.

This report presents much new information, some that is already published in atlases on specific areas within the county—the Madison, Maysville, Meridianville, and Triana areas, and some from earlier technical reports. The basic geologic and hydrologic data on which this report is based are available to engineers, architects, planners and others in a separate report. Large-scale maps from which many of the atlas' maps were made can be studied in Survey offices.

Evaluation of all technical data indicates that water, soil, limestone, and living space are the most important natural resources in Madison County and that the few constraints on use of the land are well defined. Careful development can maximize natural attributes permitting Huntsville and Madison County to accommodate industry, agriculture, and other activities, while allowing all residents to live in an unspoiled environment.

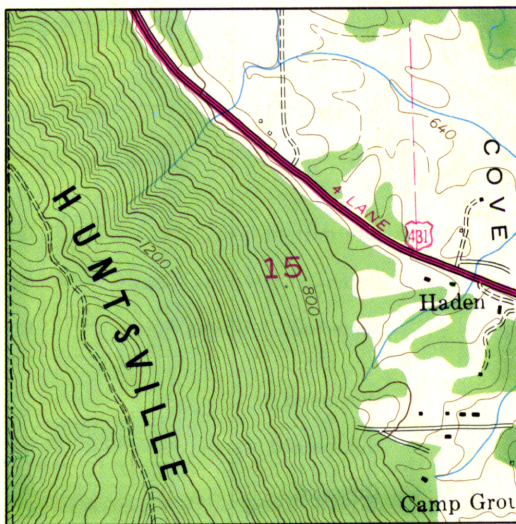
TOPOGRAPHY



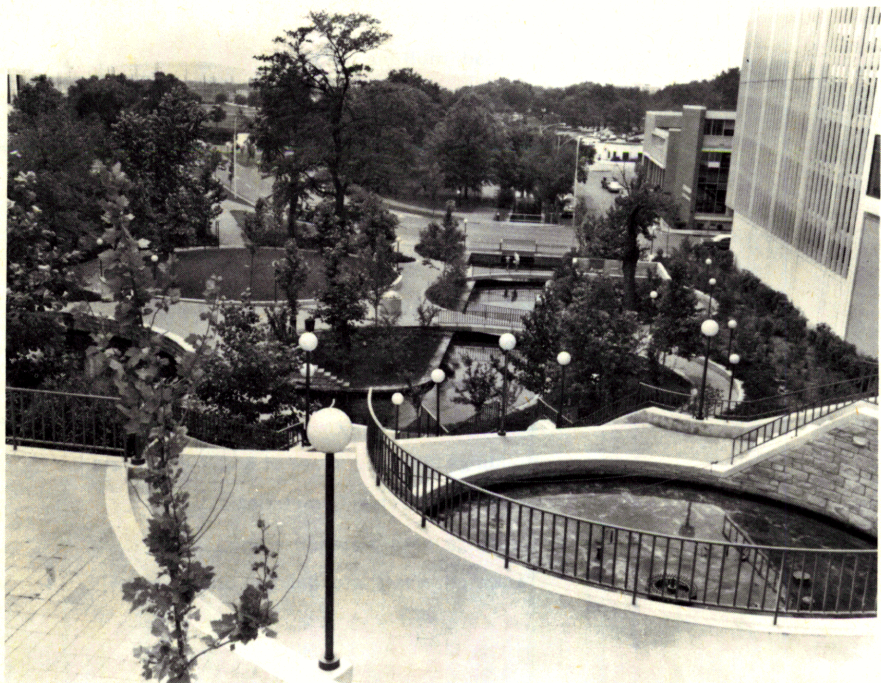
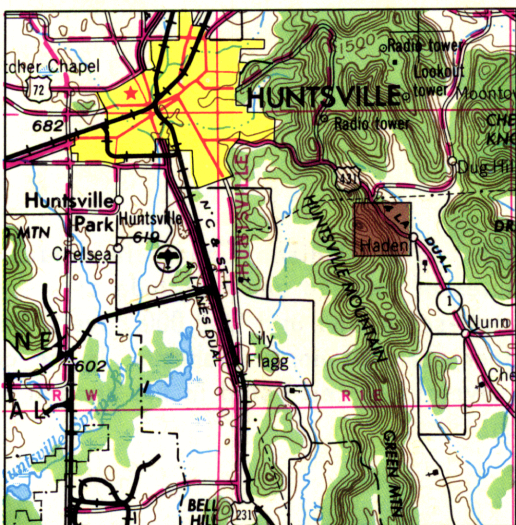
The shape of the land surface is basic to our use. Since the early days of civilization, hills, plains, valleys, and streams have influenced Man's activities.

When John Hunt came to the Huntsville area in the early 1800's, he recognized the relatively flat, fertile land and the steady flow of water from Big Spring as good reason to settle here. He probably chose the bluff above Big Spring as a site for his cabin because it helped provide a breeze and a vantage point over the valley below.

1: 24,000 scale
1 inch = 2000 feet
Area shown
1 square mile



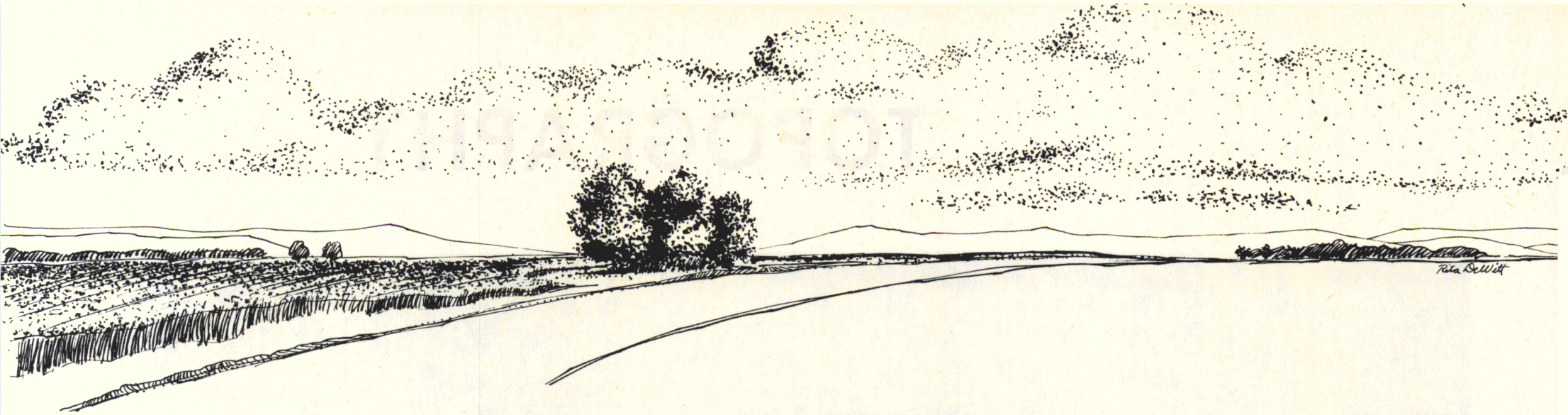
1: 250,000 scale
1 inch = nearly 4 miles
Area shown
107 square miles



As other settlers joined John Hunt a small self-contained community that used the Tennessee River and other streams for trade routes developed. Today the same natural features—shape and fertility of the land, water availability, and transportation—combine with mineral and human resources to form the basis for the growth and prosperity of Huntsville and Madison County.

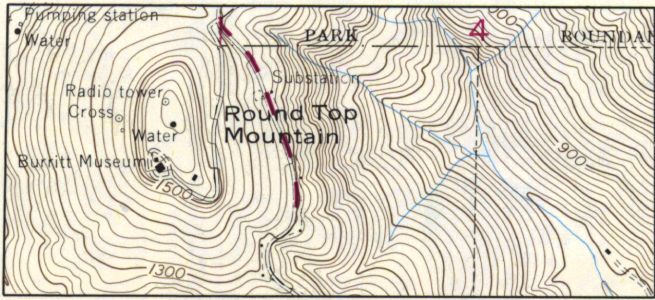
Land use is based partly on the shape of the land; consequently, topographic maps similar to the ones here are essential aids in evaluating the land.

Topographic maps depict the shape of the land. The map is drawn at a scale written as a fraction so that a unit of distance on the map equals a stated number of the same units on the ground. A scale of 1/24,000 can be read as one inch equals 24,000 inches or 2,000 feet. Smaller scale maps such as 1/250,000 cover larger areas within the same printed space. The largest maps of Madison County in this atlas are at a scale of about 1 to 185,000. Scales are shown graphically so that distances can be measured directly on the map. Orientation of the maps is such that north is toward the top of the page, unless indicated otherwise.



Contour lines and symbols are essential parts of a topographic map. The outlines and elevations of the landforms are shown by means of contour lines connecting points of equal elevation on the land. Regular vertical intervals between contour lines are chosen and the lines are labeled by elevation above mean sea level. In this way approximate elevation can be determined. Contour lines also indicate steepness of slope. The closer together they are, the steeper the slope. Furthermore, as a contour line is drawn across a gully or valley a V-shaped pattern develops with the V's pointing upstream.

Standardized symbols indicate natural and cultural features. Streams and other bodies of water are in blue, contours in brown, and man-made features in black or shades of red. Green is sometimes used to indicate vegetated areas. Commonly used symbols include these:

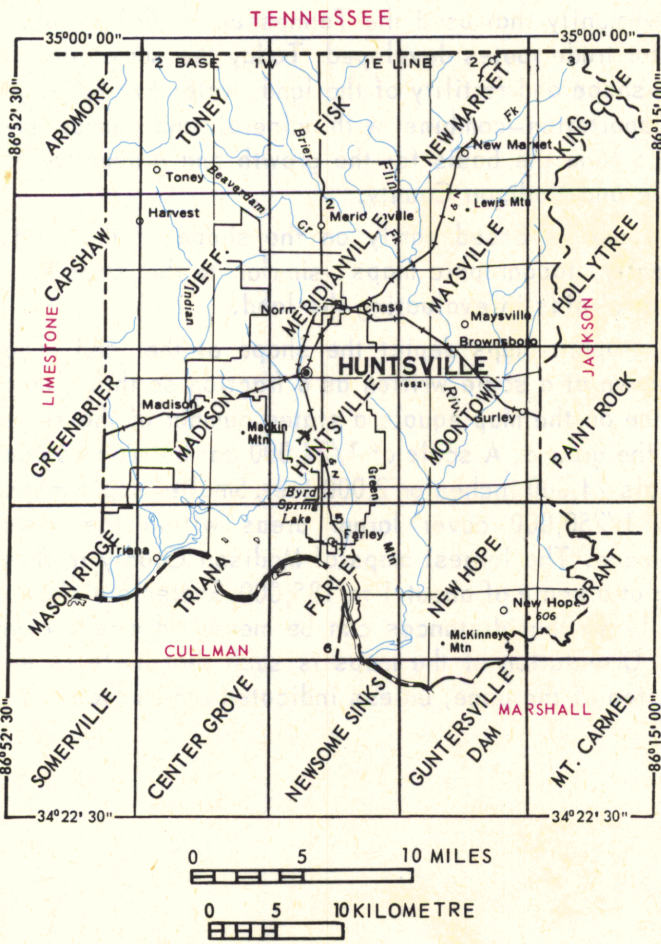


CONTOURS OUTLINING A HILL (ROUND TOP MOUNTAIN)
AND FORMING V PATTERNS ACROSS A VALLEY

TOPOGRAPHIC MAP SYMBOLS

Hard surface, heavy-duty road	—————
Hard surface, medium-duty road	—————
Improved light-duty road	—————
Unimproved dirt road	—————
Trail	—————
Railroad: single track	—————
Railroad: multiple track	—————
Bridge	—————
Overpass—Underpass	—————
Power transmission line with located tower	—————
Landmark line (labeled as to type)	TELEPHONE
Dam with lock	—————
Canal with lock	—————
Large dam	—————
Small dam: masonry — earth	—————
Buildings (dwelling, place of employment, etc.)	—————
School—Church—Cemeteries	—————
Buildings (barn, warehouse, etc.)	—————
Tanks; oil, water, etc. (labeled only if water)	—————

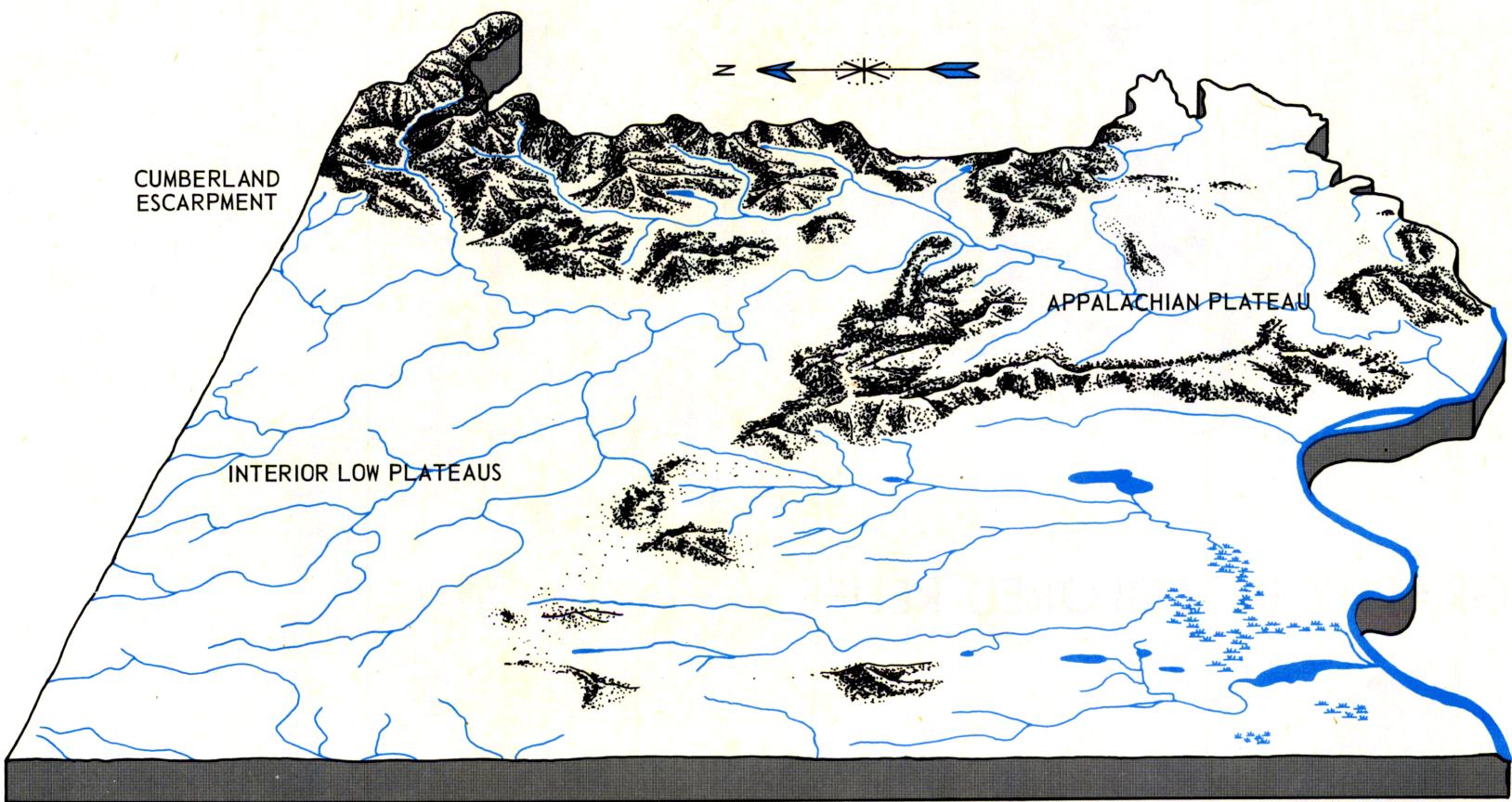
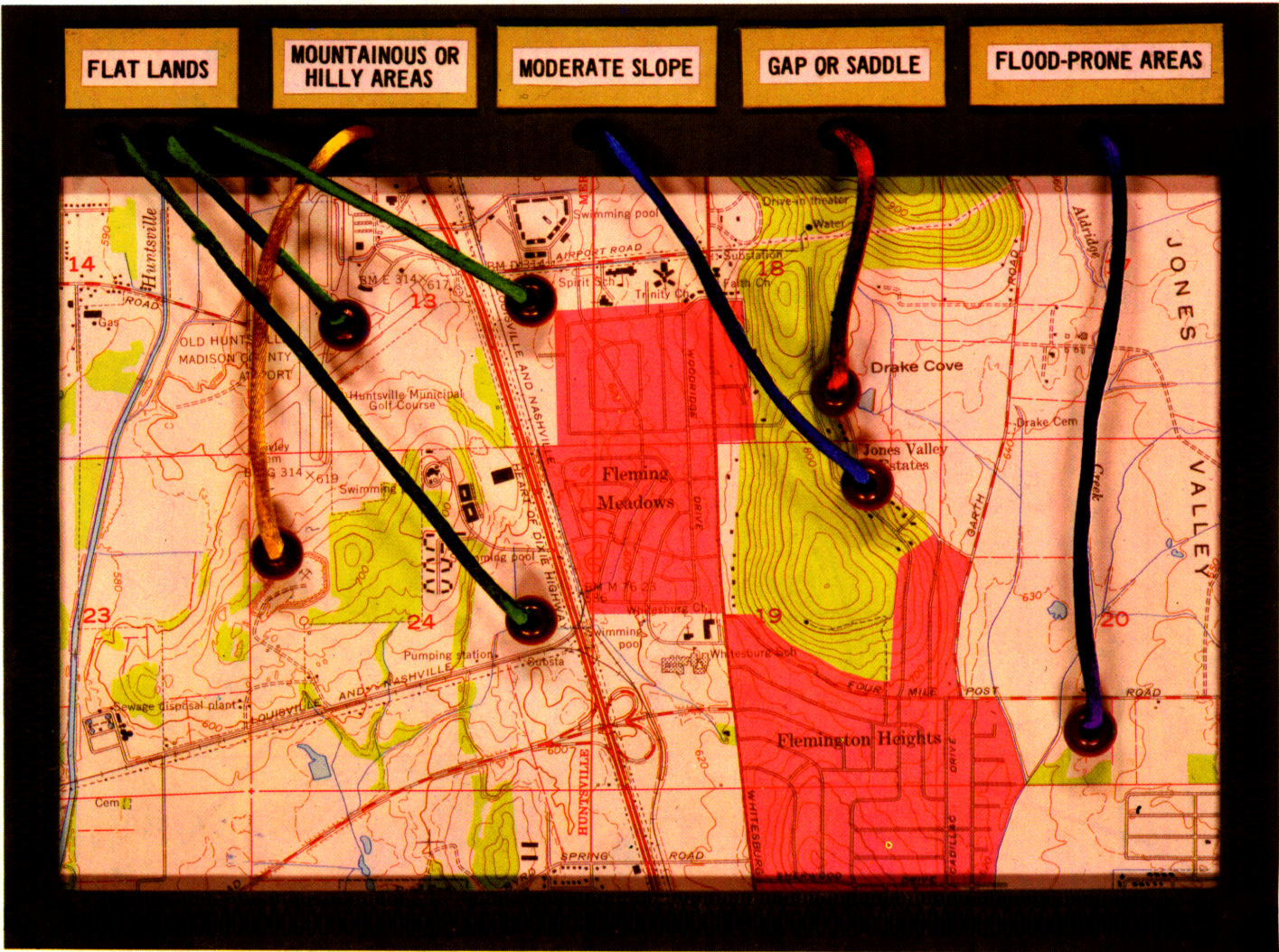
Quarry — Gravel pit	—————
Mine shaft—Tunnel or cave entrance	—————
Campsite — Picnic area	—————
Horizontal control station	—————
Vertical control station	—————
Road fork — Section corner with elevation	—————
Checked spot elevation	—————
Unchecked spot elevation	—————
Boundary:	
State	—————
county, parish, municipal	—————
civil township, precinct, town, barrio	—————
incorporated city, village, town, hamlet	—————
reservation, national or state	—————
small park, cemetery, airport, etc.	—————
land grant	—————
Township or range line, U.S. land survey	—————
Fence line or field line	—————
Section corner: found—indicated	—————
Boundary monument: land grant—other	—————
Index contour	—————
Intermediate contour	—————
Supplementary cont.	—————
Depression contours	—————
Cut — Fill	—————
Levee	—————
Intermittent lake	—————
Intermittent streams	—————
Perennial streams	—————
Marsh (swamp)	—————
Water well—Spring	—————
Inundated area	—————
Woodland	—————
Submerged marsh	—————
Bldg. omission area	—————
Orchard	—————
Wooded marsh	—————



Several maps cover Madison County in detail. Each covers 7½ minutes of latitude and longitude at a scale of 1/24,000. A small-scale map at 1/250,000 covers Madison County and other parts of north Alabama. These can be obtained from several sources listed in the section on further information.

The topography of Madison County imposes advantages and limitations on the use of the land. Flat lands are necessary for airports, and desirable for highway construction and interchanges, railroad yards and sidings, and dock facilities. These improvements influence industrial development which also is facilitated by gentle slopes. Commercial centers of urban and suburban areas have developed in the relatively flat lands of Madison County. Mountainous or hilly areas are favorable for development of rock quarries and radio and television antennas. Routes through hills and mountains cross contours gradually and follow, when possi-

ble, the pass (gap or saddle) between points of higher elevation. Areas having moderate slope can be adapted for residential development, but flood-prone areas, which can be determined from maps in the Water Resources or Land Use sections, should be avoided. Flood-plain areas and steep slopes can be developed into parks or natural preserves. Sinkholes are adaptable to farming, but are subject to temporary flooding, and because of natural drains near their centers (often hidden by soil), are undesirable as sites for waste disposal.



The hills east of Huntsville dominate Madison County's topography. These uplands are the Appalachian Plateau—part of the Appalachian Mountains. The western edge of this area, the Cumberland Escarpment, joins with the Interior Low Plateaus area at its base—the flatter, rolling lands of western Madison County.

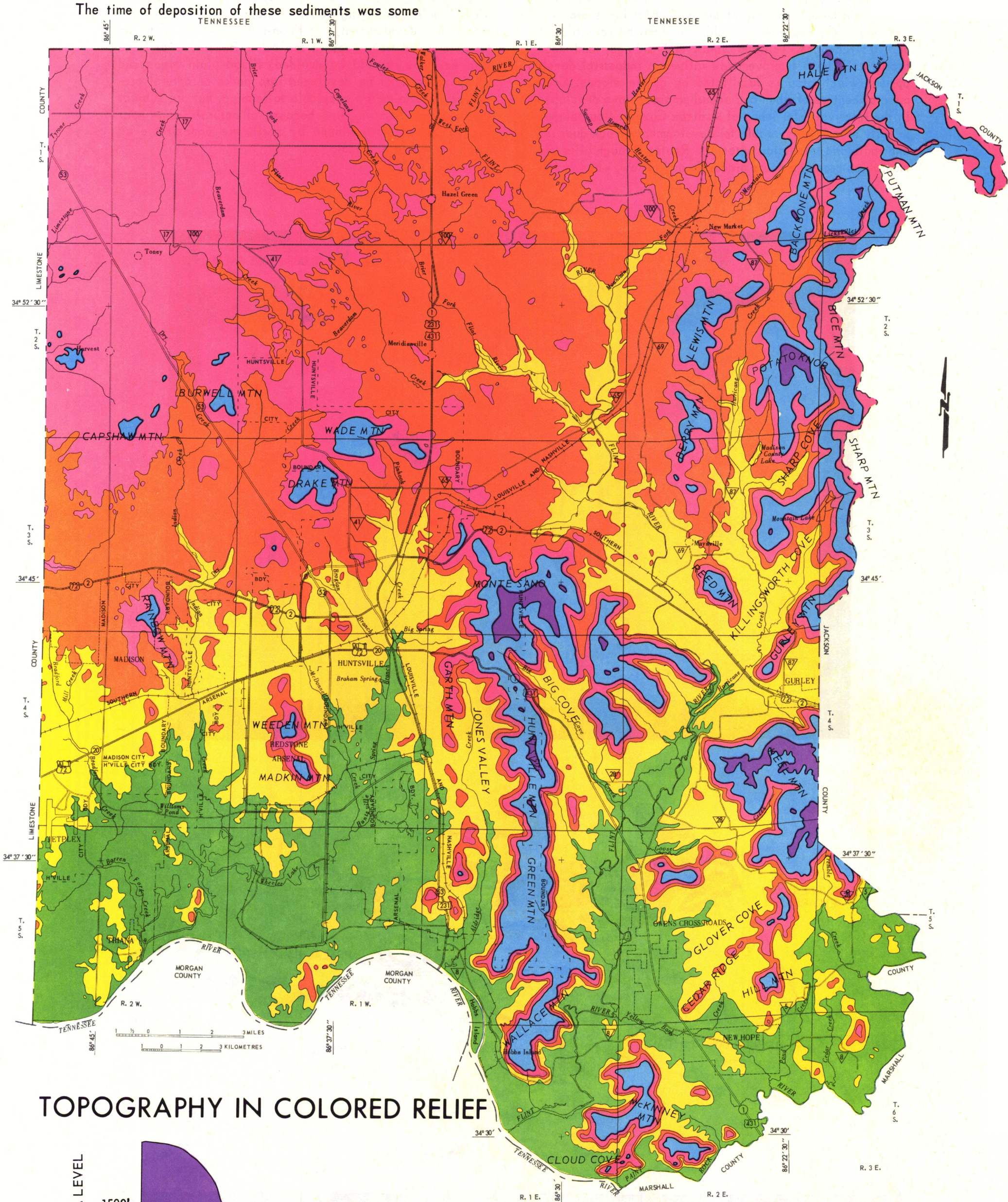
The variation in resistance of rocks to weathering by the atmosphere and erosion by running water accounts for

these differences in topography. Sandstone, which is more resistant to weathering and erosion, has not been removed in the Appalachian Plateau, but has been in the Interior Low Plateaus. The limestone and shale, which the sandstone protects in the uplands, is being weathered and eroded in the lowlands. Most of the scattered hills remaining west of the Cumberland Escarpment have no sandstone cap and will be short-lived geologically speaking.

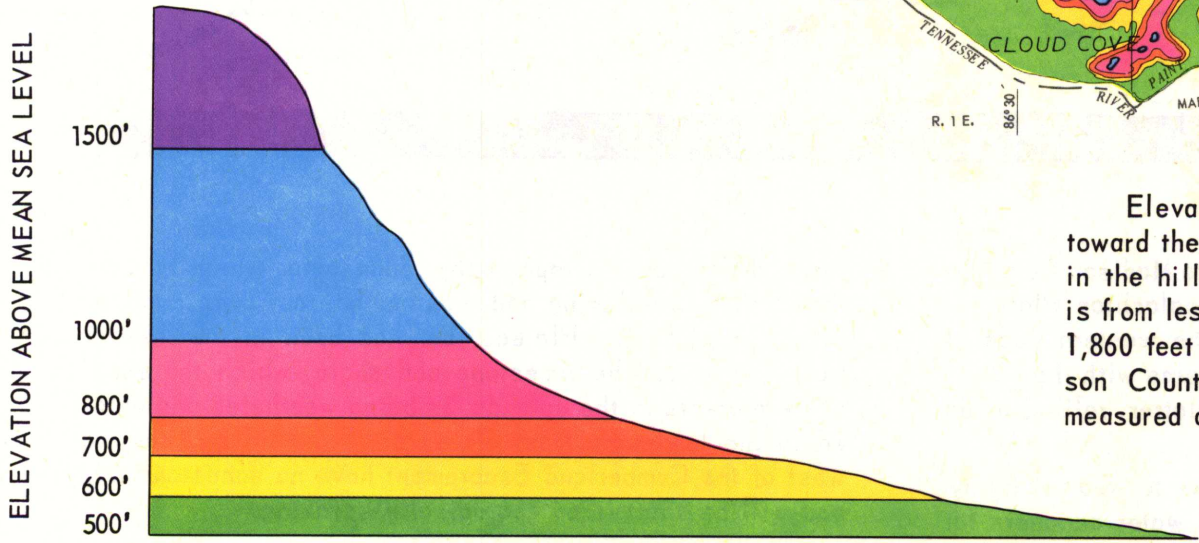
The ocean once covered Madison County, but at that time the general elevation was at least 2,000 feet lower than today. Furthermore, the undersea topography was probably relatively flat then because of the accumulation of the lime mud, sand, silt and other sediments which form the rocks exposed today.

The time of deposition of these sediments was some

300 to 500 million years ago, and the seas finally receded from the area about 200 million years ago when the Appalachian Mountains were first rising. Since then, despite periodic uplift of the land, the processes of rock breakdown and erosion have sculpted the rock into the modern landscape.



TOPOGRAPHY IN COLORED RELIEF



Elevations are lowest near the Tennessee River, rise toward the northern boundary of the county, and are highest in the hills to the east (see map). The range in elevation is from less than 560 feet near the Tennessee River to over 1,860 feet near the Tennessee border in northeastern Madison County. Relief seldom exceeds the 700 to 900 feet measured at the Cumberland Escarpment.

Contours derived from 1/250,000 scale map of U.S. Geological Survey



1-10% slope

SLOPE

The topographic map can be converted into a slope map showing gentleness or steepness of slope in another manner than by contours. The vertical rise for a given horizontal distance is expressed as a percentage using this formula:

$$\frac{\text{Vertical rise}}{\text{Horizontal distance}} \times 100 = \text{Percent slope}$$

Areas with like slopes are then grouped and shown on a map.

The percent slope method described above is one of several ways of expressing slope. Use of the ratio from which the percentage is determined and the angle of deviation from the horizontal are alternate ways to determine slope. The table shows their relationships.



10-25% slope



Less than 1% slope.

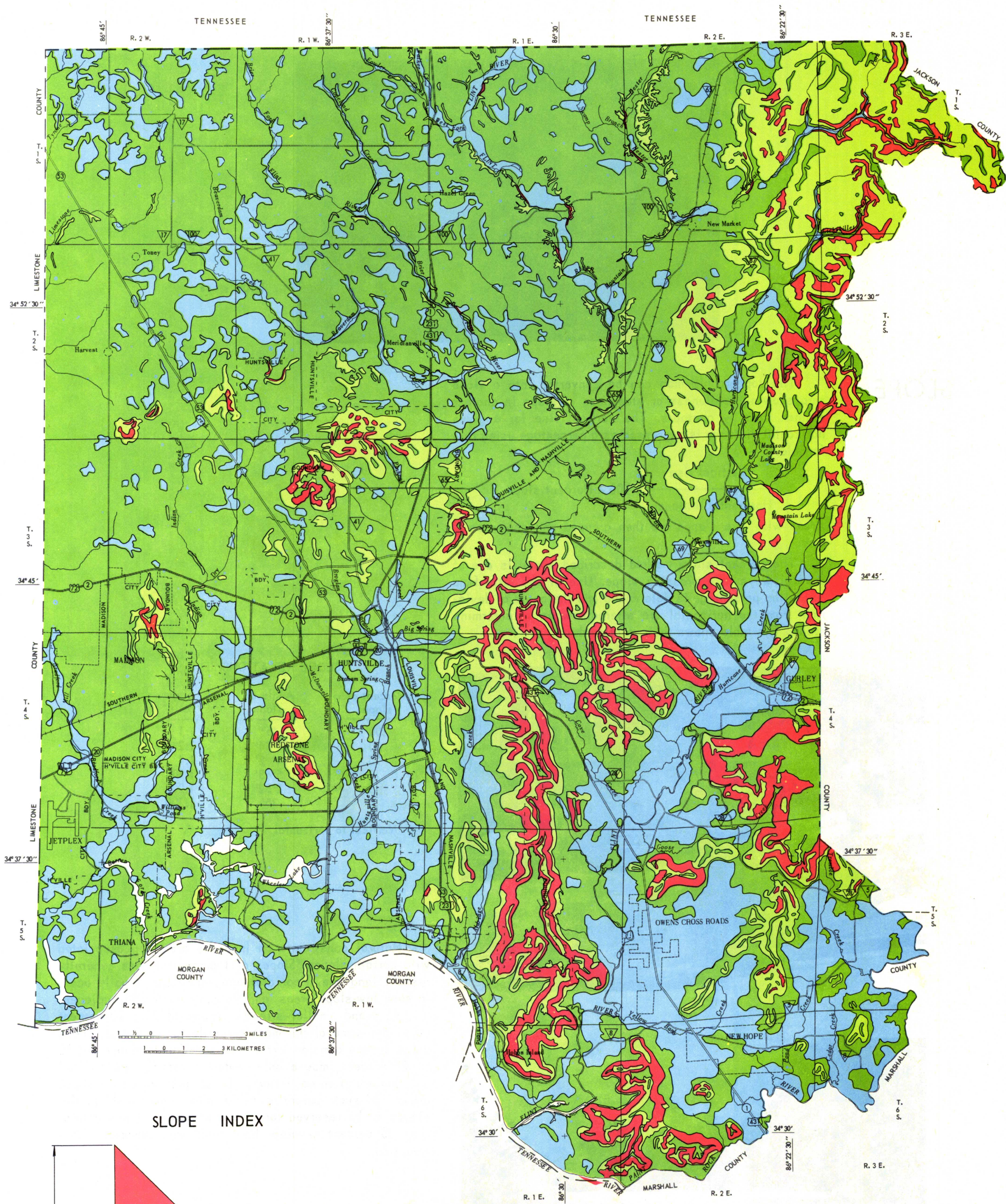
SLOPE RELATIONSHIP

Percent of slope	Angle of slope	Slope ratio*
100	45°	1:1
50	26°34'	1:2
25	14° 2'	1:4
10	5°43'	1:10
5	2°52'	1:20
1	35'	1:100

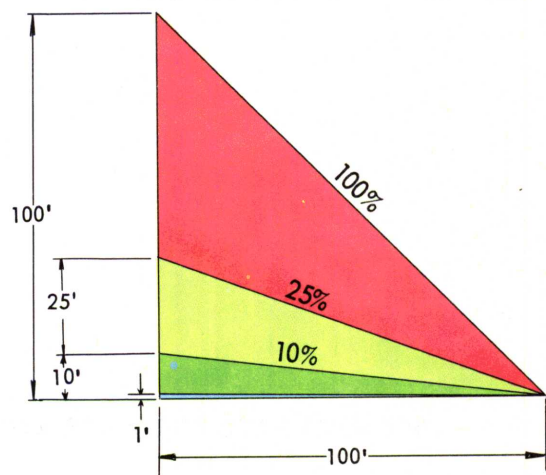
*Vertical to horizontal

Natural constraints on land use are often associated with certain slopes. Slopes of 1 percent or less generally restrict land use. Poor drainage conditions usually occur in such low-slope areas, and flooding is possible adjacent to rivers and smaller streams. Areas of 1 to 10 percent slope are some of the most versatile for land use. These areas occupy a major part of Madison County. Slopes of 10 to 25 percent impose only moderate restrictions on land use, but are often neglected as building sites. Use of these areas for such purposes could allow land with gentler slopes to be reserved for food production. Slopes greater than 25 percent severely limit land use, especially construction.

SEE NEXT PAGE FOR SLOPE MAP

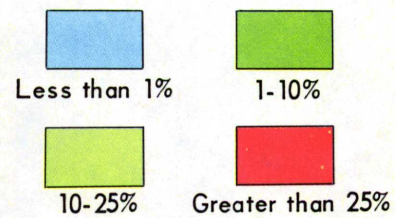


SLOPE INDEX



NOTE: A slope of 1% is equal to a 1 foot change in elevation per 100 feet of horizontal distance. Some slopes of greater than 100% (45 degrees or 1 to 1 ratio) occur in the area, and are not indicated by the diagram.

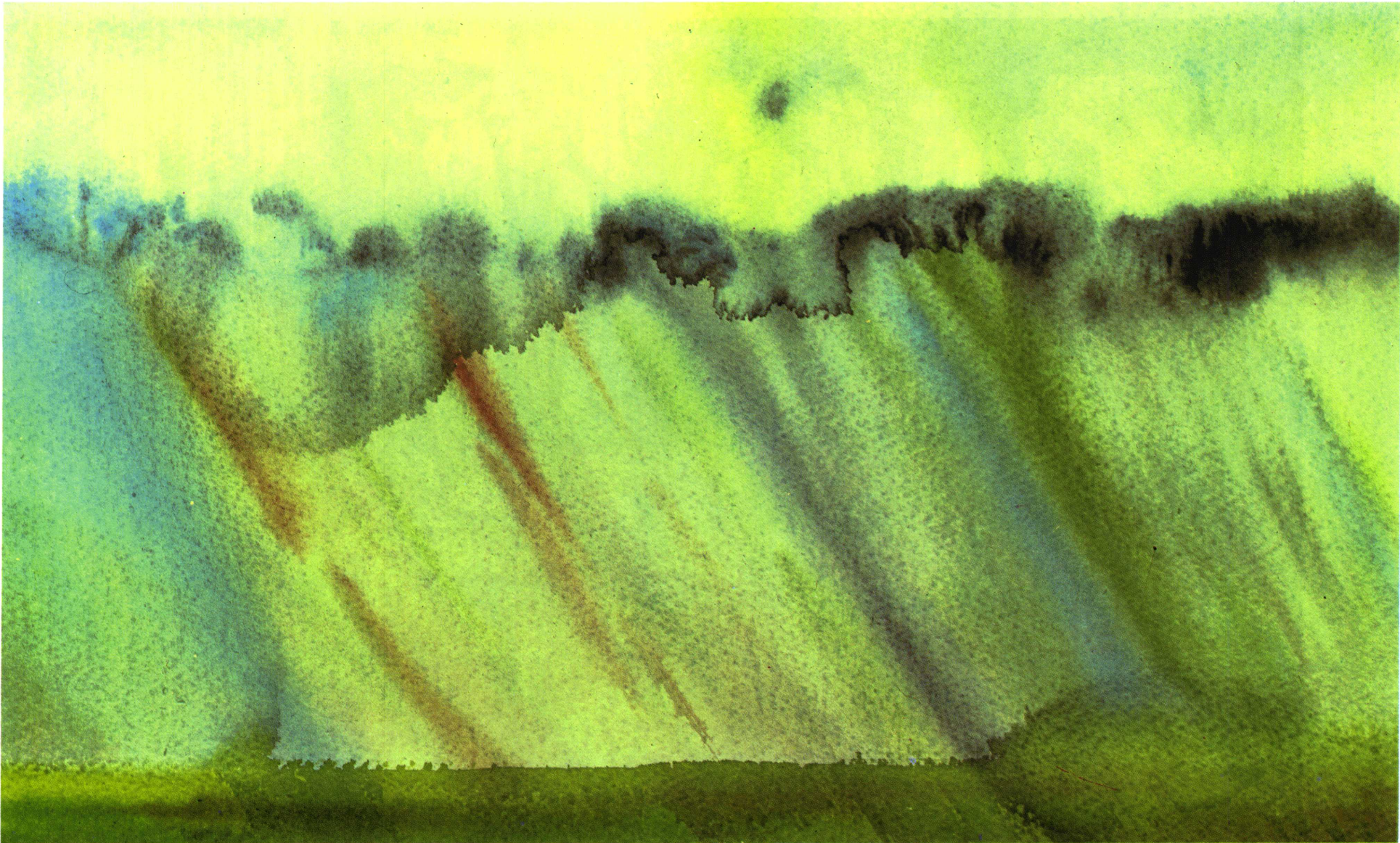
Map compiled by D. E. Bolin
Data from: P. H. Moser, D. E. Bolin, F. L. Doyle,
K. P. Hanby, J. D. Hardin



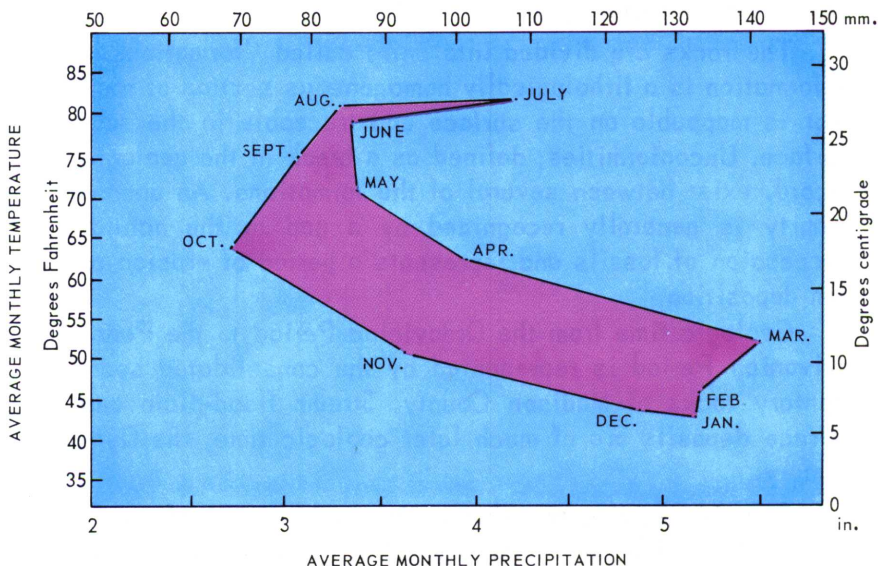
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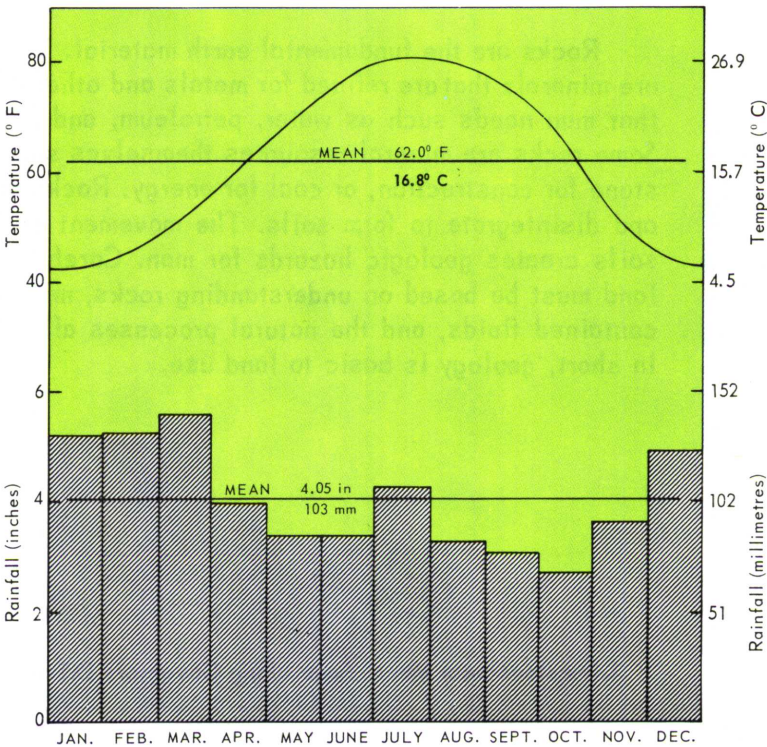
CLIMATE



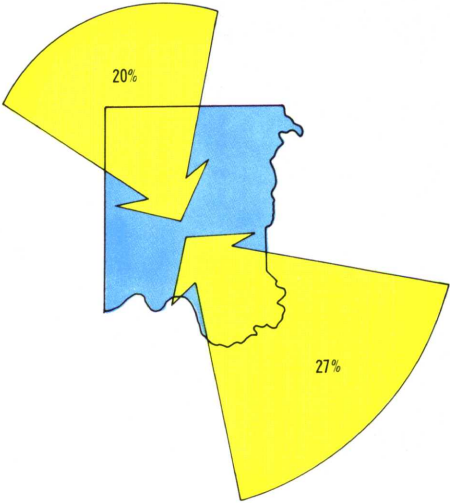
Madison County's climate is classified as humid, sub-tropical. Both winter and summer are rainy, but the autumn usually is dry. The normal monthly precipitation and temperature shown on the graph, and the mean precipitation of 48.7 inches (1237 mm) are based on averages of the National Weather Service. The climagraph is based on these averages, and it emphasizes the greater total winter precipitation as compared to that of summer. During the winter, cold air masses are often overridden by warm, moist air masses from the Gulf of Mexico, resulting in prolonged periods of precipitation. Summer precipitation is usually caused by rising air in convection cells and rainfall is often intense, but of short duration. Snow, sleet and hail are rare. Prevailing winds near Huntsville are from the north or northwest and from the southeast. The wind blows about half the time from these directions (see diagram), and 31 percent of the time from other directions (2). Tornadoes are not unknown in the county.



CLIMAGRAPH



AVERAGE MONTHLY TEMPERATURE AND PRECIPITATION



PREVAILING WINDS NEAR HUNTSVILLE

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1. National Weather Service, 1972, Local climatological data—Huntsville, Alabama: U.S. Department of Commerce, 4 p.
2. ———, 1958-1963, Wind data recorded at old Huntsville-Madison County Airport: G. W. Jones & Sons Engineers, Huntsville, Alabama.
3. Trewartha, Glenn T., 1954, An introduction to climate: New York, McGraw-Hill Book Co., 395 p.