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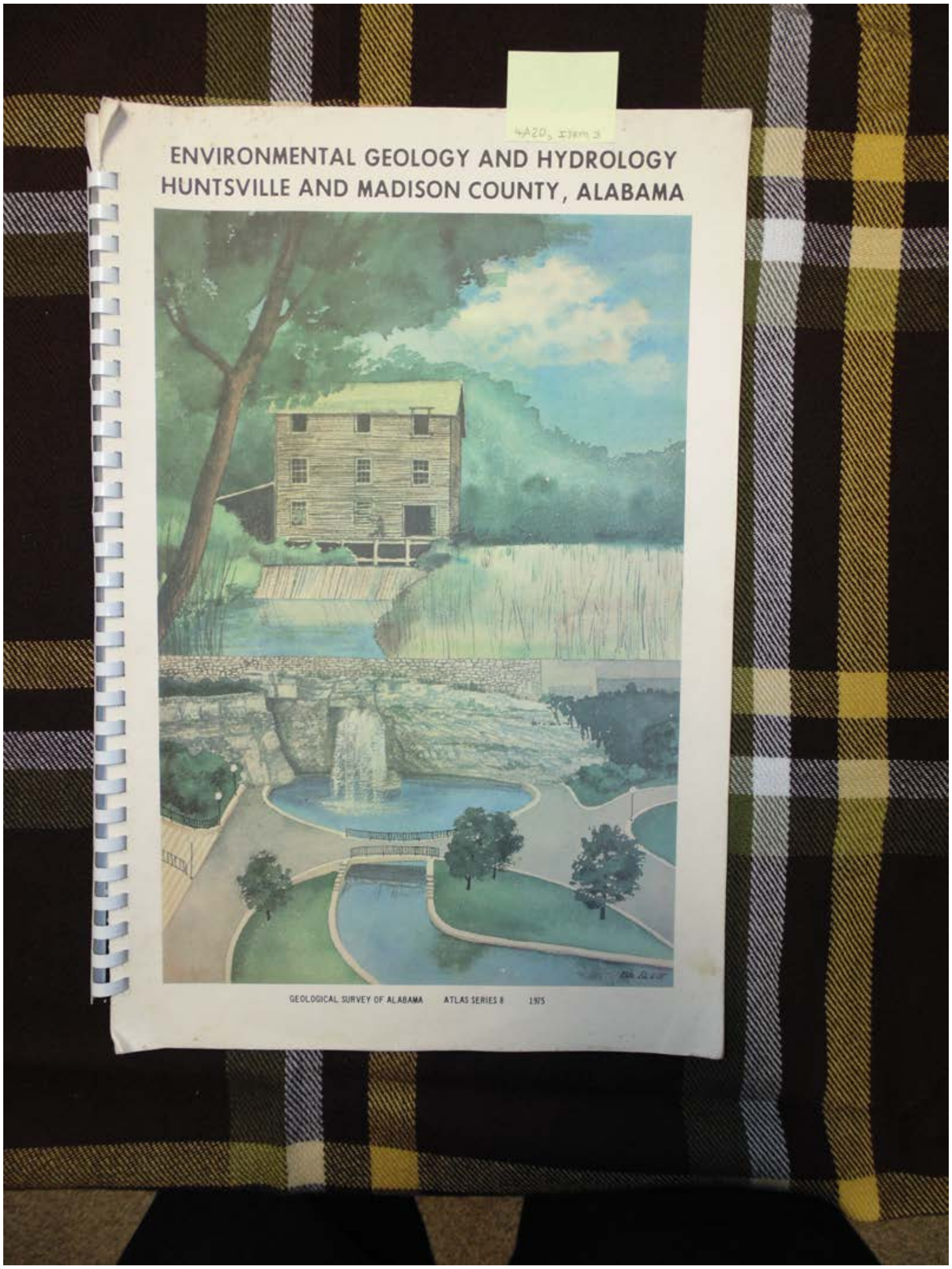
Environmental Geology and Hydrology, 1975

Image 1 r04a20-00-003-5065 Contents Index About



Names:

Environmental Geology & Hydrology

Places:

Huntsville & Madison Co., AL

Types:

atlas
painting

Dates:

1975

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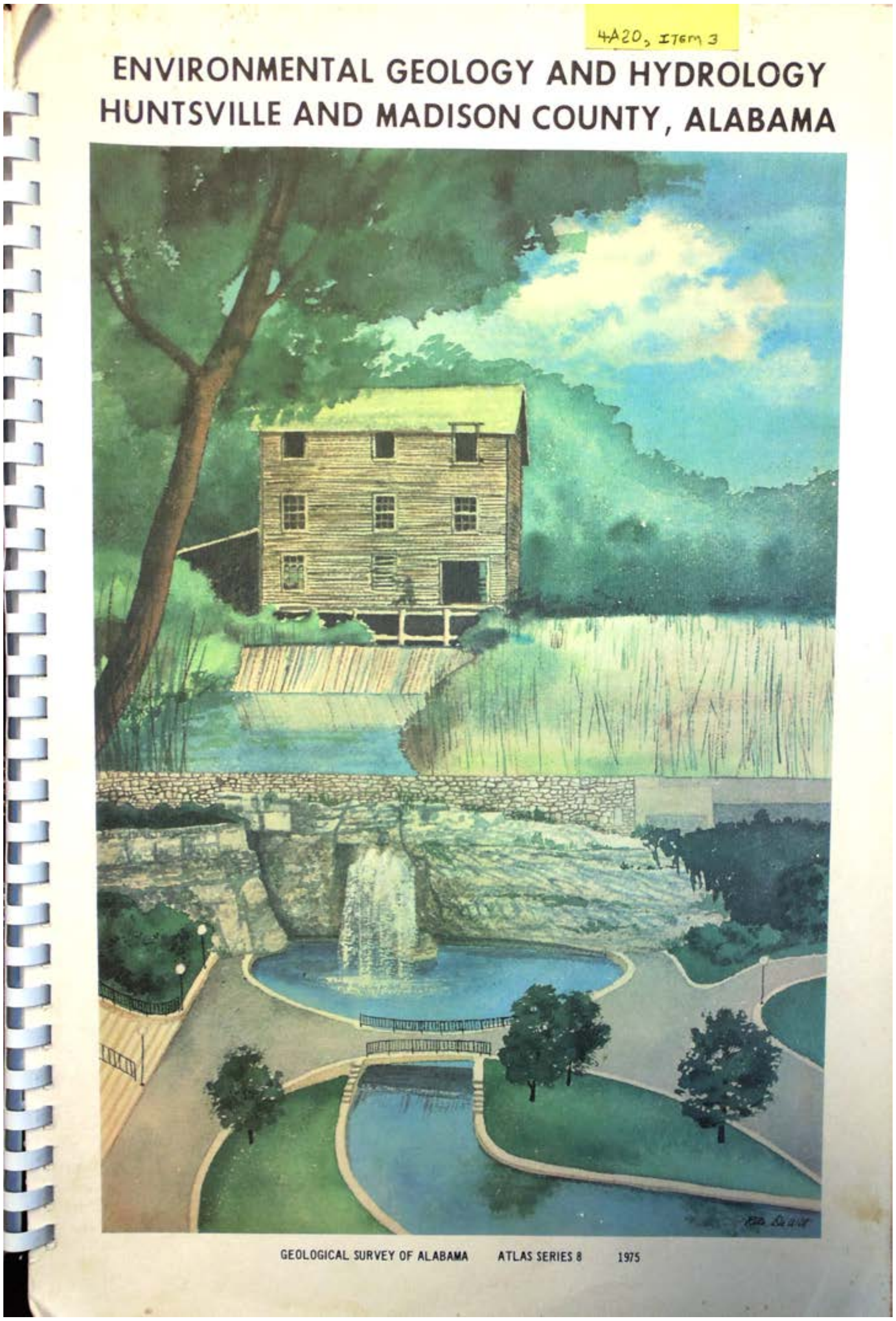

Names:

Big Spring	Environmental Geology &	Hydrology Mill

Places:

Huntsville & Madison Co., AL	Huntsville, AL Madison Co., AL

Types:

atlas	painting	painting

Dates:
1975

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Environmental Geology and Hydrology, 1975
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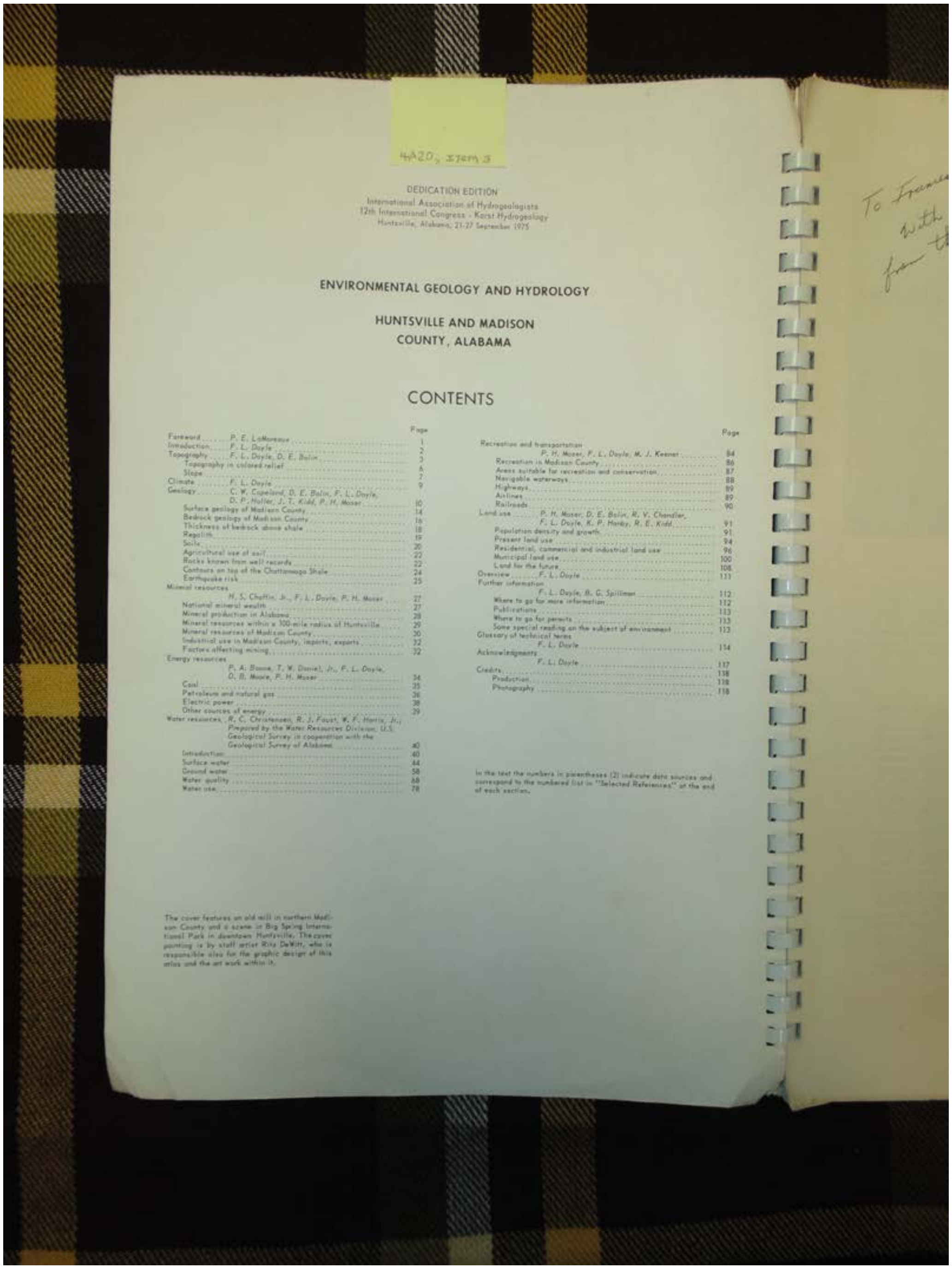

4A20, Item 3

DEDICATION EDITION
International Association of Hydrogeologists
12th International Congress - Karst Hydrogeology
Huntsville, Alabama, 21-27 September 1975

ENVIRONMENTAL GEOLOGY AND HYDROLOGY

HUNTSVILLE AND MADISON COUNTY, ALABAMA

CONTENTS

In the text the numbers in parentheses (2) indicate data sources and correspond to the numbered list in "Selected References" at the end of each section.

The cover features an old mill in northern Madison County and a scene in Big Spring International Park in downtown Huntsville. The cover painting is by staff artist Rita DeWitt, who is responsible also for the graphic design of this atlas and the art work within it.

Names:
Contents
DeWitt, Rita
Environmental Geology &
Hydrology

Places:
Huntsville & Madison Co., AL

Types:
atlas

Dates:
1975

Frances Cabaniss Roberts Collection: Series 4, Subseries A, Box 20, Item 3
Environmental Geology and Hydrology, 1975
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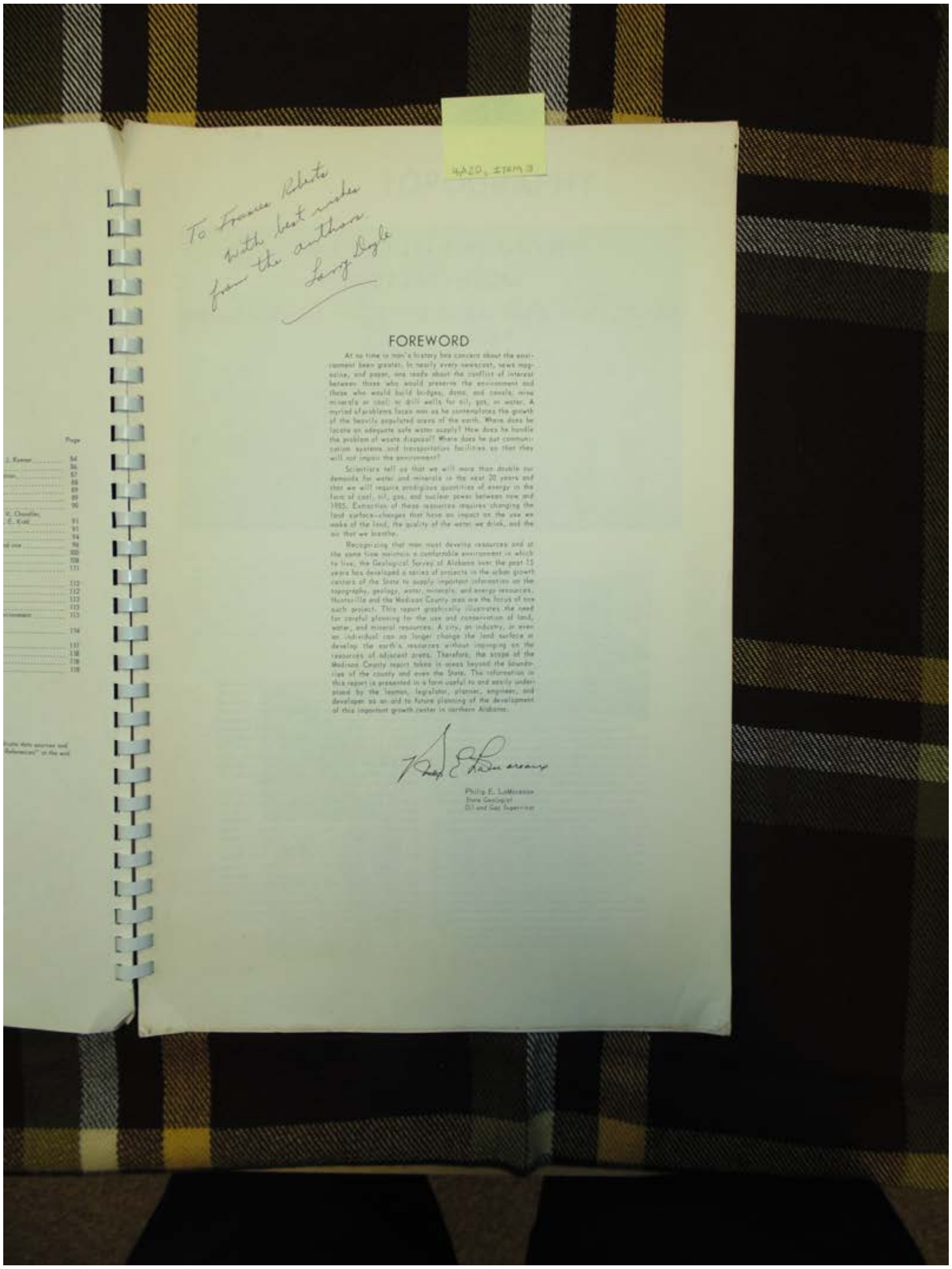


To Frances Roberts
with best wishes
from the authors.
Larry Doyle

FOREWORD

At no time in man's history has concern about the environment been greater. In nearly every newscast, news magazine, and paper, one reads about the conflict of interest between those who would preserve the environment and those who would build bridges, dams, and canals; mine minerals or coal; or drill wells for oil, gas, or water. A myriad of problems faces man as he contemplates the growth of the heavily populated areas of the earth. Where does he locate an adequate safe water supply? How does he handle the problem of waste disposal? Where does he put communication systems and transportation facilities so that they will not impair the environment?

Scientists tell us that we will more than double our demands for water and minerals in the next 20 years and that we will require prodigious quantities of energy in the form of coal, oil, gas, and nuclear power between now and 1985. Extraction of these resources requires changing the land surface—changes that have an impact on the use we make of the land, the quality of the water we drink, and the air that we breathe.

Recognizing that man must develop resources and at the same time maintain a comfortable environment in which to live, the Geological Survey of Alabama over the past 15 years has developed a series of projects in the urban growth centers of the State to supply important information on the topography, geology, water, minerals, and energy resources. Huntsville and the Madison County area are the focus of one such project. This report graphically illustrates the need for careful planning for the use and conservation of land, water, and mineral resources. A city, an industry, or even an individual can no longer change the land surface or develop the earth's resources without impinging on the resources of adjacent areas. Therefore, the scope of the Madison County report takes in areas beyond the boundaries of the county and even the State. The information in this report is presented in a form useful to and easily understood by the layman, legislator, planner, engineer, and developer as an aid to future planning of the development of this important growth center in northern Alabama.

Philip E. LaMoreaux
State Geologist
Oil and Gas Supervisor

Names:

Doyle, Larry
Foreword
Geological Survey of Alabama
LaMoreaux, Phillip E.
Roberts, Frances

Places:

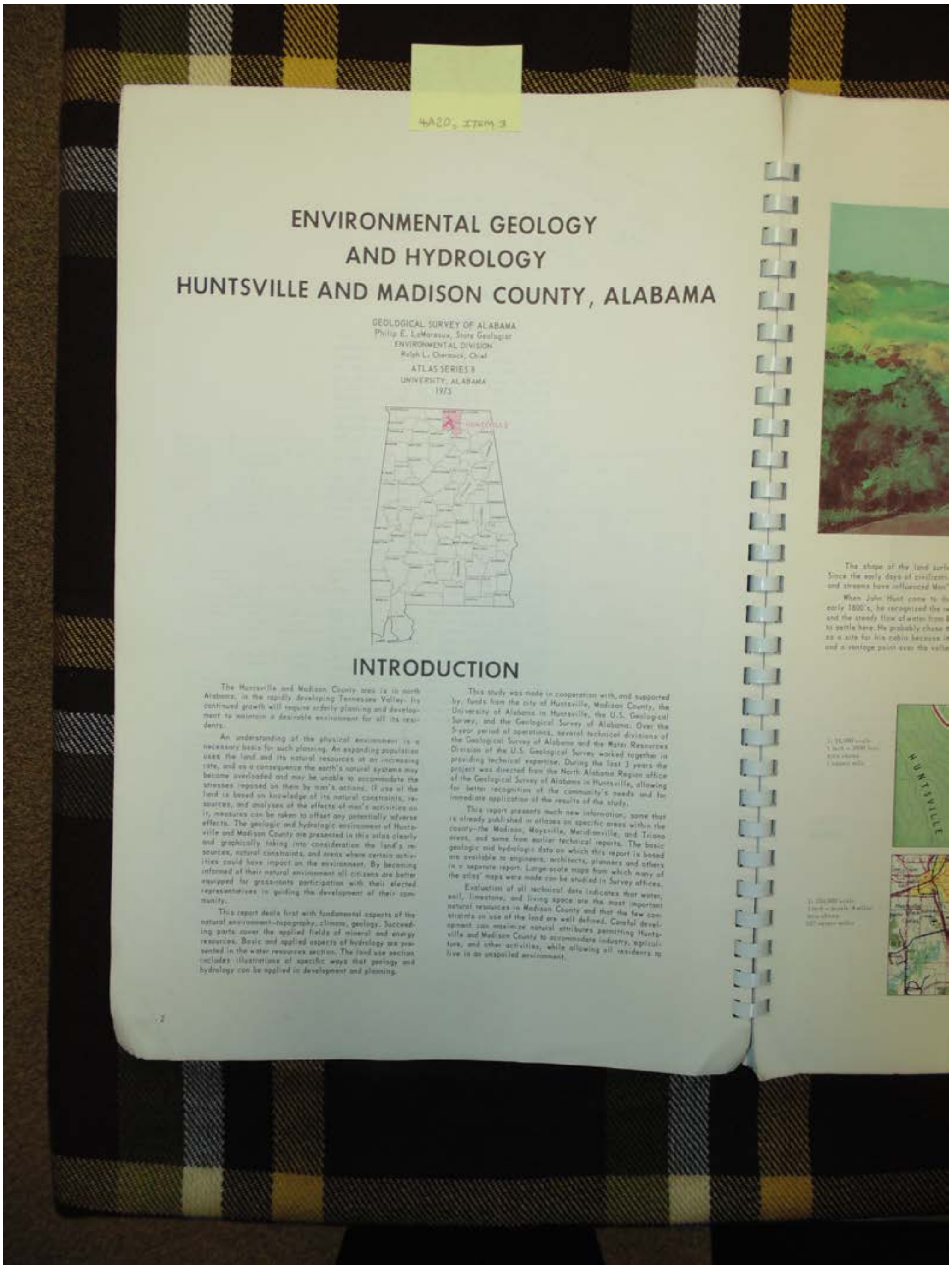
Huntsville & Madison Co., AL

Types:

atlas
correspondence

Dates:

1975



ENVIRONMENTAL GEOLOGY AND HYDROLOGY HUNTSVILLE AND MADISON COUNTY, ALABAMA

GEOLOGICAL SURVEY OF ALABAMA
Philip E. LaMoreaux, State Geologist
ENVIRONMENTAL DIVISION
Ralph L. Chermock, Chief
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.

Names:
Environmental Geology &
Hydrology
Introduction: Huntsville &
Madison County

Places:
Huntsville & Madison Co., AL

Types:
atlas

Dates:
1975

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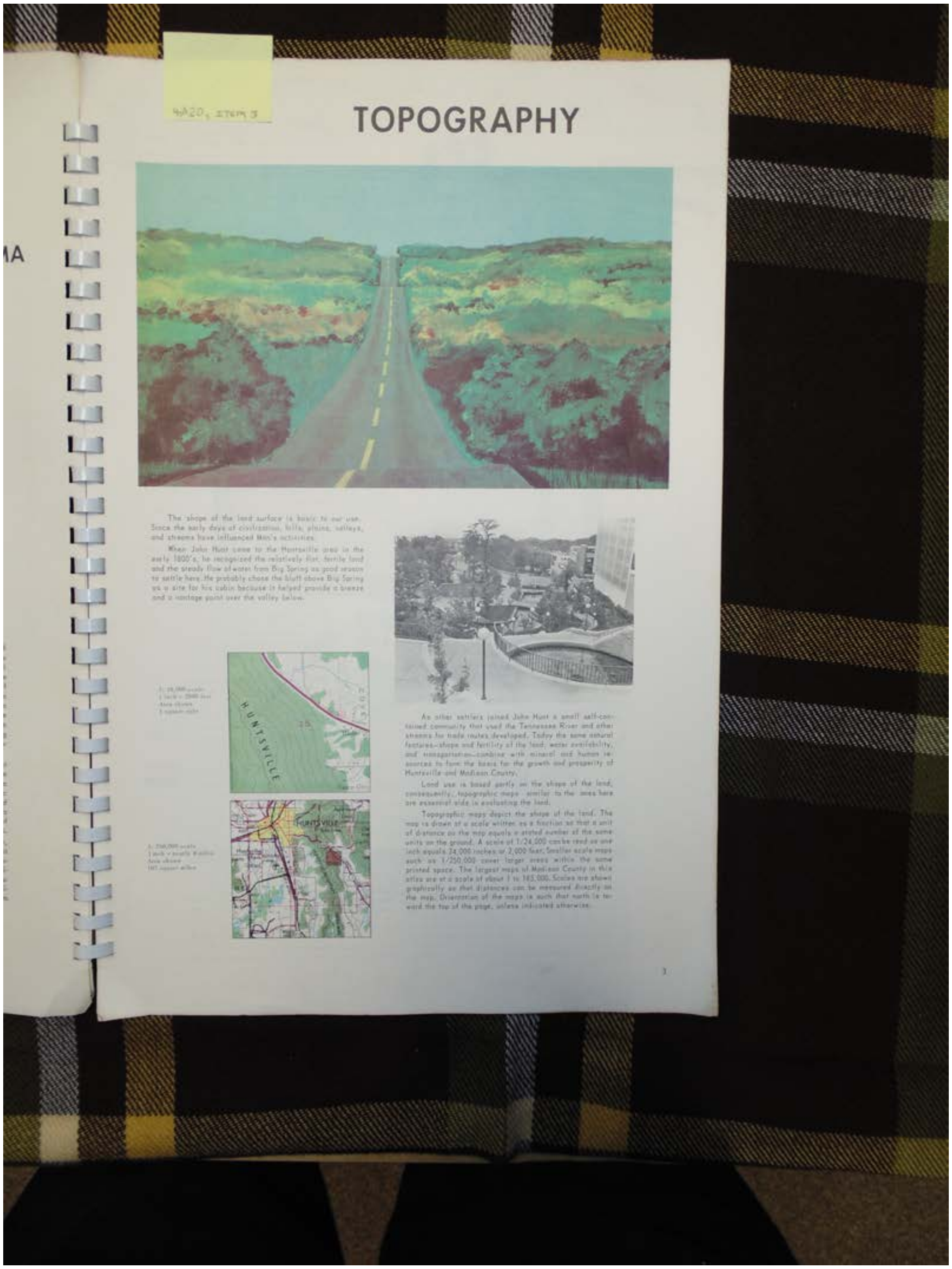

Names:
Hunt, John
topographic maps

Places:
Huntsville &
Madison Co., AL

Types:
atlas

Dates:
1975

Frances Cabaniss Roberts Collection: **Series 4, Subseries A, Box 20, Item 3**
Environmental Geology and Hydrology, 1975
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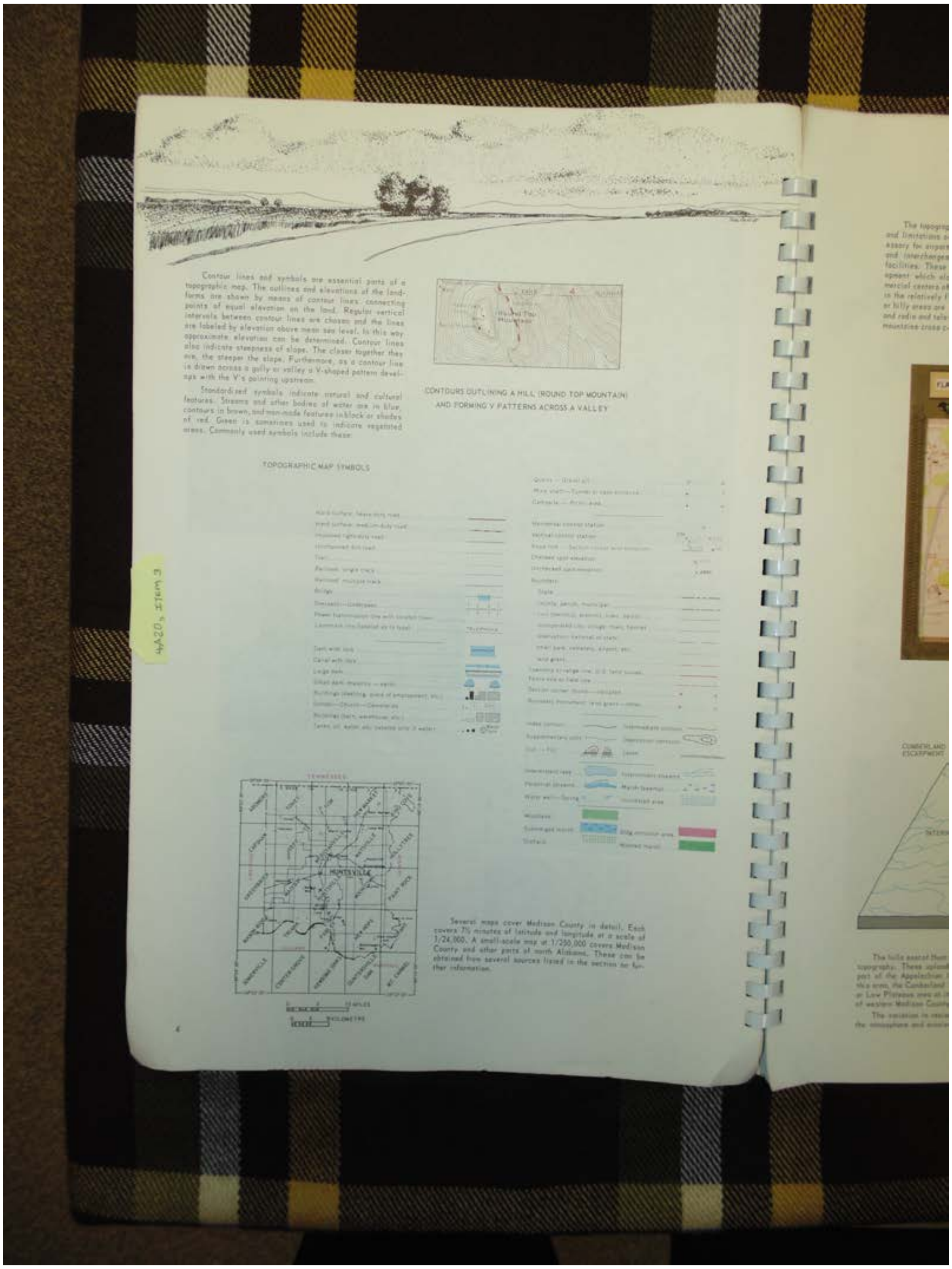

Names:
Contour lines & Symbols
topographic map symbols

Places:
Huntsville & Madison Co., AL

Types:
atlas

Dates:
1975

Frances Cabaniss Roberts Collection: Series 4, Subseries A, Box 20, Item 3
Environmental Geology and Hydrology, 1975

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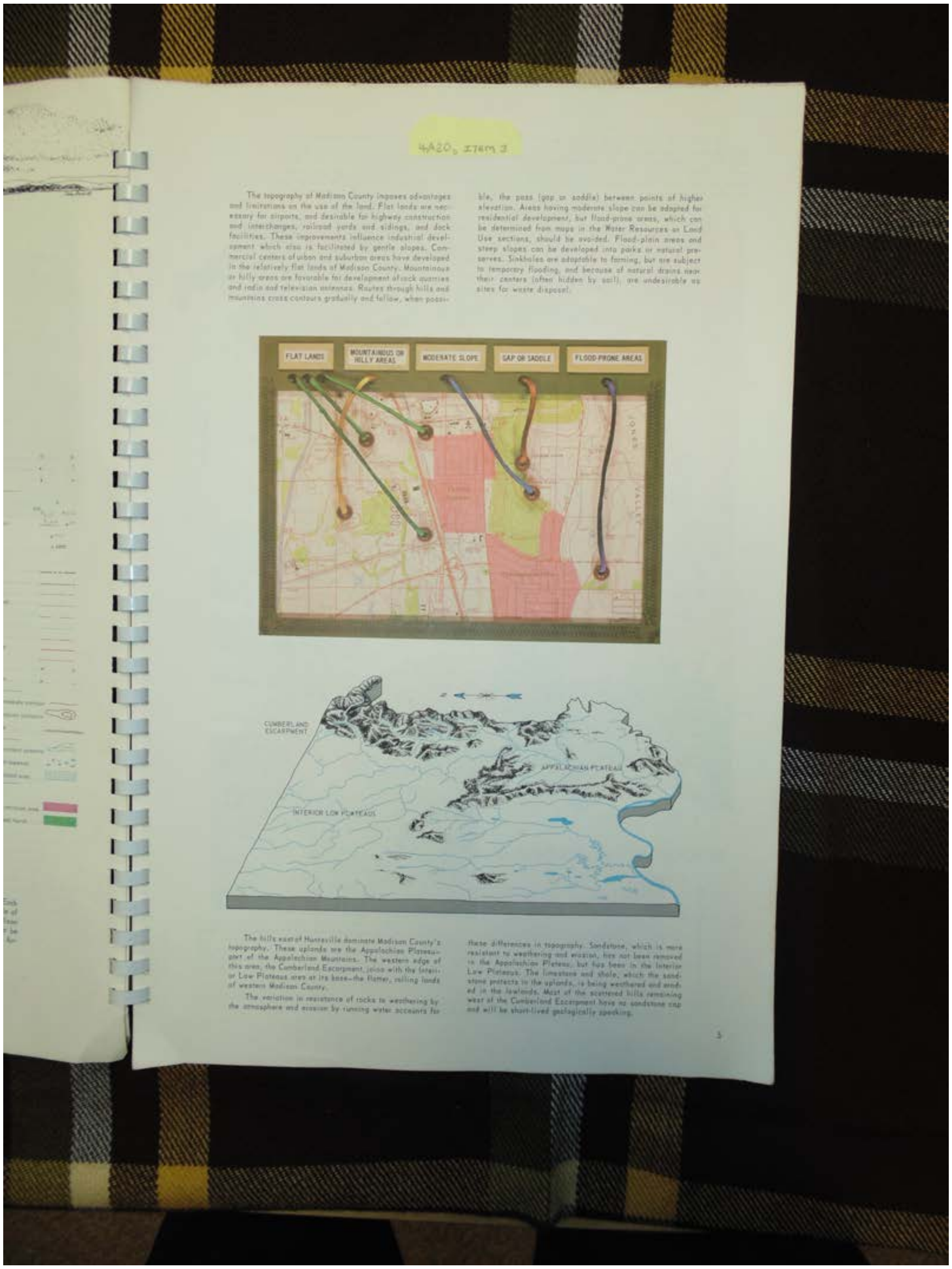

4A20, ITEM 3

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 possible, 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.

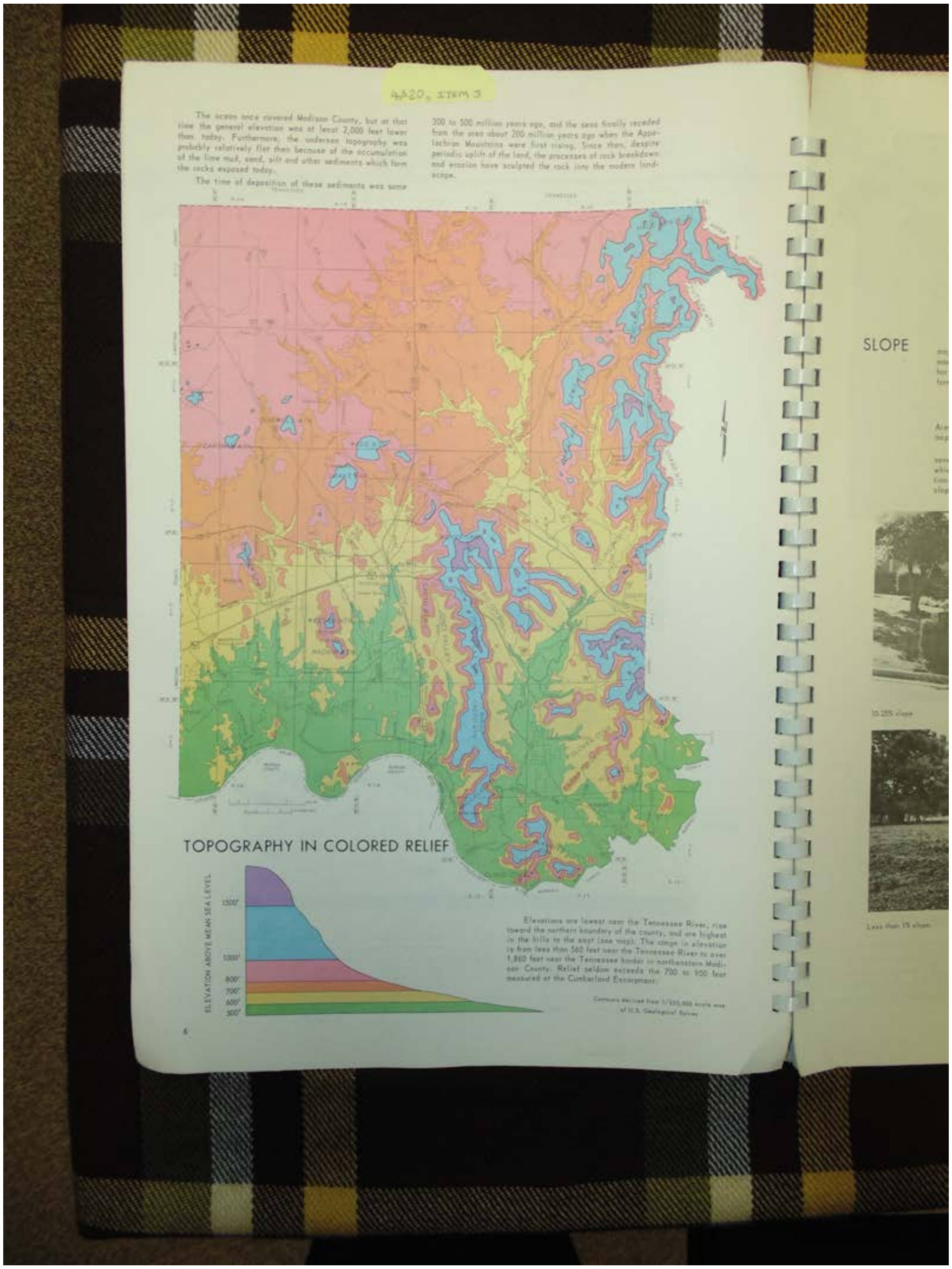
The variation in resistance of rocks to weathering by the atmosphere and erosion by running water accounts for these differences in topography. Sandstone, which is more resistant to weathering and erosion, has not been removed in the Appalachian Plateau, but has been in the Interior Low Plateaus. The 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.

Names:
Madison County
Topography

Places:
Madison Co., AL

Types:
atlas diagram

Dates:
1975

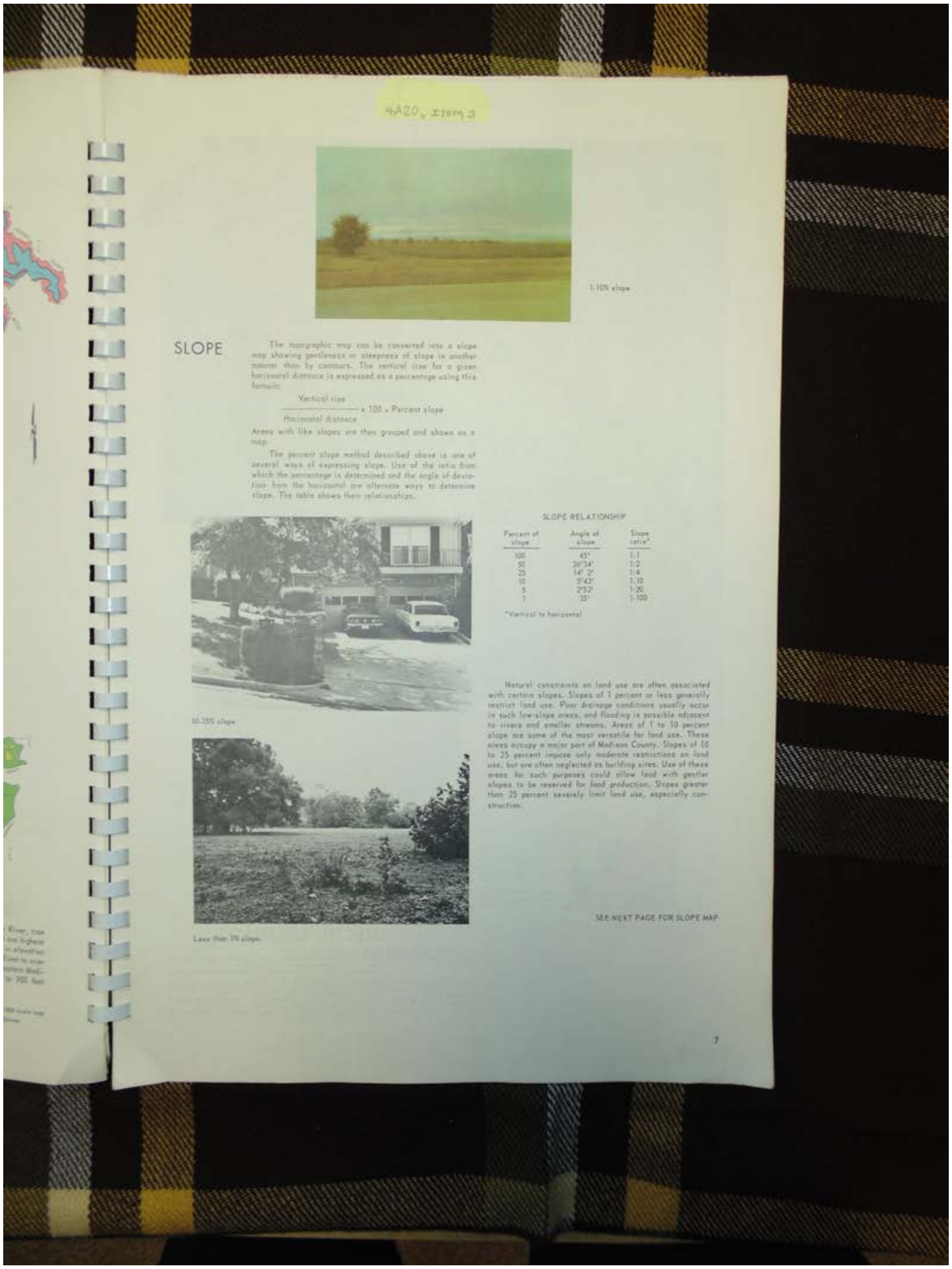


Names:
Topography in Colored Relief

Places:
Madison Co., AL

Types:
atlas map

Dates:
1975



4A20, Item 3

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.

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

10-25% slope

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.

Less than 1% slope

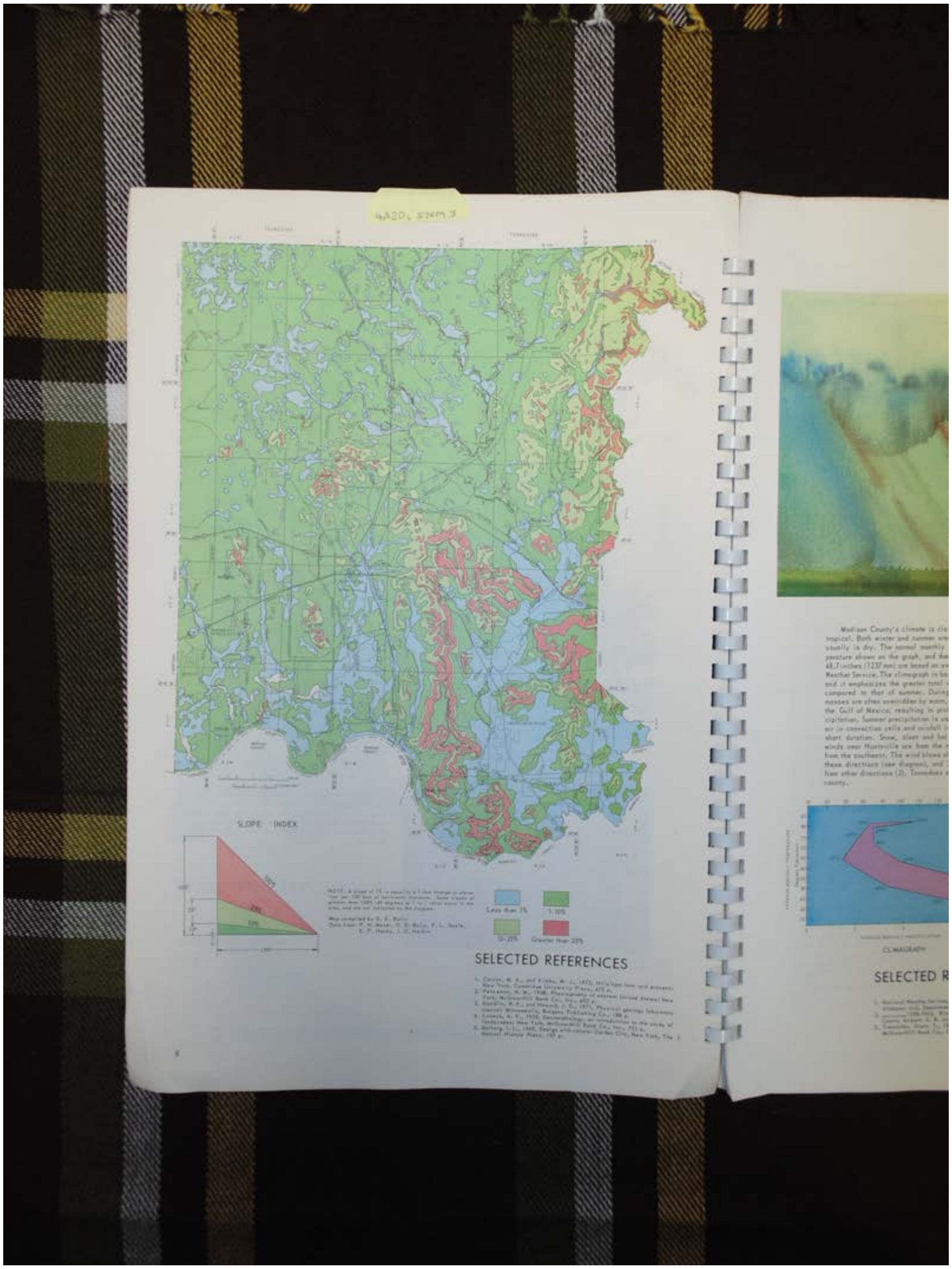
SEE NEXT PAGE FOR SLOPE MAP

Names:
Slope described

Places:
Madison Co., AL

Types:
atlas

Dates:
1975

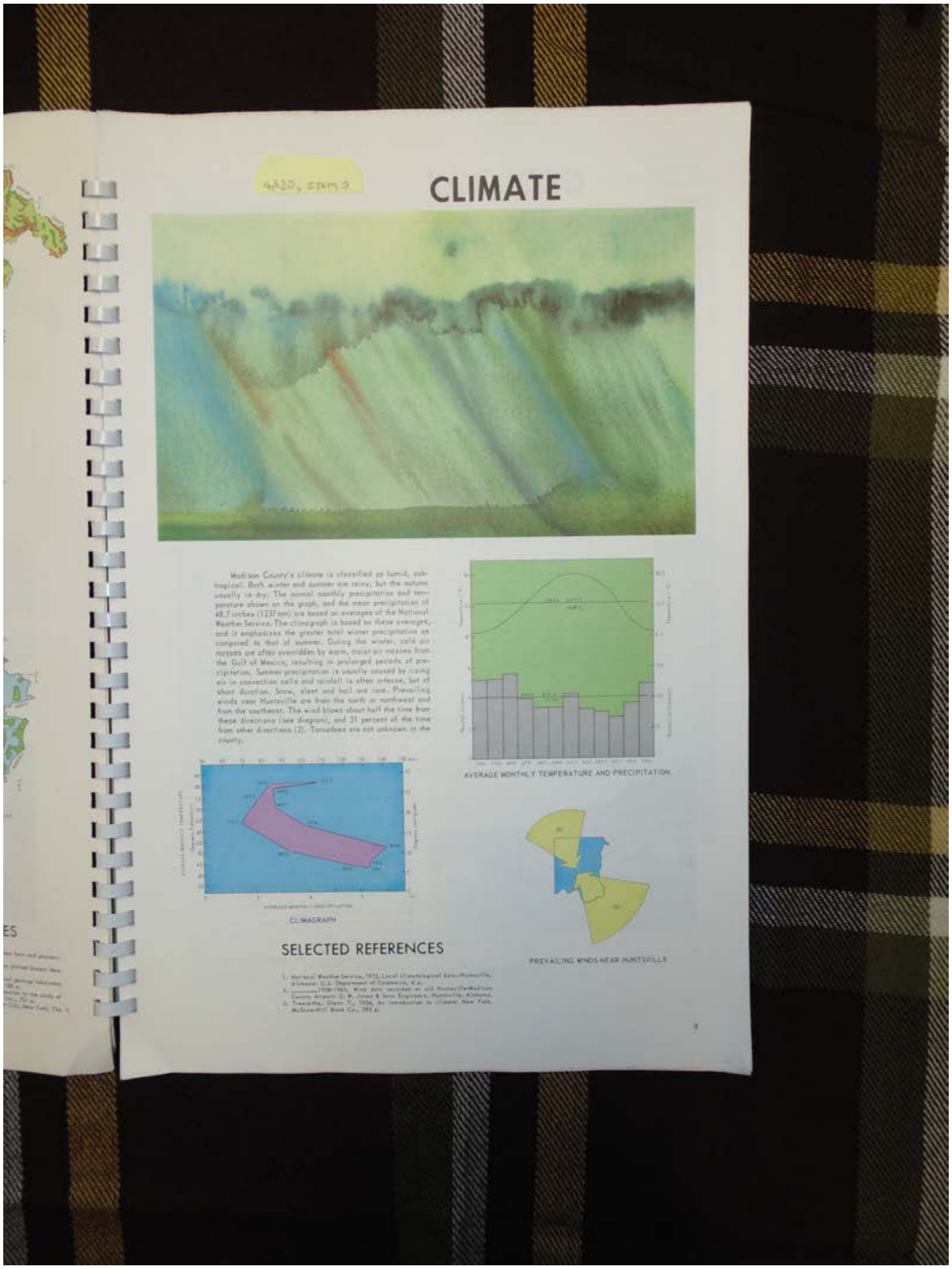


Names:
Slope map

Places:
Madison Co., AL

Types:
atlas
map

Dates:
1975

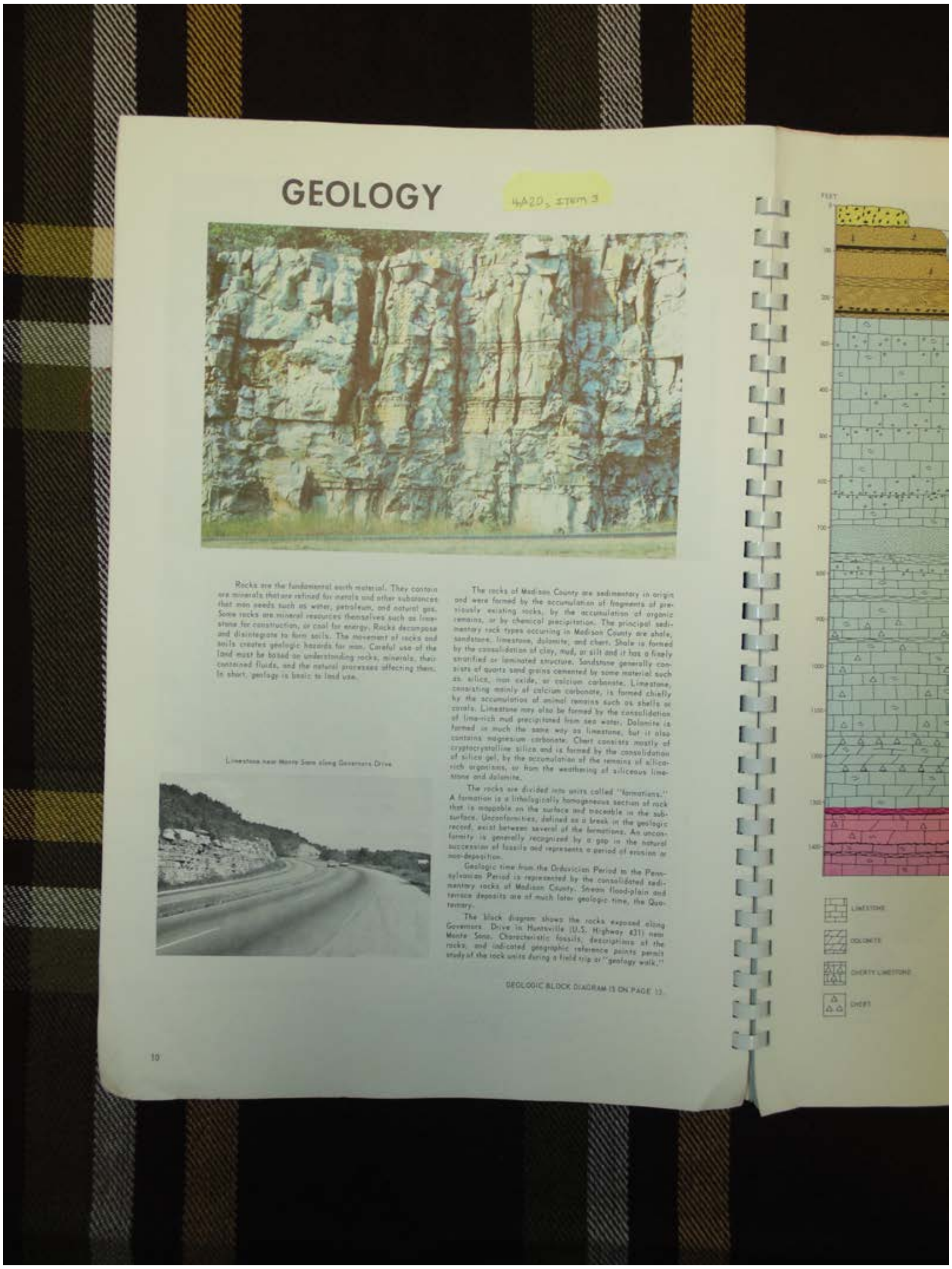


Names:
Climate

Places:
Madison Co., AL

Types:
atlas

Dates:
1975



GEOLOGY

4A20, Item 3

Rocks are the fundamental earth material. They contain ore minerals that are refined for metals and other substances that man needs such as water, petroleum, and natural gas. Some rocks are mineral resources themselves such as limestone for construction, or coal for energy. Rocks decompose and disintegrate to form soils. The movement of rocks and soils creates geologic hazards for man. Careful use of the land must be based on understanding rocks, minerals, their contained fluids, and the natural processes affecting them. In short, geology is basic to land use.

Limestone near Monte Sano along Governors Drive

The rocks of Madison County are sedimentary in origin and were formed by the accumulation of fragments of previously existing rocks, by the accumulation of organic remains, or by chemical precipitation. The principal sedimentary rock types occurring in Madison County are shale, sandstone, limestone, dolomite, and chert. Shale is formed by the consolidation of clay, mud, or silt and it has a finely stratified or laminated structure. Sandstone generally consists of quartz sand grains cemented by some material such as silica, iron oxide, or calcium carbonate. Limestone, consisting mainly of calcium carbonate, is formed chiefly by the accumulation of animal remains such as shells or corals. Limestone may also be formed by the consolidation of lime-rich mud precipitated from sea water. Dolomite is formed in much the same way as limestone, but it also contains magnesium carbonate. Chert consists mostly of cryptocrystalline silica and is formed by the consolidation of silica gel, by the accumulation of the remains of silica-rich organisms, or from the weathering of siliceous limestone and dolomite.

The rocks are divided into units called "formations." A formation is a lithologically homogeneous section of rock that is mappable on the surface and traceable in the subsurface. Unconformities, defined as a break in the geologic record, exist between several of the formations. An unconformity is generally recognized by a gap in the natural succession of fossils and represents a period of erosion or non-deposition.

Geologic time from the Ordovician Period to the Pennsylvanian Period is represented by the consolidated sedimentary rocks of Madison County. Stream flood-plain and terrace deposits are of much later geologic time, the Quaternary.

The block diagram shows the rocks exposed along Governors Drive in Huntsville (U.S. Highway 431) near Monte Sano. Characteristic fossils, descriptions of the rocks, and indicated geographic reference points permit study of the rock units during a field trip or "geology walk."

GEOLOGIC BLOCK DIAGRAM IS ON PAGE 13

Names:
Geology
Limestone along Governors Drive

Places:
Madison Co., AL

Types:
atlas
atlas
photograph

Dates:
1975

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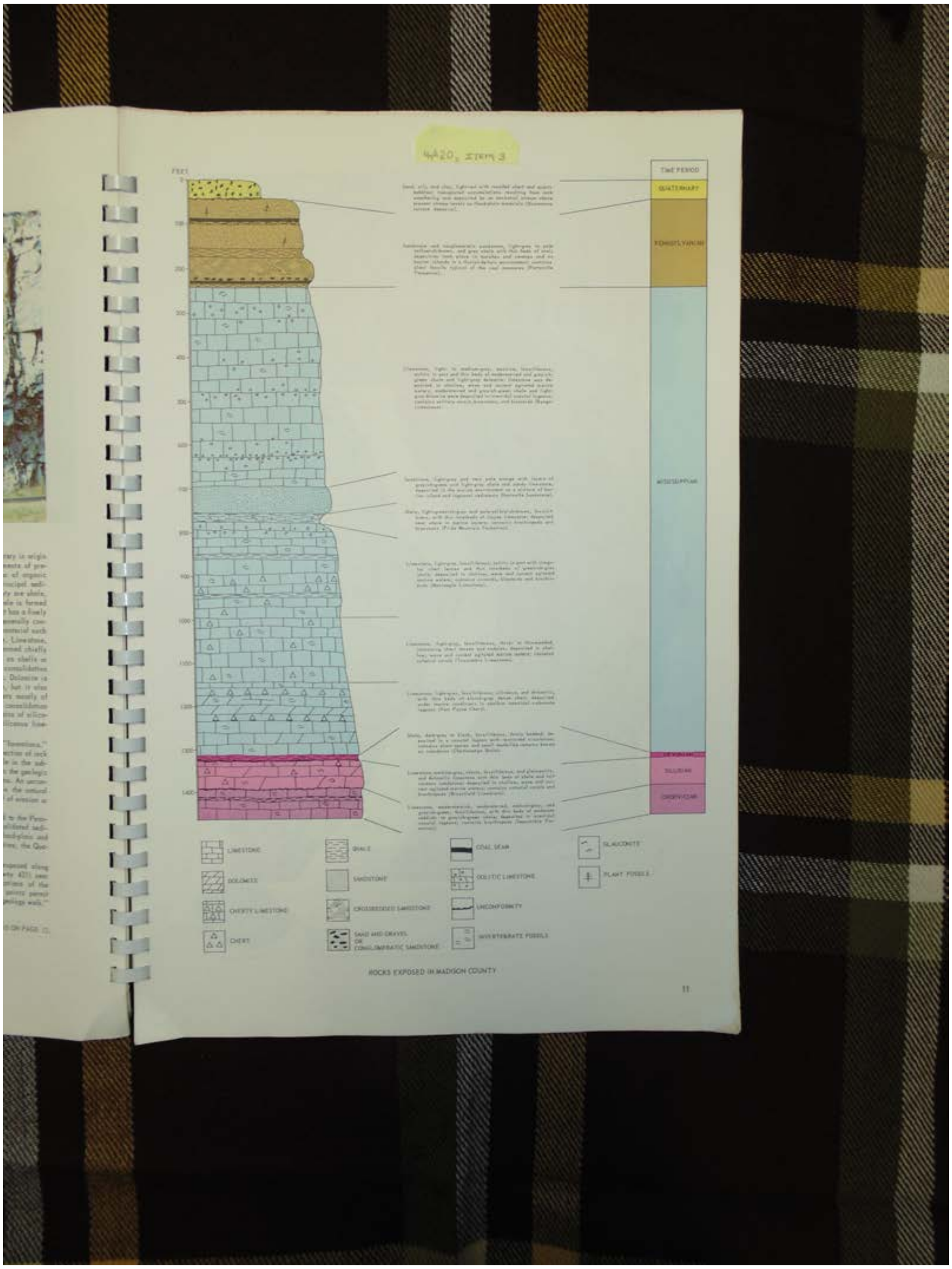
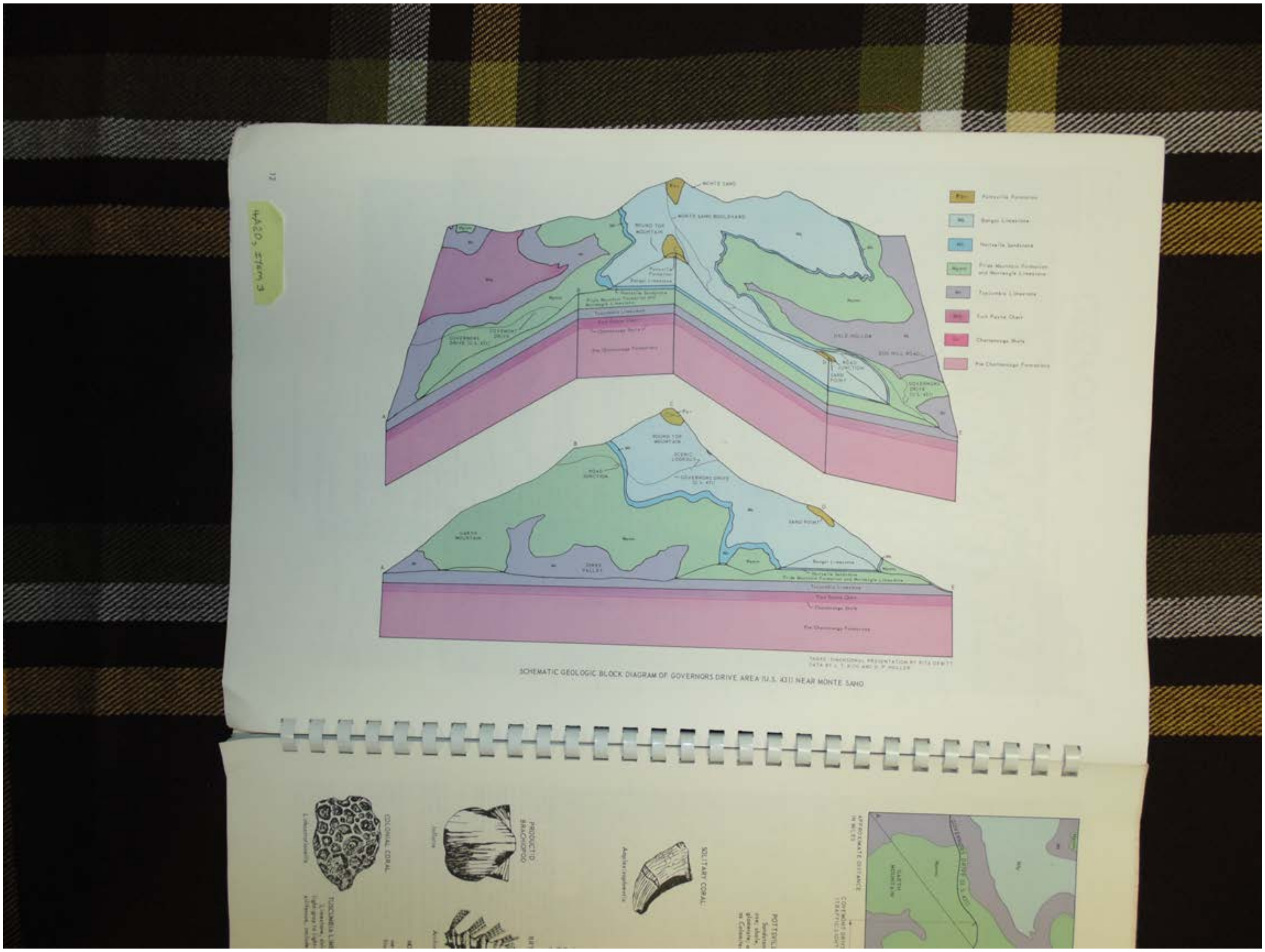


Names:
Rocks Exposed in
Madison County

Places:
Madison Co., AL

Types:
diagram

Dates:
1975



Governors Drive area

Names:
Geologic Block Diagram

Places:
Madison Co., AL

Types:
diagram

Dates:
1975

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Environmental Geology and Hydrology, 1975
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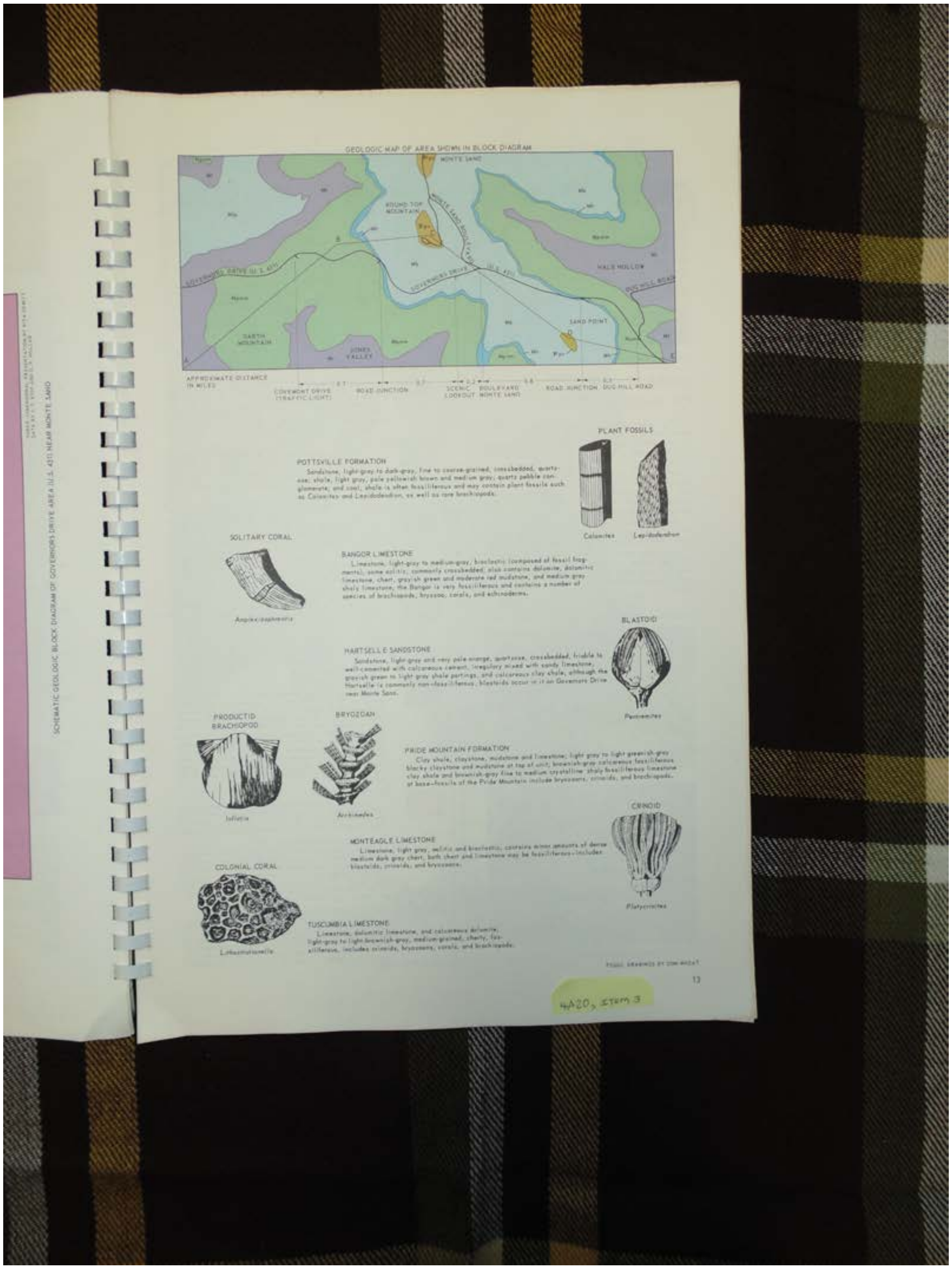


Governors Drive area

Names:

Geologic Map of Block Diagram

Places:

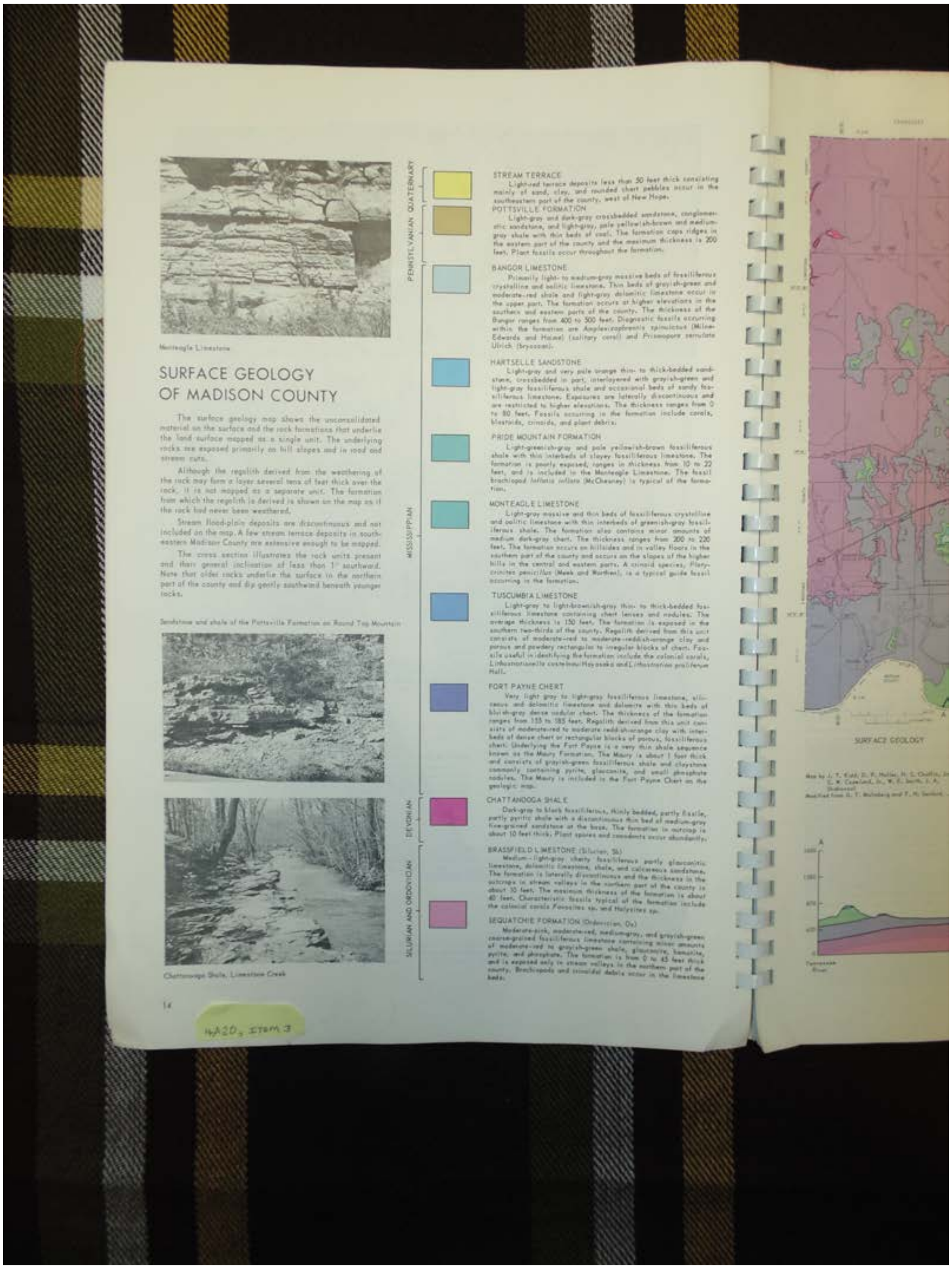
Madison Co., AL

Types:

map

Dates:

1975



Names:

Limestone Creek Round Top Mountain Surface Geology

Places:

Madison Co., AL

Types:

atlas atlas photograph

Dates:

1975

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Environmental Geology and Hydrology, 1975
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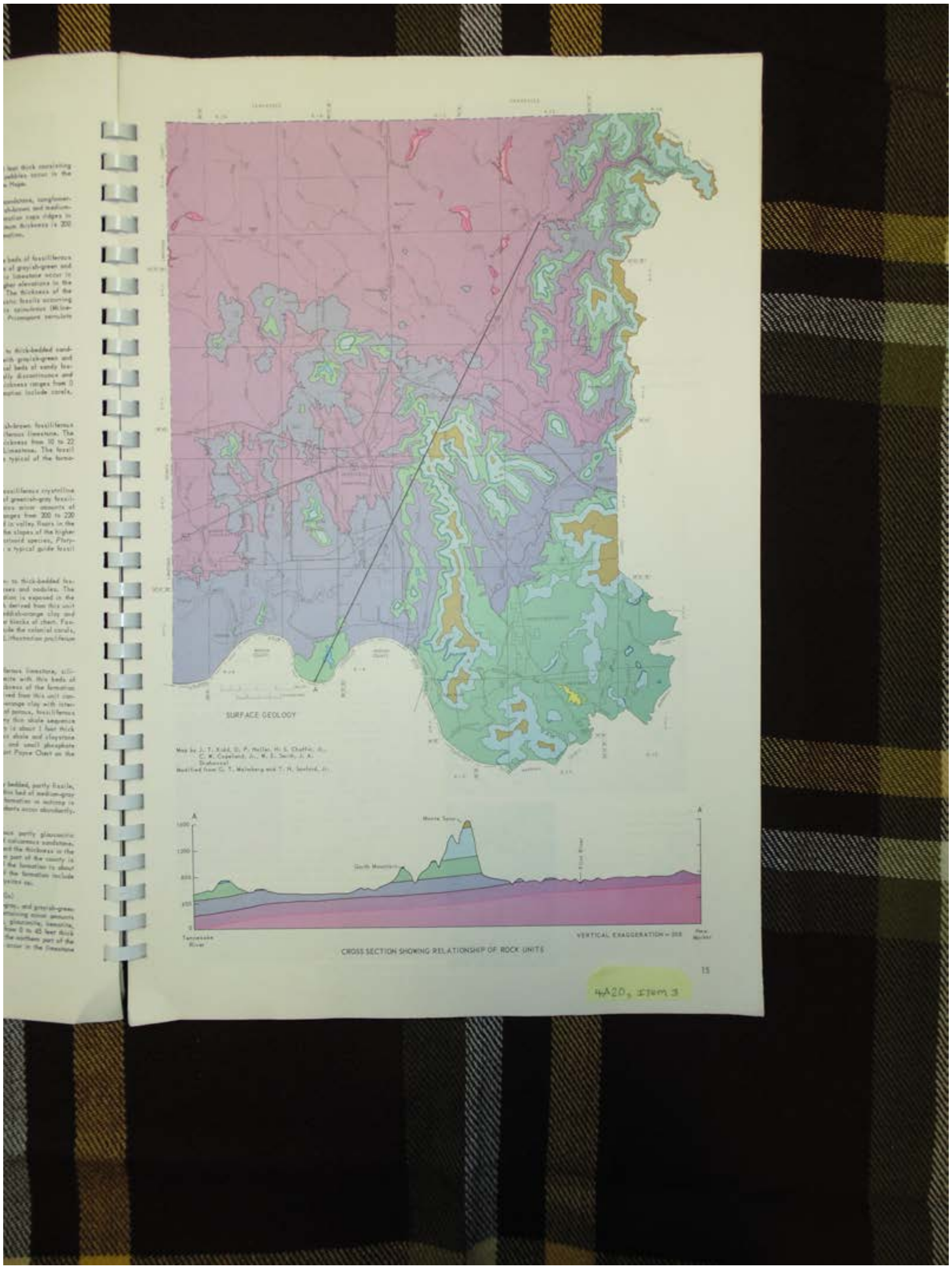

Names:
Surface Geology

Places:
Madison Co., AL

Types:
map

Dates:
1975

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Environmental Geology and Hydrology, 1975
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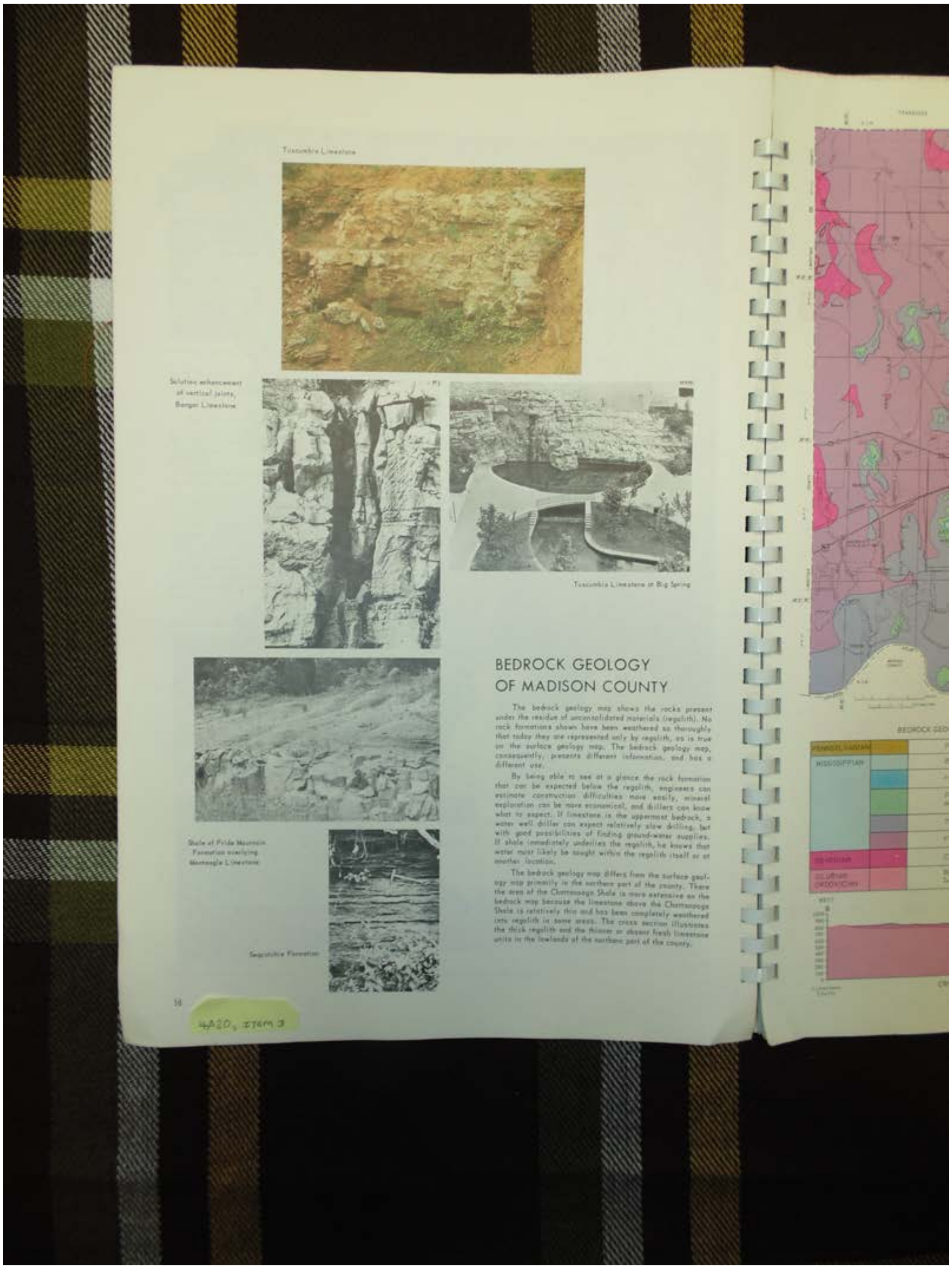

Names:
Bedrock Geology

Places:
Madison Co., AL

Types:
atlas

Dates:
1975

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Environmental Geology and Hydrology, 1975
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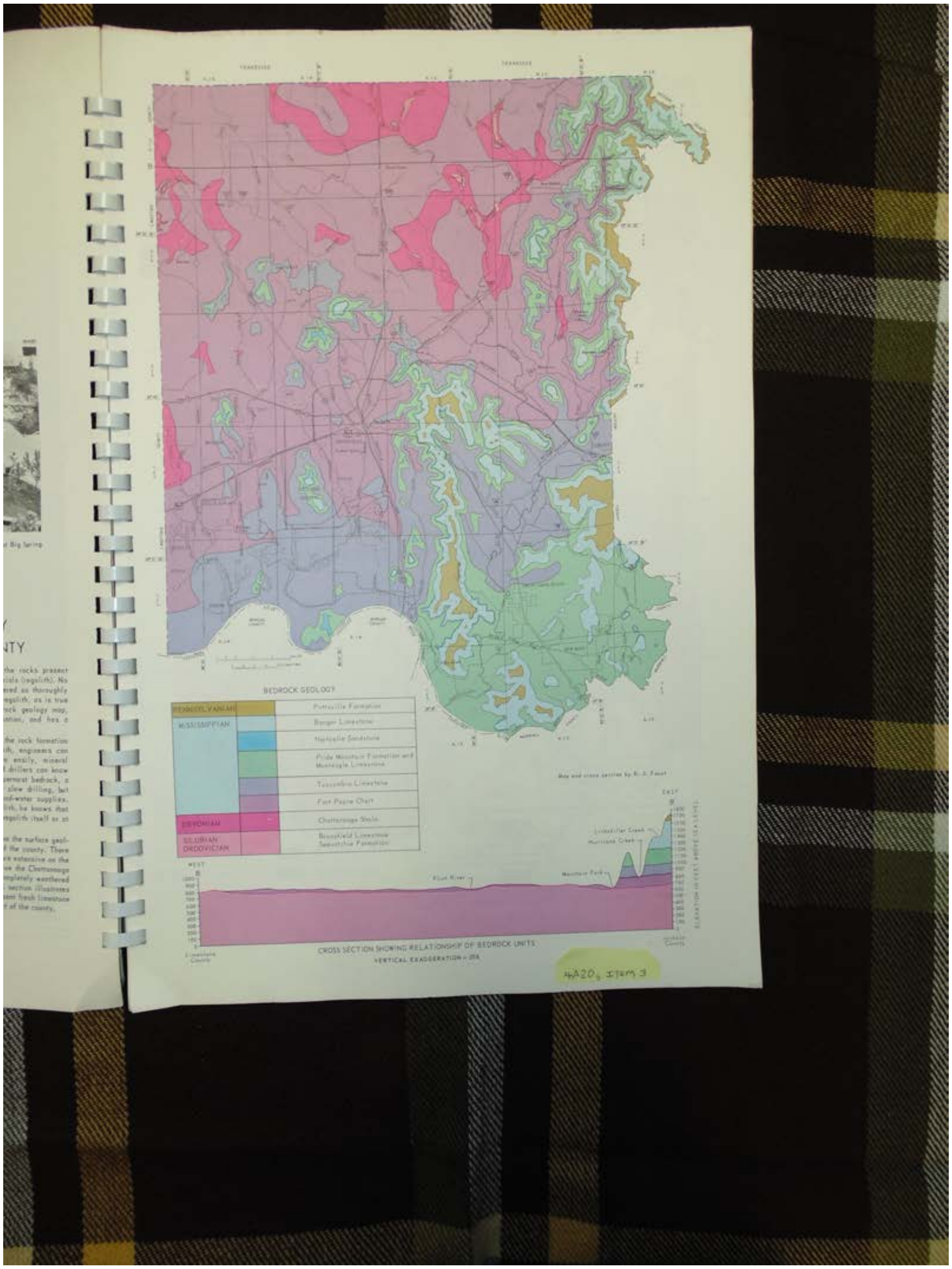

Names:
Bedrock Geology

Places:
Madison Co., AL

Types:
map

Dates:
1975

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Environmental Geology and Hydrology, 1975
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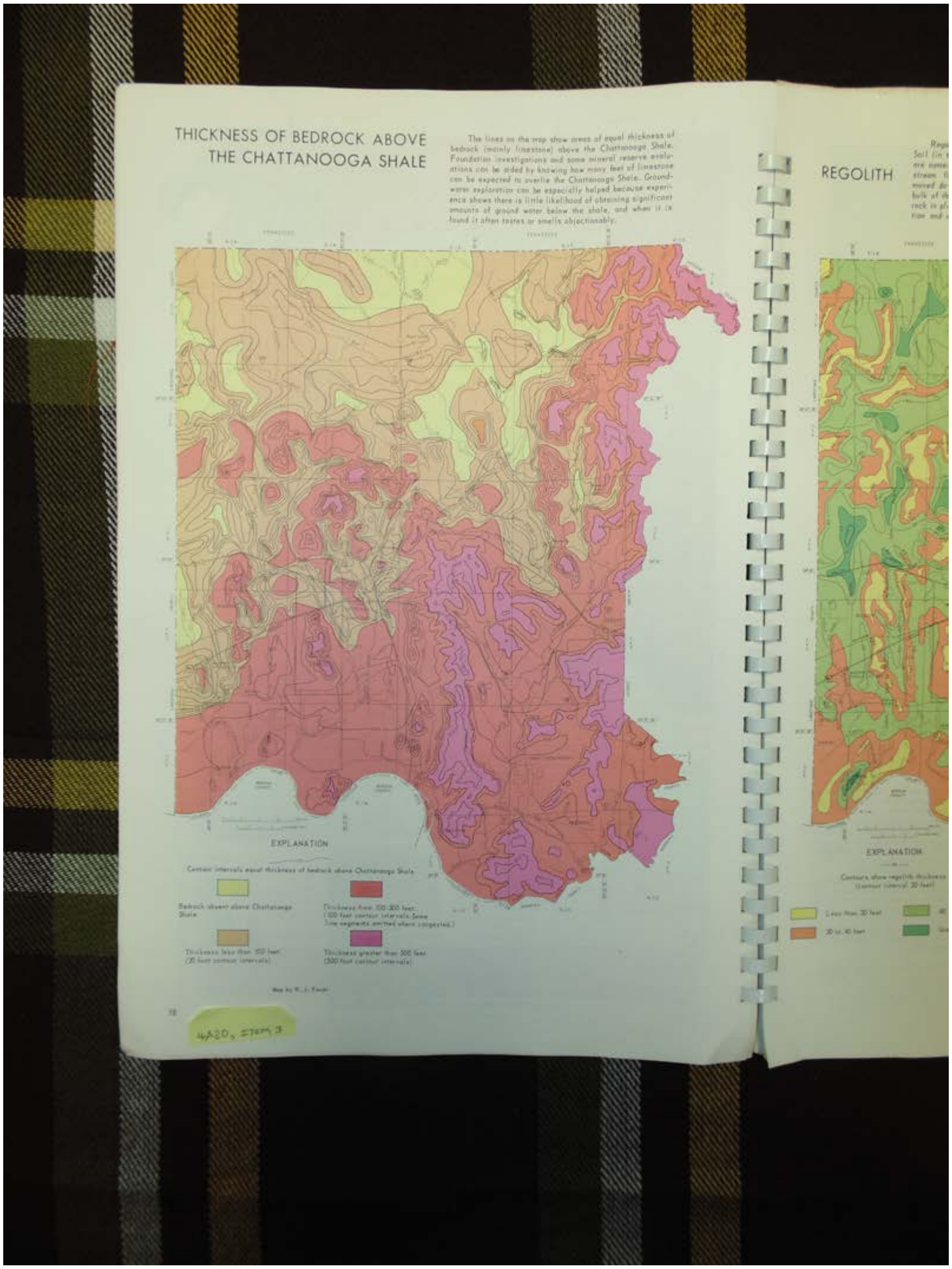

Names:
Thickness of Bedrock

Places:
Madison Co., AL

Types:
atlas map

Dates:
1975

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Environmental Geology and Hydrology, 1975
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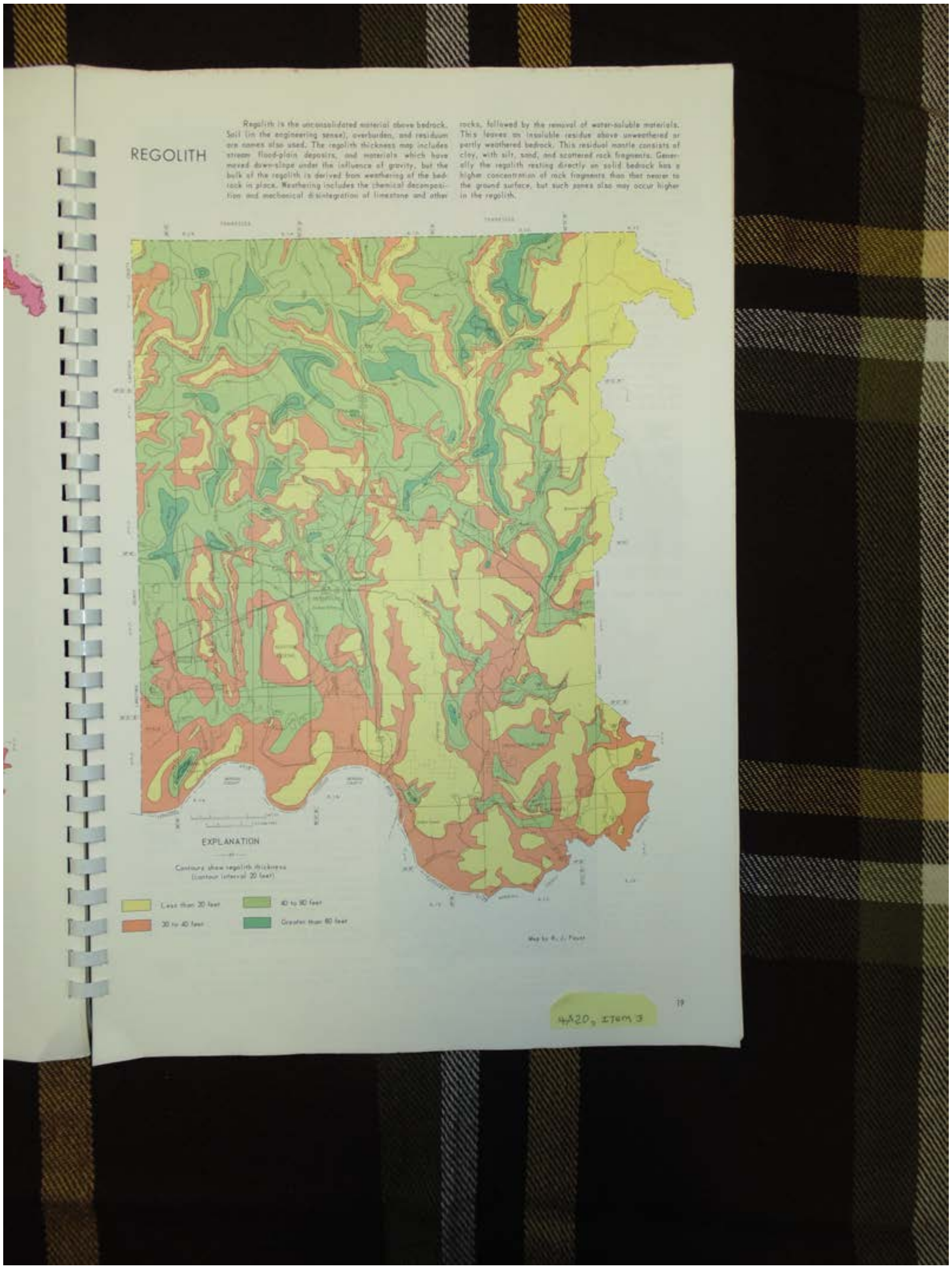

Names:
Regolith

Places:
Madison Co., AL

Types:
atlas map

Dates:
1975

Frances Cabaniss Roberts Collection: Series 4, Subseries A, Box 20, Item 3
Environmental Geology and Hydrology, 1975
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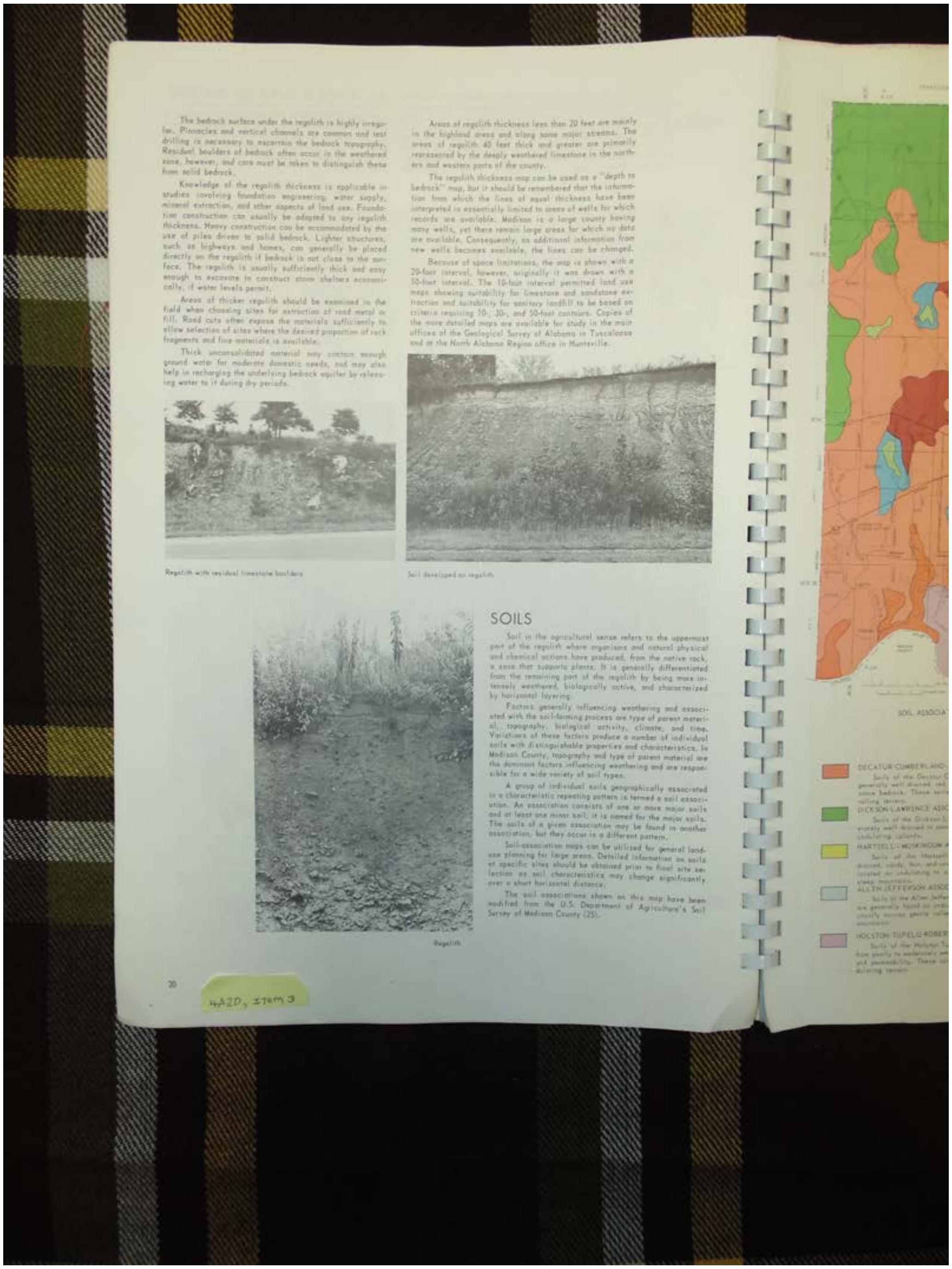

The bedrock surface under the regolith is highly irregular. Pinnacles and vertical channels are common and test drilling is necessary to ascertain the bedrock topography. Residual boulders of bedrock often occur in the weathered zone, however, and care must be taken to distinguish these from solid bedrock.

Knowledge of the regolith thickness is applicable in studies involving foundation engineering, water supply, mineral extraction, and other aspects of land use. Foundation construction can usually be adapted to any regolith thickness. Heavy construction can be accommodated by the use of piles driven to solid bedrock. Lighter structures, such as highways and homes, can generally be placed directly on the regolith if bedrock is not close to the surface. The regolith is usually sufficiently thick and easy enough to excavate to construct storm shelters economically, if water levels permit.

Areas of thicker regolith should be examined in the field when choosing sites for extraction of road metal or fill. Road cuts often expose the materials sufficiently to allow selection of sites where the desired proportion of rock fragments and fine materials is available.

Thick unconsolidated material may contain enough ground water for moderate domestic needs, and may also help in recharging the underlying bedrock aquifer by releasing water to it during dry periods.

Areas of regolith thickness less than 20 feet are mainly in the highland areas and along some major streams. The areas of regolith 40 feet thick and greater are primarily represented by the deeply weathered limestone in the northern and western parts of the county.

The regolith thickness map can be used as a "depth to bedrock" map, but it should be remembered that the information from which the lines of equal thickness have been interpreted is essentially limited to areas of wells for which records are available. Madison is a large county having many wells, yet there remain large areas for which no data are available. Consequently, as additional information from new wells becomes available, the lines can be changed.

Because of space limitations, the map is shown with a 20-foot interval, however, originally it was drawn with a 10-foot interval. The 10-foot interval permitted land use maps showing suitability for limestone and sandstone extraction and suitability for sanitary landfill to be based on criteria requiring 10-, 30-, and 50-foot contours. Copies of the more detailed maps are available for study in the main offices of the Geological Survey of Alabama in Tuscaloosa and at the North Alabama Region office in Huntsville.

Regolith with residual limestone boulders

Soil developed on regolith

SOILS

Soil in the agricultural sense refers to the uppermost part of the regolith where organisms and natural physical and chemical actions have produced, from the native rock, a zone that supports plants. It is generally differentiated from the remaining part of the regolith by being more intensely weathered, biologically active, and characterized by horizontal layering.

Factors generally influencing weathering and associated with the soil-forming process are type of parent material, topography, biological activity, climate, and time. Variations of these factors produce a number of individual soils with distinguishable properties and characteristics. In Madison County, topography and type of parent material are the dominant factors influencing weathering and are responsible for a wide variety of soil types.

A group of individual soils geographically associated in a characteristic repeating pattern is termed a soil association. An association consists of one or more major soils and at least one minor soil; it is named for the major soils. The soils of a given association may be found in another association, but they occur in a different pattern.

Soil-association maps can be utilized for general land-use planning for large areas. Detailed information on soils at specific sites should be obtained prior to final site selection as soil characteristics may change significantly over a short horizontal distance.

The soil associations shown on this map have been modified from the U.S. Department of Agriculture's Soil Survey of Madison County (25).

Regolith

20

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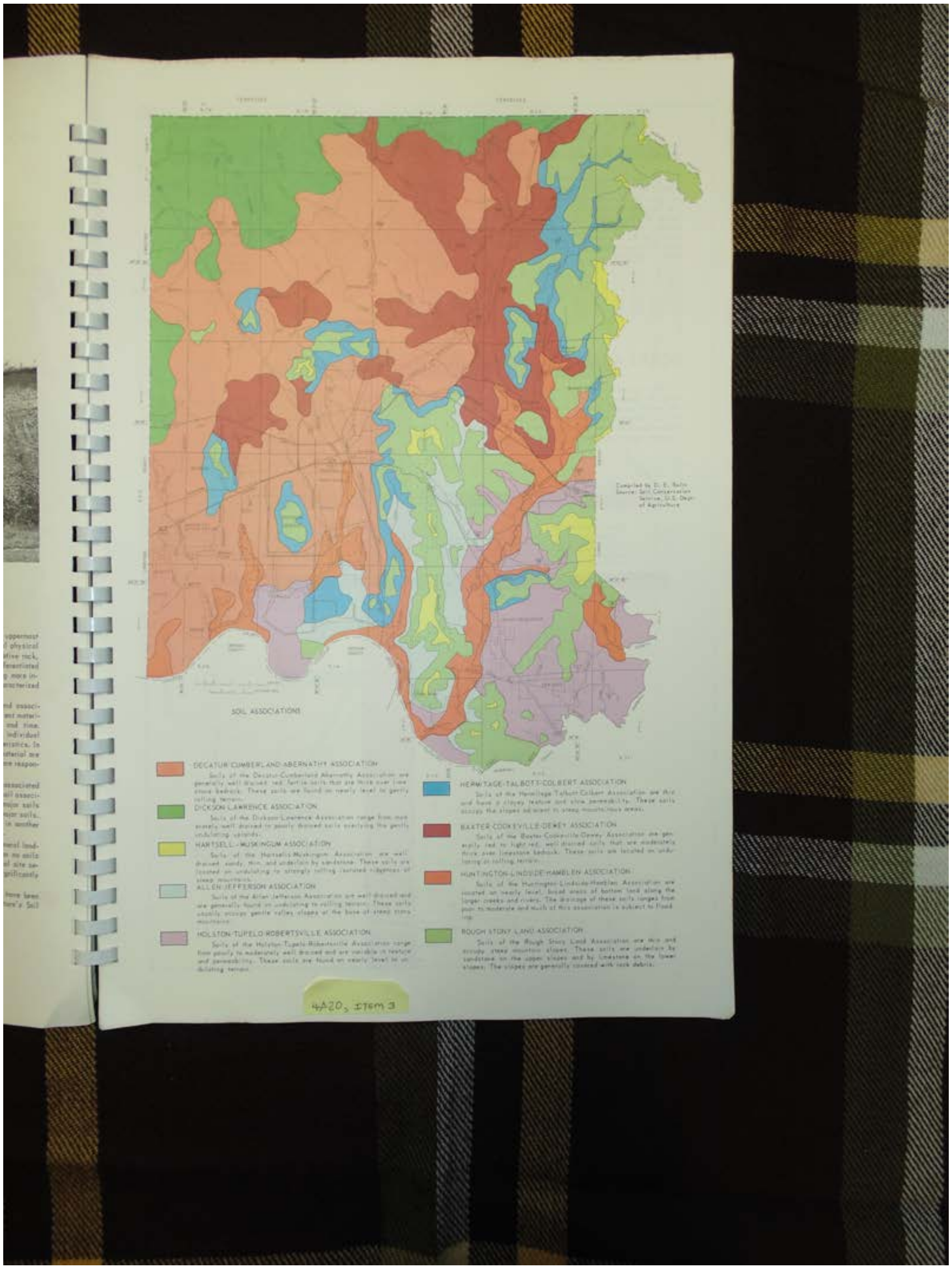
Names:
Regolith Soils

Places:
Madison Co., AL

Types:
atlas atlas photograph

Dates:
1975



Names:
Soil Associations

Places:
Madison Co., AL

Types:
atlas map

Dates:
1975

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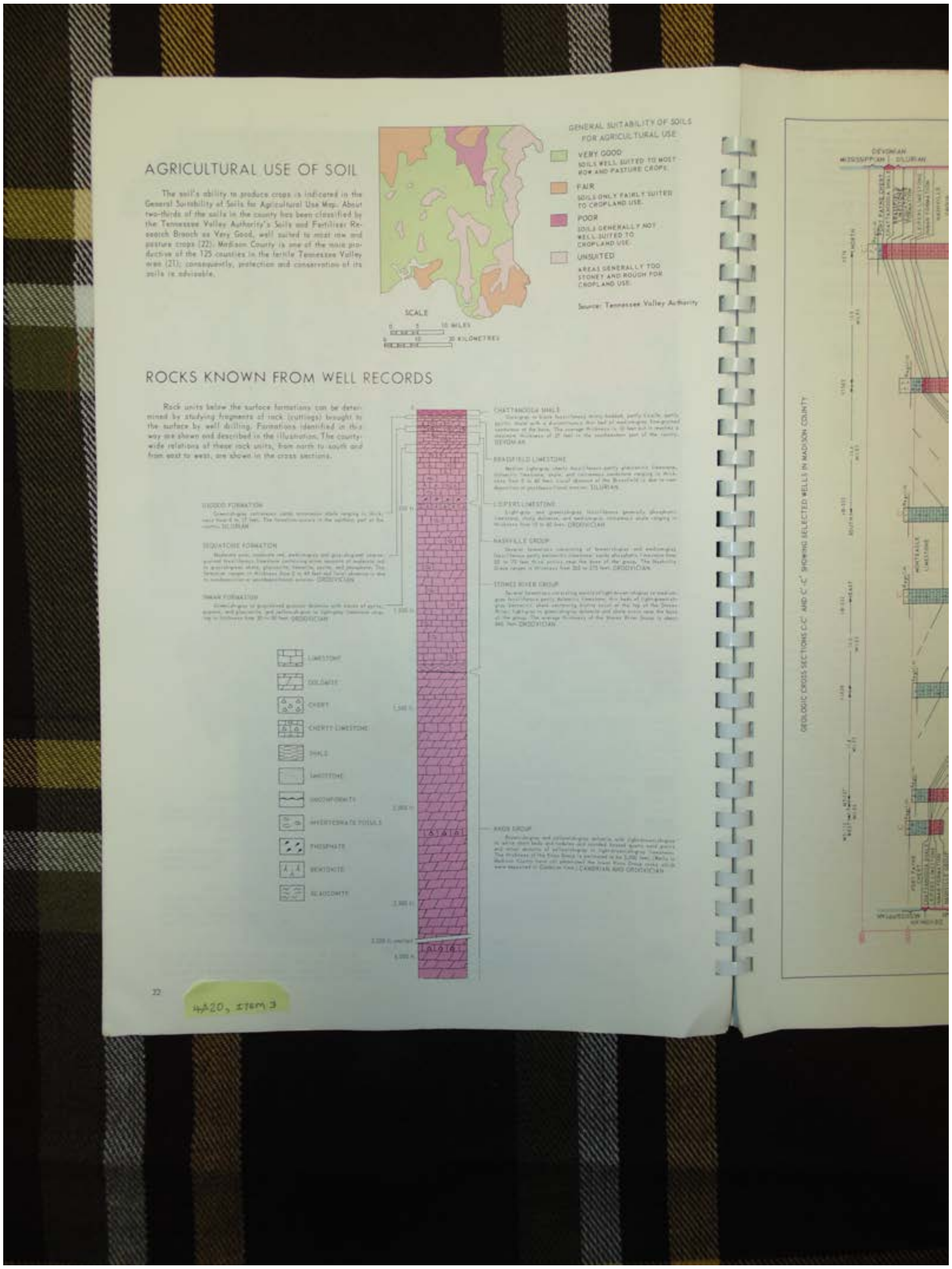


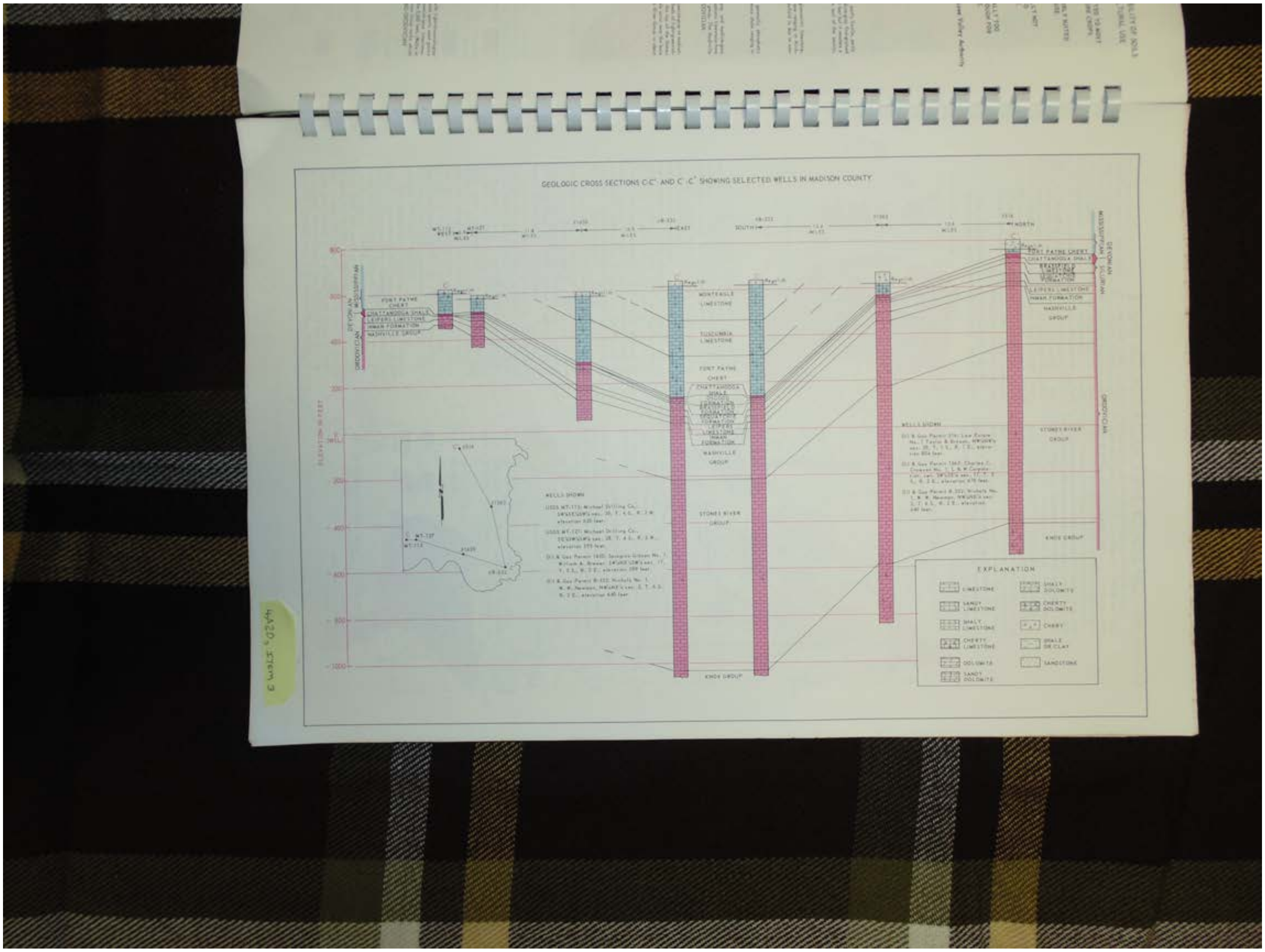
Names:
Agricultural Use of Soil
Rocks Known From Well Records

Places:
Madison Co., AL

Types:
atlas
map
illustration

Dates:
1975

Frances Cabaniss Roberts Collection: Series 4, Subseries A, Box 20, Item 3
Environmental Geology and Hydrology, 1975
Image 26 r04a20-00-003-5089 Contents Index About



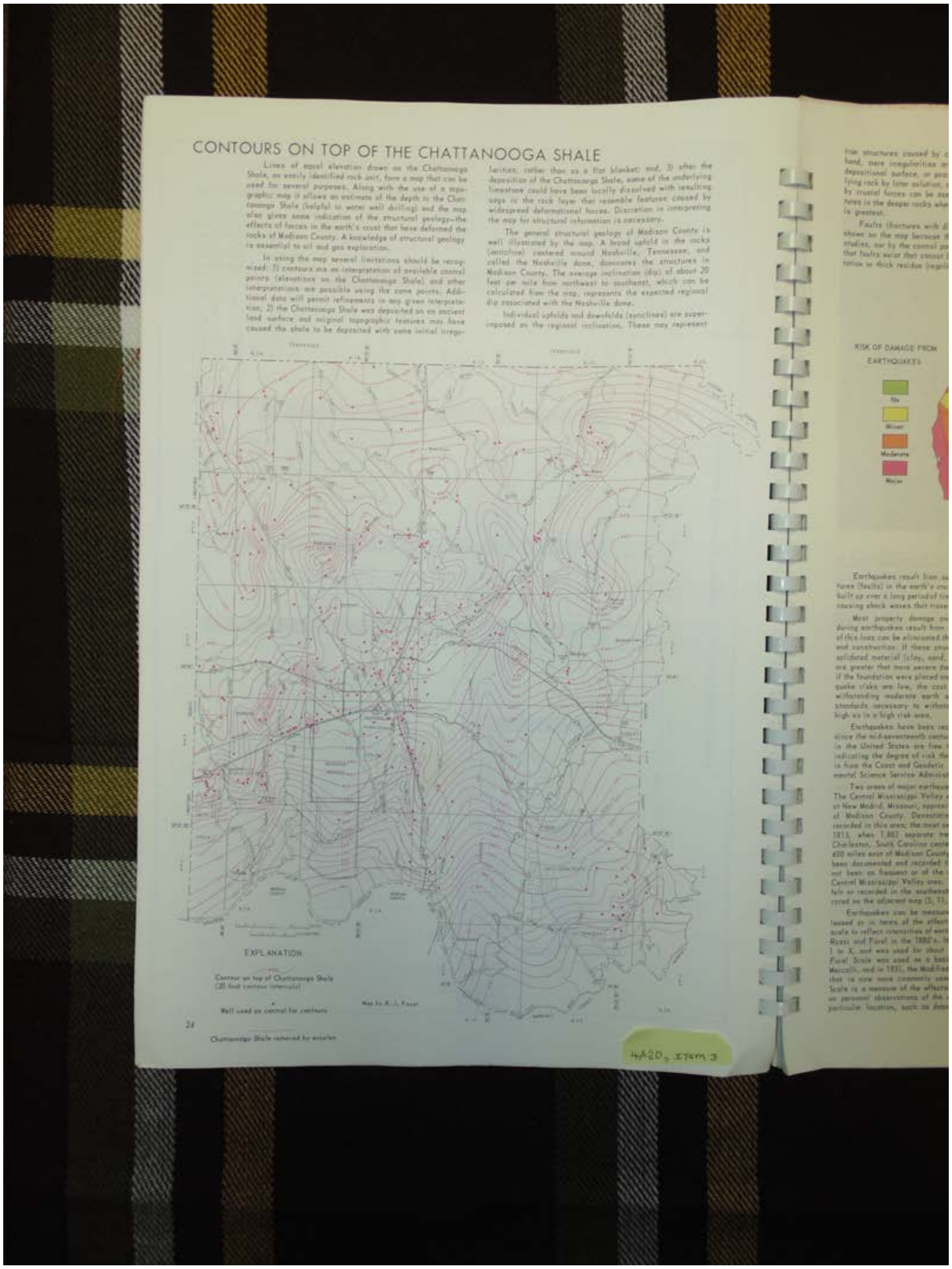
Names:
Geologic Cross Sections of Wells

Places:
Madison Co., AL

Types:
illustration

Dates:
1975

Frances Cabaniss Roberts Collection: Series 4, Subseries A, Box 20, Item 3
Environmental Geology and Hydrology, 1975
Image 27 r04a20-00-003-5090 [Contents](#) [Index](#) [About](#)



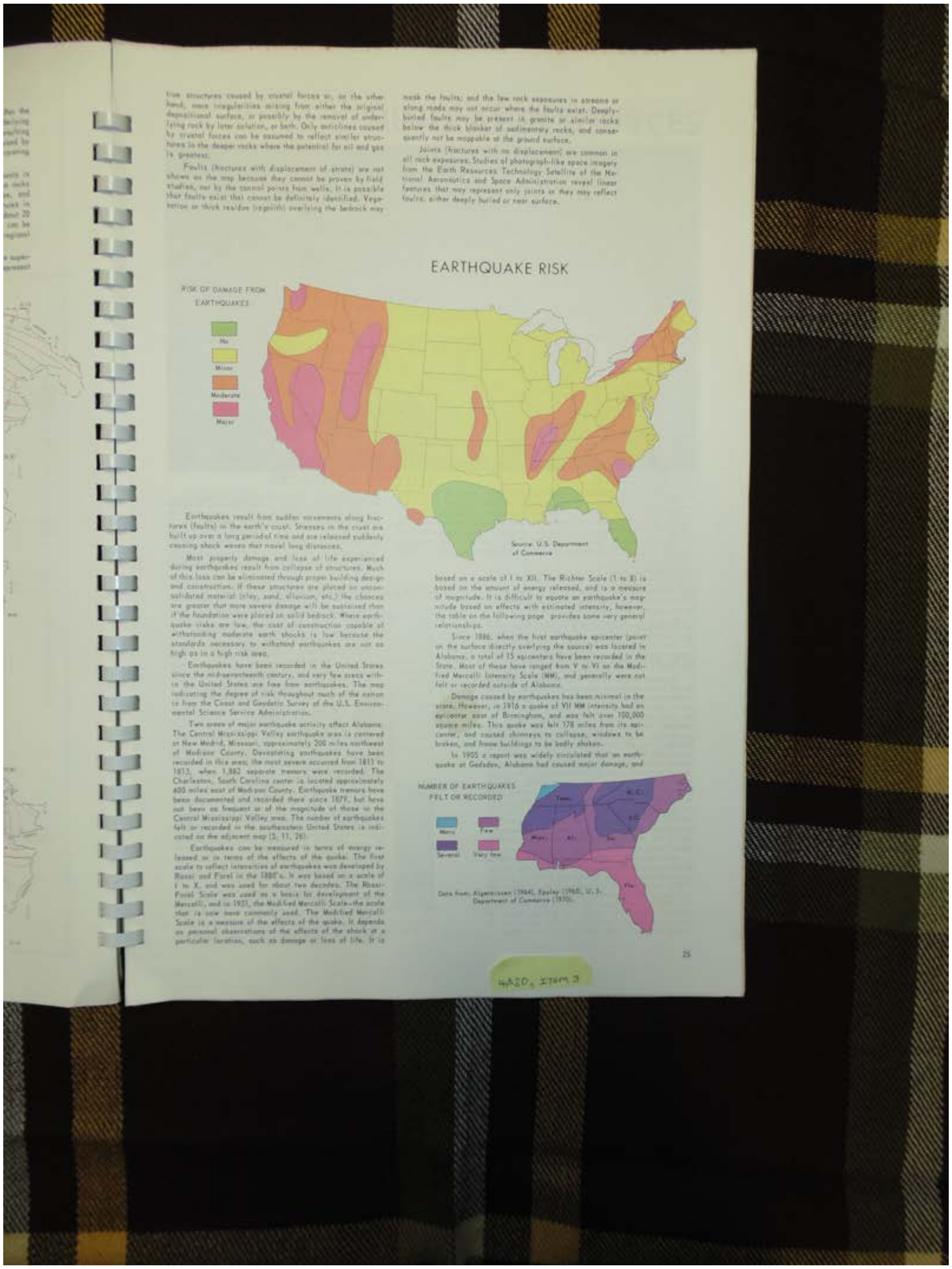
Names:
Contours on Top of Chattanooga Shale

Places:
Madison Co., AL

Types:
atlas
map

Dates:
1975

Frances Cabaniss Roberts Collection: **Series 4, Subseries A, Box 20, Item 3**
Environmental Geology and Hydrology, 1975
Image 28 r04a20-00-003-5091 [Contents](#) [Index](#) [About](#)

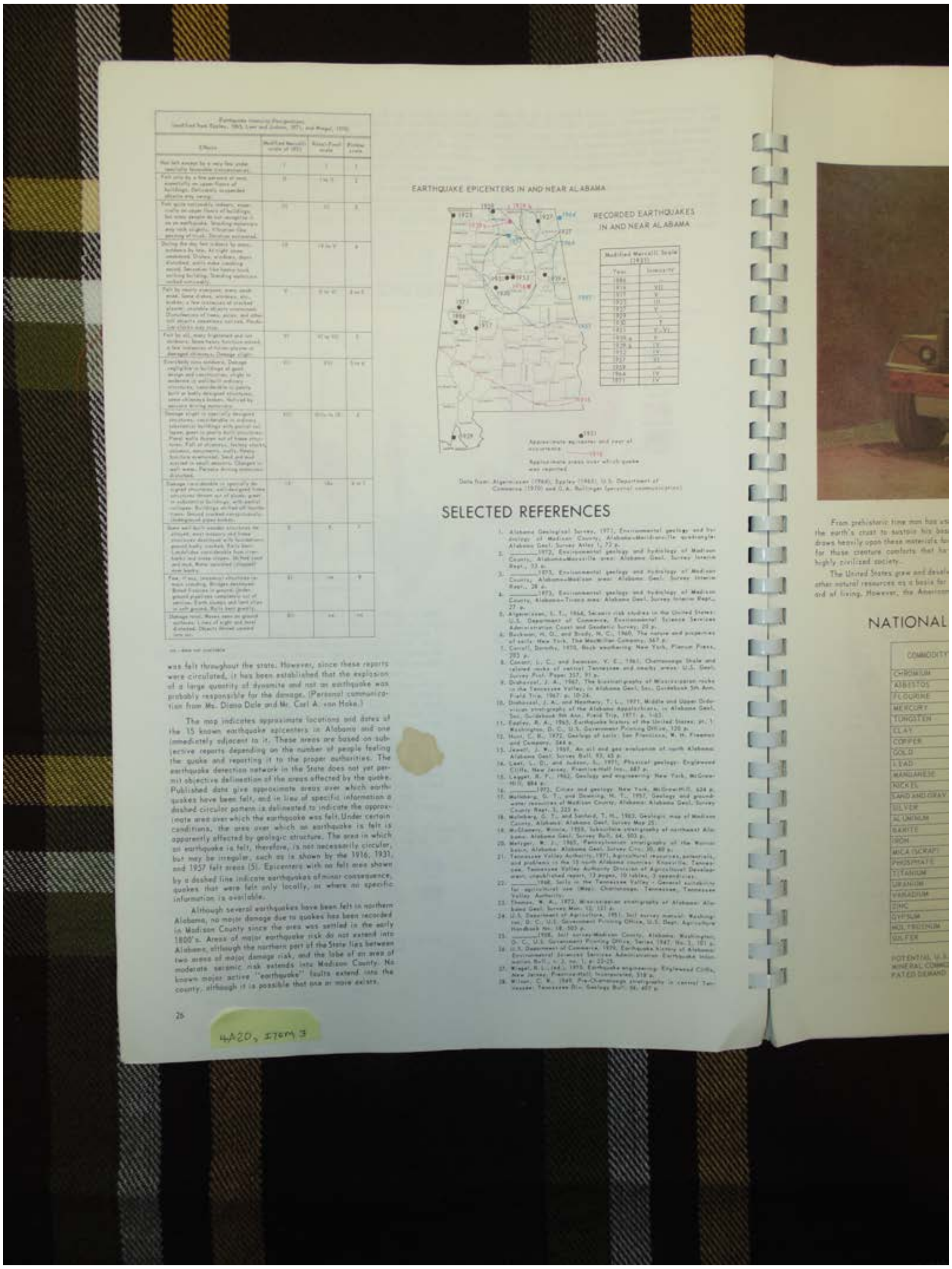


Names:
Earthquake Risk

Places:
Madison Co., AL

Types:
atlas map

Dates:
1975

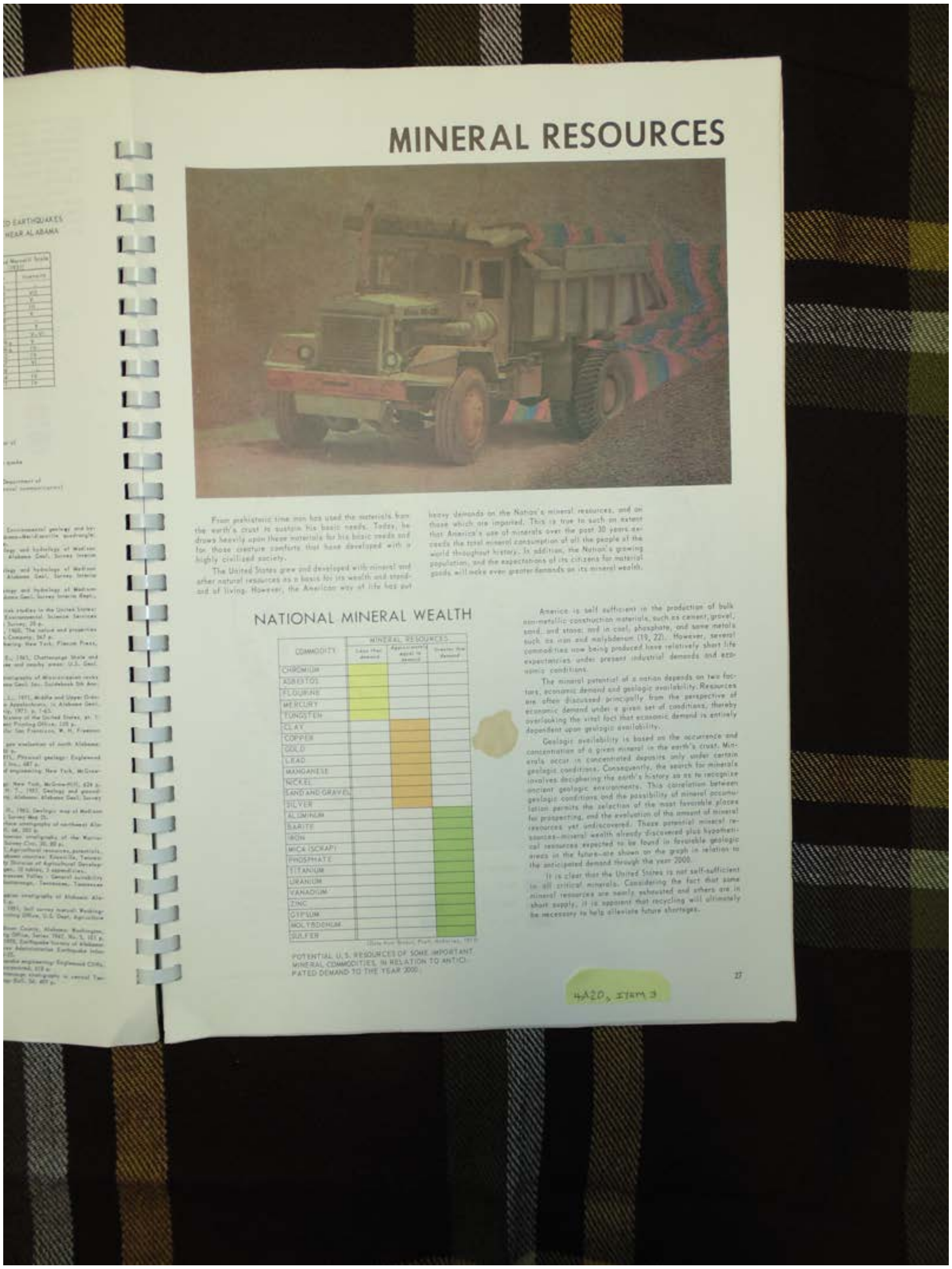


Names:
Earthquake Epicenters in & Near Alabama

Places:
Alabama

Types:
atlas map chart

Dates:
1886-1971



MINERAL RESOURCES

From prehistoric time man has used the materials from the earth's crust to sustain his basic needs. Today, he draws heavily upon these materials for his basic needs and for those creature comforts that have developed with a highly civilized society.

The United States grew and developed with mineral and other natural resources as a basis for its wealth and standard of living. However, the American way of life has put heavy demands on the Nation's mineral resources, and on those which are imported. This is true to such an extent that America's use of minerals over the past 30 years exceeds the total mineral consumption of all the people of the world throughout history. In addition, the Nation's growing population, and the expectations of its citizens for material goods, will make even greater demands on its mineral wealth.

NATIONAL MINERAL WEALTH

POTENTIAL U.S. RESOURCES OF SOME IMPORTANT MINERAL COMMODITIES, IN RELATION TO ANTICIPATED DEMAND TO THE YEAR 2000.

America is self sufficient in the production of bulk nonmetallic construction materials, such as cement, gravel, sand, and stone; and in coal, phosphate, and some metals such as iron and molybdenum (19, 22). However, several commodities now being produced have relatively short life expectancies under present industrial demands and economic conditions.

The mineral potential of a nation depends on two factors, economic demand and geologic availability. Resources are often discussed principally from the perspective of economic demand under a given set of conditions, thereby overlooking the vital fact that economic demand is entirely dependent upon geologic availability.

Geologic availability is based on the occurrence and concentration of a given mineral in the earth's crust. Minerals occur in concentrated deposits only under certain geologic conditions. Consequently, the search for minerals involves deciphering the earth's history so as to recognize ancient geologic environments. This correlation between geologic conditions and the possibility of mineral accumulation permits the selection of the most favorable places for prospecting, and the evaluation of the amount of mineral resources yet undiscovered. These potential mineral resources—mineral wealth already discovered plus hypothetical resources expected to be found in favorable geologic areas in the future—are shown on the graph in relation to the anticipated demand through the year 2000.

It is clear that the United States is not self-sufficient in all critical minerals. Considering the fact that some mineral resources are nearly exhausted and others are in short supply, it is apparent that recycling will ultimately be necessary to help alleviate future shortages.

4A20, ITEM 3

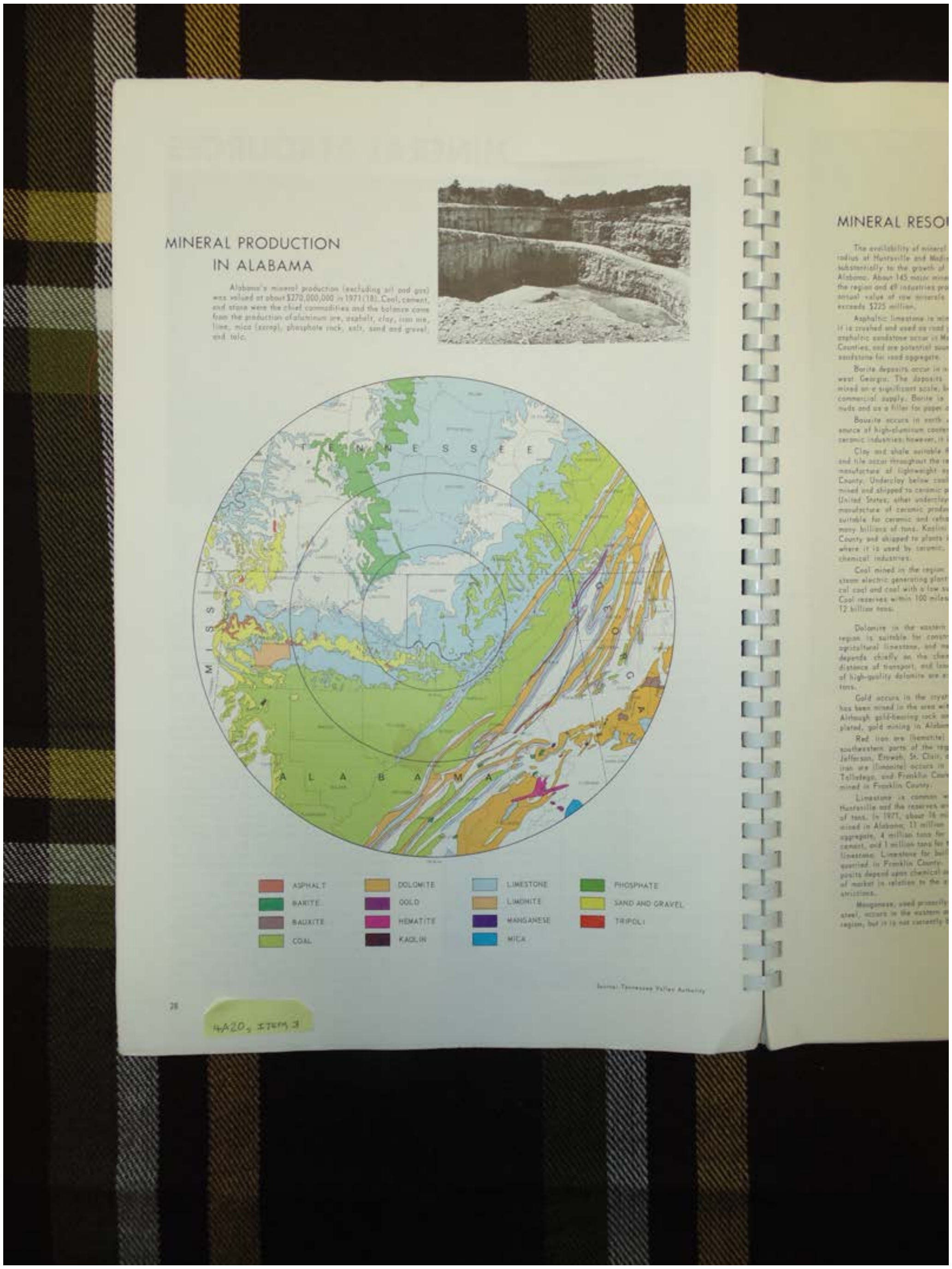
Names:
Mineral Resources

Places:
United States

Types:
atlas chart

Dates:
1975

Frances Cabaniss Roberts Collection: **Series 4, Subseries A, Box 20, Item 3**
Environmental Geology and Hydrology, 1975
Image 31 r04a20-00-003-5094 Contents Index About



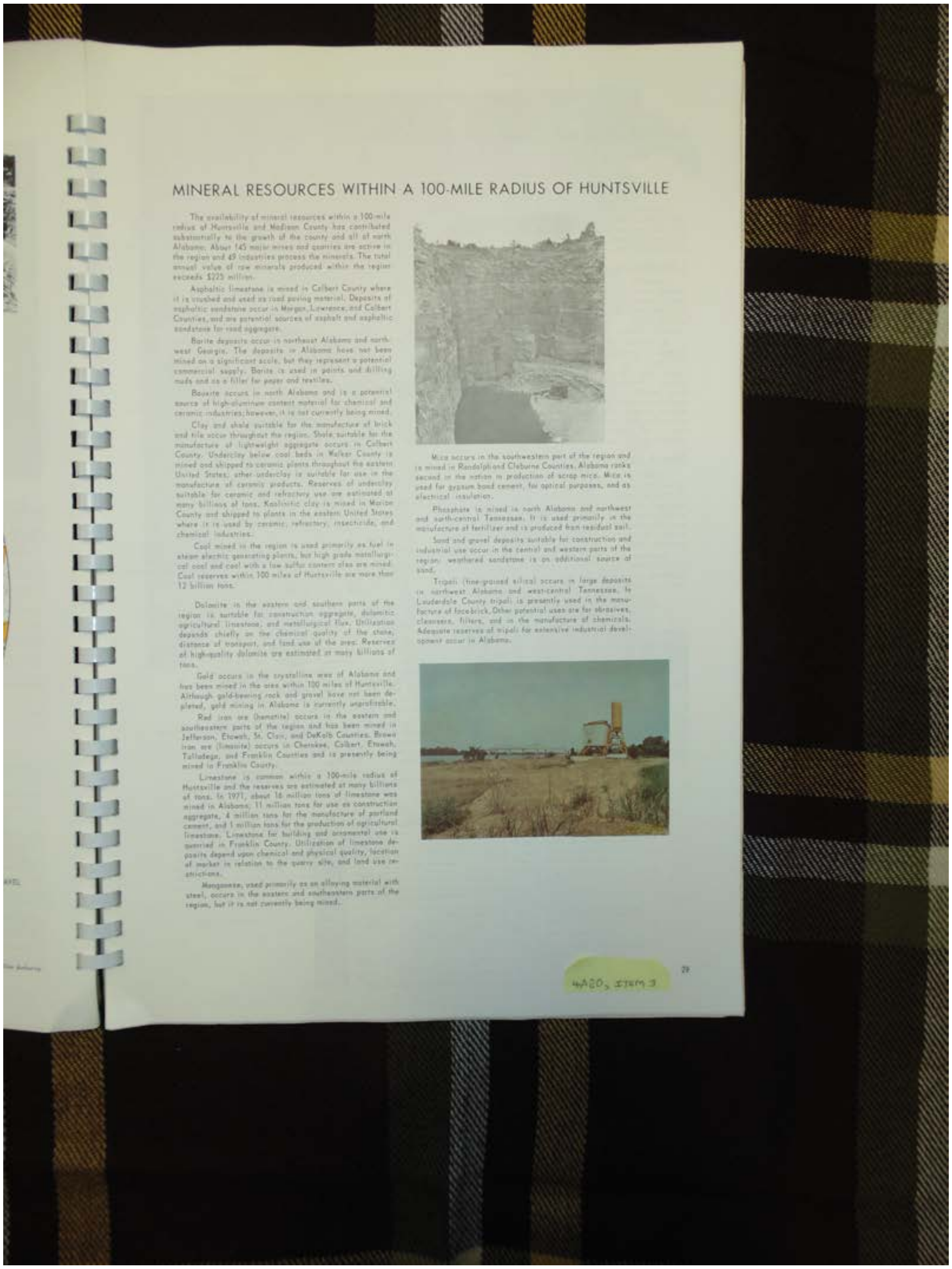
Names:
Mineral Production

Places:
Alabama

Types:
atlas map chart

Dates:
1975

Frances Cabaniss Roberts Collection: **Series 4, Subseries A, Box 20, Item 3**
Environmental Geology and Hydrology, 1975
Image 32 r04a20-00-003-5095 Contents Index About



MINERAL RESOURCES WITHIN A 100-MILE RADIUS OF HUNTSVILLE

The availability of mineral resources within a 100-mile radius of Huntsville and Madison County has contributed substantially to the growth of the county and all of north Alabama. About 145 major mines and quarries are active in the region and 49 industries process the minerals. The total annual value of raw minerals produced within the region exceeds $225 million.

Asphaltic limestone is mined in Colbert County where it is crushed and used as road paving material. Deposits of asphaltic sandstone occur in Morgan, Lawrence, and Colbert Counties, and are potential sources of asphalt and asphaltic sandstone for road aggregate.

Barite deposits occur in northeast Alabama and northwest Georgia. The deposits in Alabama have not been mined on a significant scale, but they represent a potential commercial supply. Barite is used in paints and drilling muds and as a filler for paper and textiles.

Bauxite occurs in north Alabama and is a potential source of high-aluminum content material for chemical and ceramic industries; however, it is not currently being mined.

Clay and shale suitable for the manufacture of brick and tile occur throughout the region. Shale suitable for the manufacture of lightweight aggregate occurs in Colbert County. Underclay below coal beds in Walker County is mined and shipped to ceramic plants throughout the eastern United States; other underclay is suitable for use in the manufacture of ceramic products. Reserves of underclay suitable for ceramic and refractory use are estimated at many billions of tons. Kaolinitic clay is mined in Marion County and shipped to plants in the eastern United States where it is used by ceramic, refractory, insecticide, and chemical industries.

Coal mined in the region is used primarily as fuel in steam electric generating plants, but high grade metallurgical coal and coal with a low sulfur content also are mined. Coal reserves within 100 miles of Huntsville are more than 12 billion tons.

Dolomite in the eastern and southern parts of the region is suitable for construction aggregate, dolomitic agricultural limestone, and metallurgical flux. Utilization depends chiefly on the chemical quality of the stone, distance of transport, and land use of the area. Reserves of high-quality dolomite are estimated at many billions of tons.

Gold occurs in the crystalline area of Alabama and has been mined in the area within 100 miles of Huntsville. Although gold-bearing rock and gravel have not been depleted, gold mining in Alabama is currently unprofitable.

Red iron ore (hematite) occurs in the eastern and southeastern parts of the region and has been mined in Jefferson, Etowah, St. Clair, and DeKalb Counties. Brown iron ore (limonite) occurs in Cherokee, Colbert, Etowah, Talladega, and Franklin Counties and is presently being mined in Franklin County.

Limestone is common within a 100-mile radius of Huntsville and the reserves are estimated at many billions of tons. In 1971, about 16 million tons of limestone was mined in Alabama; 11 million tons for use as construction aggregate, 4 million tons for the manufacture of portland cement, and 1 million tons for the production of agricultural limestone. Limestone for building and ornamental use is quarried in Franklin County. Utilization of limestone deposits depend upon chemical and physical quality, location of market in relation to the quarry site, and land use restrictions.

Manganese, used primarily as an alloying material with steel, occurs in the eastern and southeastern parts of the region, but it is not currently being mined.

Mica occurs in the southwestern part of the region and is mined in Randolph and Cleburne Counties. Alabama ranks second in the nation in production of scrap mica. Mica is used for gypsum bond cement, for optical purposes, and as electrical insulation.

Phosphate is mined in north Alabama and northwest and north-central Tennessee. It is used primarily in the manufacture of fertilizer and is produced from residual soil.

Sand and gravel deposits suitable for construction and industrial use occur in the central and western parts of the region; weathered sandstone is an additional source of sand.

Tripoli (fine-grained silica) occurs in large deposits in northwest Alabama and west-central Tennessee. In Lauderdale County tripoli is presently used in the manufacture of face-brick. Other potential uses are for abrasives, cleansers, filters, and in the manufacture of chemicals. Adequate reserves of tripoli for extensive industrial development occur in Alabama.

Names:

Asphaltic Limestone	Dolomite	Mineral Resources Near Huntsville	Red Iron Ore (Hematite)
Barite	Gold	Phosphate	Sand & Gravel
Clay & Shale	Manganese		Tripoli
Coal	Mica		

Places:

Huntsville & Madison Co., AL
North Alabama

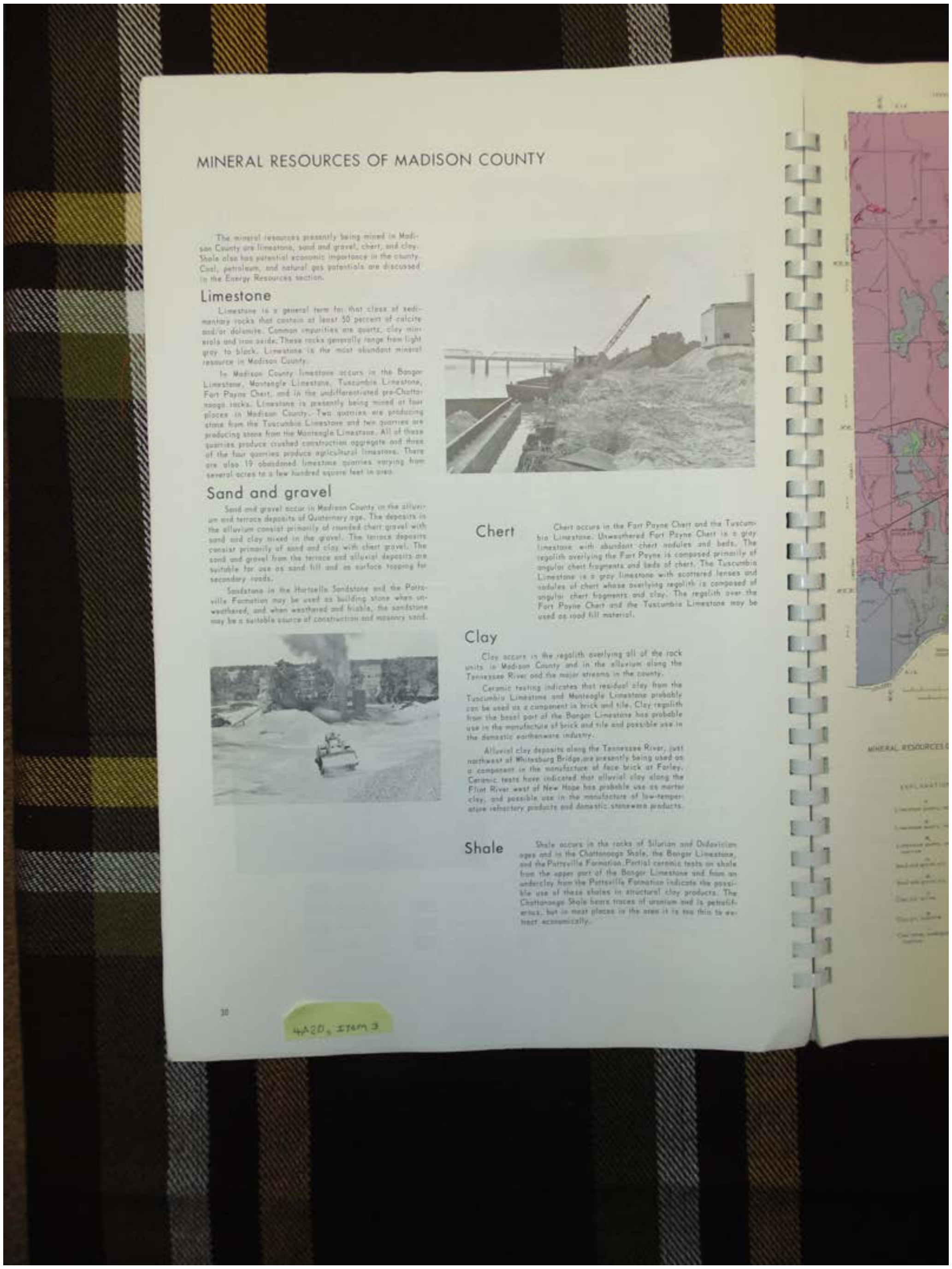
Types:

atlas

Dates:

1975

Frances Cabaniss Roberts Collection: **Series 4, Subseries A, Box 20, Item 3**
Environmental Geology and Hydrology, 1975
Image 33 r04a20-00-003-5096 Contents Index About



MINERAL RESOURCES OF MADISON COUNTY

The mineral resources presently being mined in Madison County are limestone, sand and gravel, chert, and clay. Shale also has potential economic importance in the county. Coal, petroleum, and natural gas potentials are discussed in the Energy Resources section.

Limestone

Limestone is a general term for that class of sedimentary rocks that contain at least 50 percent of calcite and/or dolomite. Common impurities are quartz, clay minerals and iron oxide. These rocks generally range from light gray to black. Limestone is the most abundant mineral resource in Madison County.

In Madison County limestone occurs in the Bangor Limestone, Monteagle Limestone, Tuscumbia Limestone, Fort Payne Chert, and in the undifferentiated pre-Chattanooga rocks. Limestone is presently being mined at four places in Madison County. Two quarries are producing stone from the Tuscumbia Limestone and two quarries are producing stone from the Monteagle Limestone. All of these quarries produce crushed construction aggregate and three of the four quarries produce agricultural limestone. There are also 19 abandoned limestone quarries varying from several acres to a few hundred square feet in area.

Sand and gravel

Sand and gravel occur in Madison County in the alluvium and terrace deposits of Quaternary age. The deposits in the alluvium consist primarily of rounded chert gravel with sand and clay mixed in the gravel. The terrace deposits consist primarily of sand and clay with chert gravel. The sand and gravel from the terrace and alluvial deposits are suitable for use as sand fill and as surface topping for secondary roads.

Sandstone in the Hartselle Sandstone and the Pottsville Formation may be used as building stone when unweathered, and when weathered and friable, the sandstone may be a suitable source of construction and masonry sand.

Chert

Chert occurs in the Fort Payne Chert and the Tuscumbia Limestone. Unweathered Fort Payne Chert is a gray limestone with abundant chert nodules and beds. The regolith overlying the Fort Payne is composed primarily of angular chert fragments and beds of chert. The Tuscumbia Limestone is a gray limestone with scattered lenses and nodules of chert whose overlying regolith is composed of angular chert fragments and clay. The regolith over the Fort Payne Chert and the Tuscumbia Limestone may be used as road fill material.

Clay

Clay occurs in the regolith overlying all of the rock units in Madison County and in the alluvium along the Tennessee River and the major streams in the county.

Ceramic testing indicates that residual clay from the Tuscumbia Limestone and Monteagle Limestone probably can be used as a component in brick and tile. Clay regolith from the basal part of the Bangor Limestone has probable use in the manufacture of brick and tile and possible use in the domestic earthenware industry.

Alluvial clay deposits along the Tennessee River, just northwest of Whitesburg Bridge, are presently being used as a component in the manufacture of face brick at Farley. Ceramic tests have indicated that alluvial clay along the Flint River west of New Hope has probable use as mortar clay, and possible use in the manufacture of low-temperature refractory products and domestic stoneware products.

Shale

Shale occurs in the rocks of Silurian and Ordovician ages and in the Chattanooga Shale, the Bangor Limestone, and the Pottsville Formation. Partial ceramic tests on shale from the upper part of the Bangor Limestone and from an underclay from the Pottsville Formation indicate the possible use of these shales in structural clay products. The Chattanooga Shale bears traces of uranium and is petroliferous, but in most places in the area it is too thin to extract economically.

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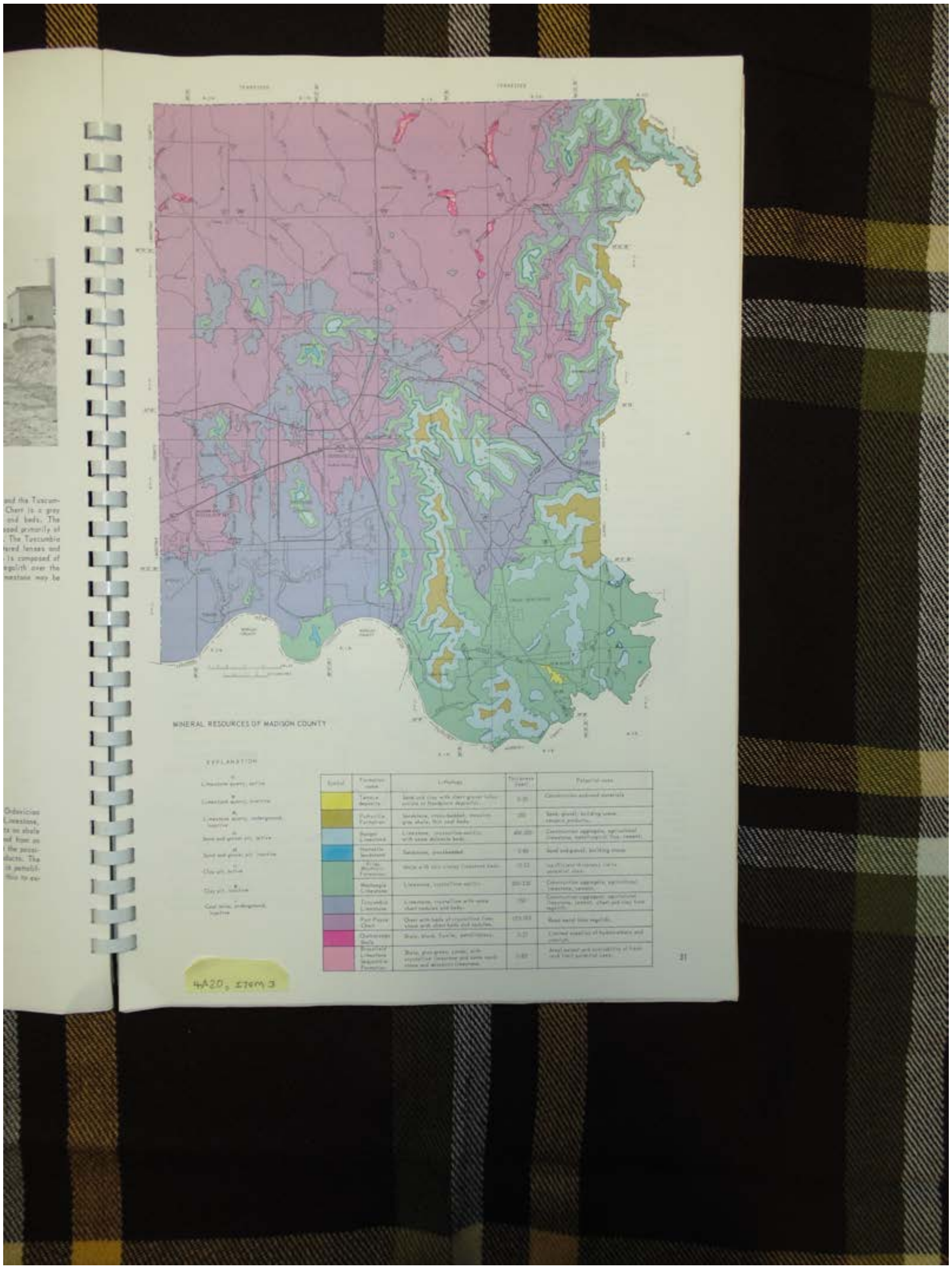
Names:
Chert
Clay
Limestone
Sand & Gravel
Shale

Places:
Madison Co., AL

Types:
atlas
atlas
photograph

Dates:
1975



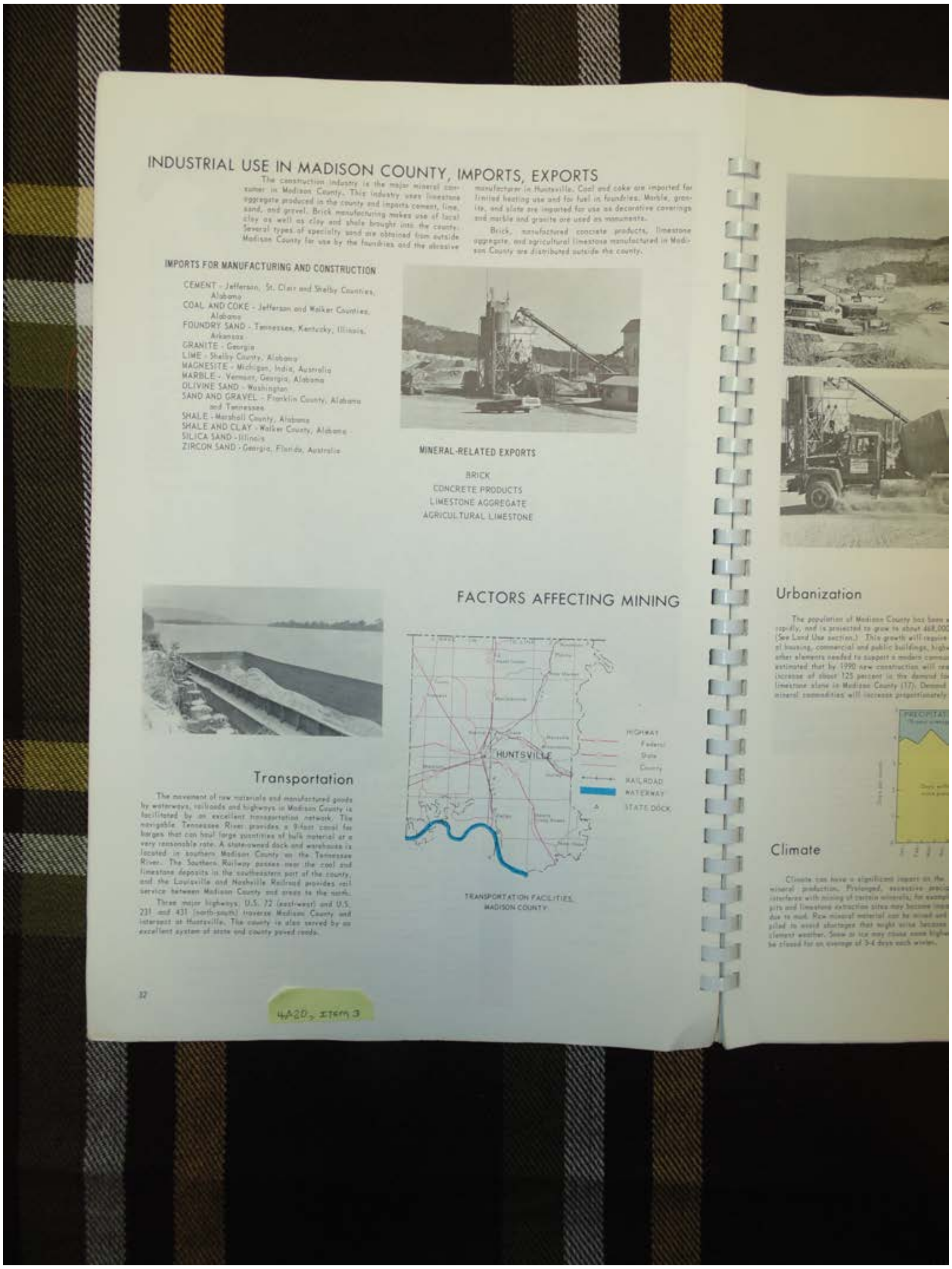
Names:
Mineral Resources

Places:
Madison Co., AL

Types:
map chart

Dates:
1975

Frances Cabaniss Roberts Collection: Series 4, Subseries A, Box 20, Item 3
Environmental Geology and Hydrology, 1975
Image 35 r04a20-00-003-5098 Contents Index About


INDUSTRIAL USE IN MADISON COUNTY, IMPORTS, EXPORTS

The construction industry is the major mineral consumer in Madison County. This industry uses limestone aggregate produced in the county and imports cement, lime, sand, and gravel. Brick manufacturing makes use of local clay as well as clay and shale brought into the county. Several types of specialty sand are obtained from outside Madison County for use by the foundries and the abrasive manufacturer in Huntsville. Coal and coke are imported for limited heating use and for fuel in foundries. Marble, granite, and slate are imported for use as decorative coverings and marble and granite are used as monuments.

Brick, manufactured concrete products, limestone aggregate, and agricultural limestone manufactured in Madison County are distributed outside the county.

IMPORTS FOR MANUFACTURING AND CONSTRUCTION

CEMENT - Jefferson, St. Clair and Shelby Counties, Alabama
COAL AND COKE - Jefferson and Walker Counties, Alabama
FOUNDRY SAND - Tennessee, Kentucky, Illinois, Arkansas
GRANITE - Georgia
LIME - Shelby County, Alabama
MAGNESITE - Michigan, India, Australia
MARBLE - Vermont, Georgia, Alabama
OLIVINE SAND - Washington
SAND AND GRAVEL - Franklin County, Alabama and Tennessee
SHALE - Marshall County, Alabama
SHALE AND CLAY - Walker County, Alabama
SILICA SAND - Illinois
ZIRCON SAND - Georgia, Florida, Australia

MINERAL-RELATED EXPORTS

BRICK
CONCRETE PRODUCTS
LIMESTONE AGGREGATE
AGRICULTURAL LIMESTONE

FACTORS AFFECTING MINING

Transportation

The movement of raw materials and manufactured goods by waterways, railroads and highways in Madison County is facilitated by an excellent transportation network. The navigable Tennessee River provides a 9-foot canal for barges that can haul large quantities of bulk material at a very reasonable rate. A state-owned dock and warehouse is located in southern Madison County on the Tennessee River. The Southern Railway passes near the coal and limestone deposits in the southeastern part of the county, and the Louisville and Nashville Railroad provides rail service between Madison County and areas to the north.

Three major highways, U.S. 72 (east-west) and U.S. 231 and 431 (north-south) traverse Madison County and intersect at Huntsville. The county is also served by an excellent system of state and county paved roads.

HUNTSVILLE
HIGHWAY
Federal
State
County
RAILROAD
WATERWAY
STATE DOCK

TRANSPORTATION FACILITIES, MADISON COUNTY

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4A20, ITEM 3

Urbanization

Climate

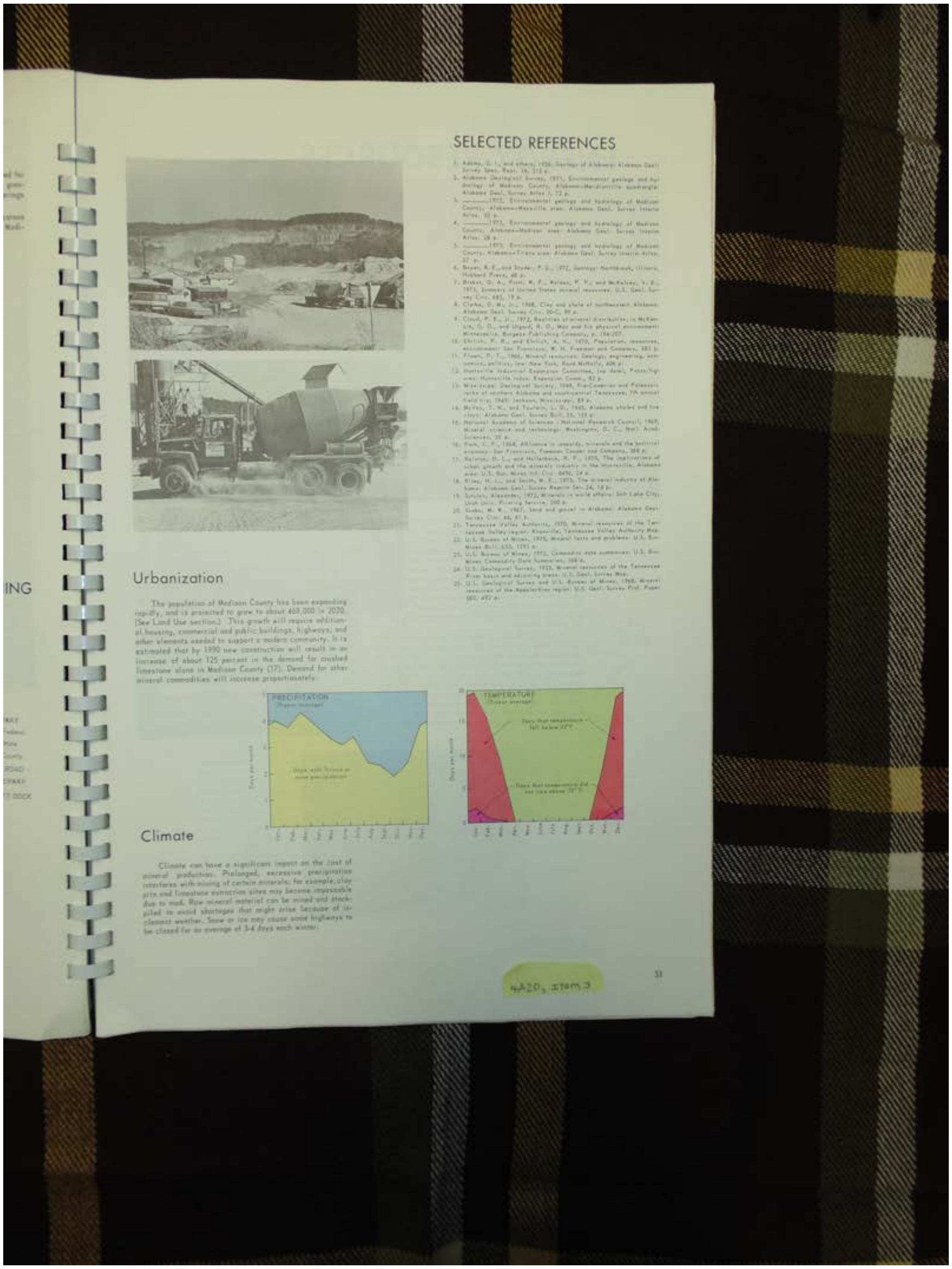
Names:
Factors Affecting Mining
Imports For Maufacturing & Construction
Industrial Use, Imports, Exports
Mineral-Related Exports
Transportation Facilities

Places:
Madison Co., AL

Types:
atlas
atlas
map
list

Dates:
1975

Frances Cabaniss Roberts Collection: Series 4, Subseries A, Box 20, Item 3
Environmental Geology and Hydrology, 1975
Image 36 r04a20-00-003-5099 [Contents](#) [Index](#) [About](#)



SELECTED REFERENCES

Urbanization

The population of Madison County has been expanding rapidly, and is projected to grow to about 469,000 in 2020 (See Land Use section.) This growth will require additional housing, commercial and public buildings, highways, and other elements needed to support a modern community. It is estimated that by 1990 new construction will result in an increase of about 125 percent in the demand for crushed limestone alone in Madison County (17). Demand for other mineral commodities will increase proportionately.

Climate

Climate can have a significant impact on the cost of mineral production. Prolonged, excessive precipitation interferes with mining of certain minerals; for example, clay pits and limestone extraction sites may become impassable due to mud. Raw mineral material can be mined and stockpiled to avoid shortages that might arise because of inclement weather. Snow or ice may cause some highways to be closed for an average of 3-4 days each winter.

4A20, item 3

Names:
Climate
Urbanization

Places:
Madison Co., AL

Types:
atlas

Dates:
1975

Frances Cabaniss Roberts Collection: Series 4, Subseries A, Box 20, Item 3
Environmental Geology and Hydrology, 1975
Image 37 r04a20-00-003-5100 [Contents](#) [Index](#) [About](#)

ENERGY RESOURCES

Energy is a basic natural resource. All energy used by man is ultimately derived from four natural sources: the radiation of the sun, the energy of the tides, the heat inside the earth, and the energy stored in the atomic nucleus. The energy from the traditional primary sources—wood and the fossil fuels, coal, lignite, petroleum, and natural gas—are all ultimately derived from solar radiation. Nuclear energy, geothermal energy, and direct utilization of solar radiation are primary energy sources that are beginning to supplement the traditional energy sources. Electrical power is a secondary energy source which may be generated using any of the primary sources.

The United States has abundant energy sources. Our plentiful coal and lignite and considerable reserves in petroleum and natural gas put America in an enviable position among the nations of the world. Estimates of the life expectancy of the fossil fuels and of the nuclear fuels (uranium and thorium) vary greatly, but, periodic shortages underscore the fact that energy resources are finite and cannot last indefinitely. The frontier-oriented outlook that resources are inexhaustible clearly must give way to a conservative approach of careful, thorough development and use of resources.

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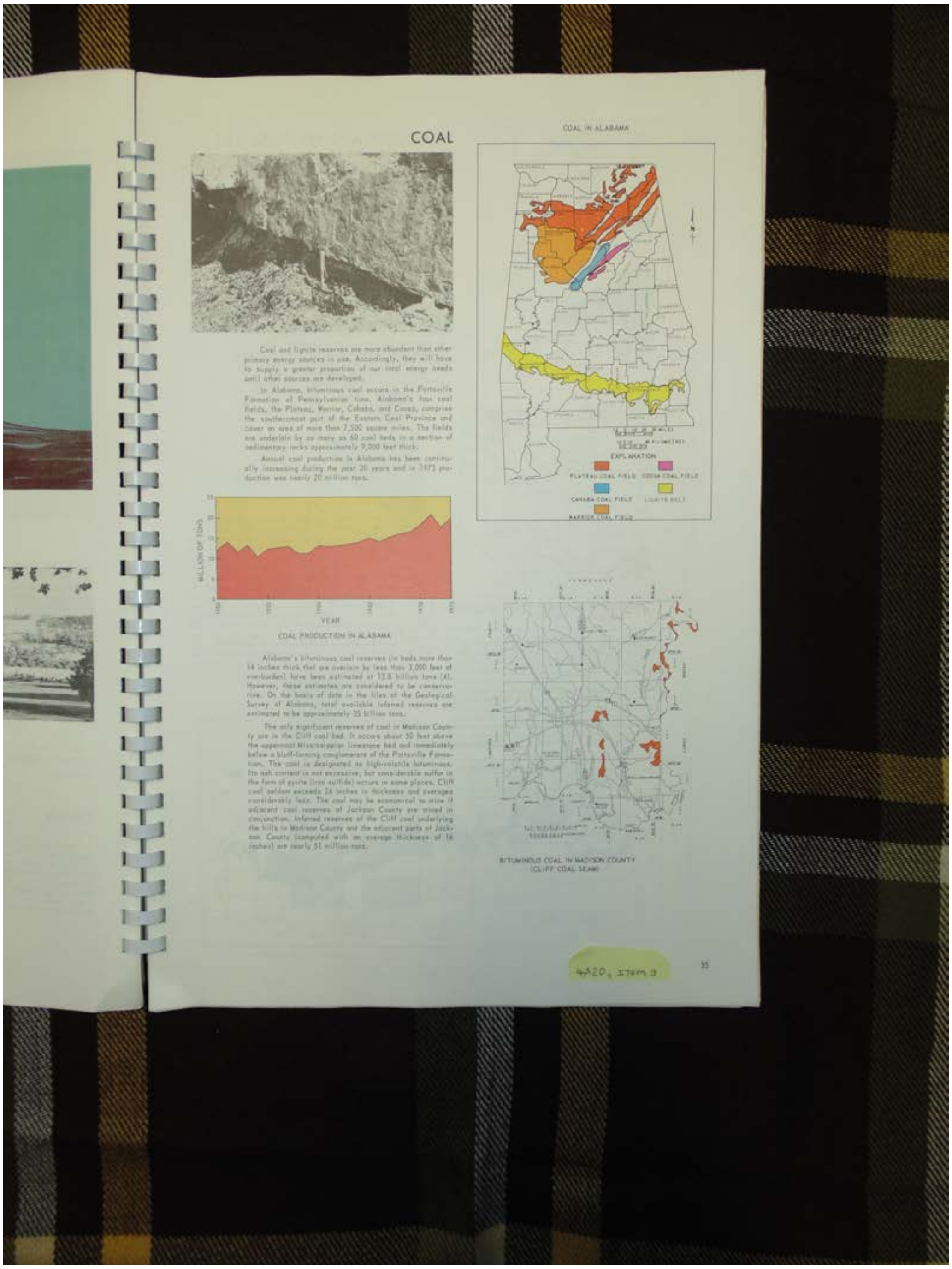
Names:
Energy Resources

Places:
United States

Types:
atlas

Dates:
1975



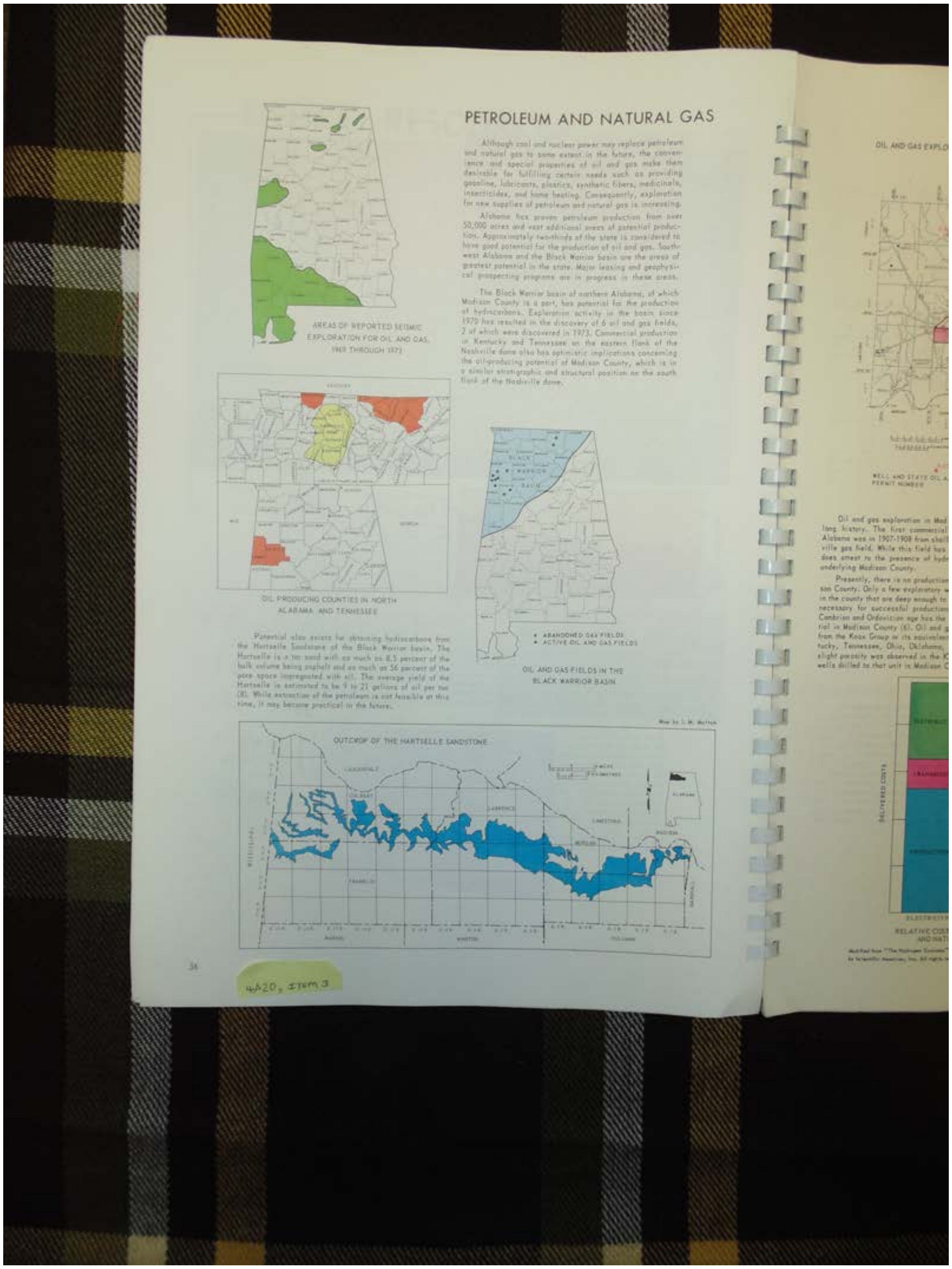
Names:
Coal in Alabama

Places:
Alabama

Types:
atlas map

Dates:
1975

Frances Cabaniss Roberts Collection: **Series 4, Subseries A, Box 20, Item 3**
Environmental Geology and Hydrology, 1975
Image 39 r04a20-00-003-5102 Contents Index About



PETROLEUM AND NATURAL GAS

Although coal and nuclear power may replace petroleum and natural gas to some extent in the future, the convenience and special properties of oil and gas make them desirable for fulfilling certain needs such as providing gasoline, lubricants, plastics, synthetic fibers, medicinals, insecticides, and home heating. Consequently, exploration for new supplies of petroleum and natural gas is increasing.

Alabama has proven petroleum production from over 50,000 acres and vast additional areas of potential production. Approximately two-thirds of the state is considered to have good potential for the production of oil and gas. Southwest Alabama and the Black Warrior basin are the areas of greatest potential in the state. Major leasing and geophysical prospecting programs are in progress in these areas.

The Black Warrior basin of northern Alabama, of which Madison County is a part, has potential for the production of hydrocarbons. Exploration activity in the basin since 1970 has resulted in the discovery of 6 oil and gas fields, 2 of which were discovered in 1973. Commercial production in Kentucky and Tennessee on the eastern flank of the Nashville dome also has optimistic implications concerning the oil-producing potential of Madison County, which is in a similar stratigraphic and structural position on the south flank of the Nashville dome.

AREAS OF REPORTED SEISMIC EXPLORATION FOR OIL AND GAS, 1969 THROUGH 1973

OIL PRODUCING COUNTIES IN NORTH ALABAMA AND TENNESSEE

OIL AND GAS FIELDS IN THE BLACK WARRIOR BASIN

Potential also exists for obtaining hydrocarbons from the Hartselle Sandstone of the Black Warrior basin. The Hartselle is a tar sand with as much as 8.5 percent of the bulk volume being asphalt and as much as 56 percent of the pore space impregnated with oil. The average yield of the Hartselle is estimated to be 9 to 21 gallons of oil per ton (8). While extraction of the petroleum is not feasible at this time, it may become practical in the future.

OUTCROP OF THE HARTSELLE SANDSTONE

4A20, Item 3

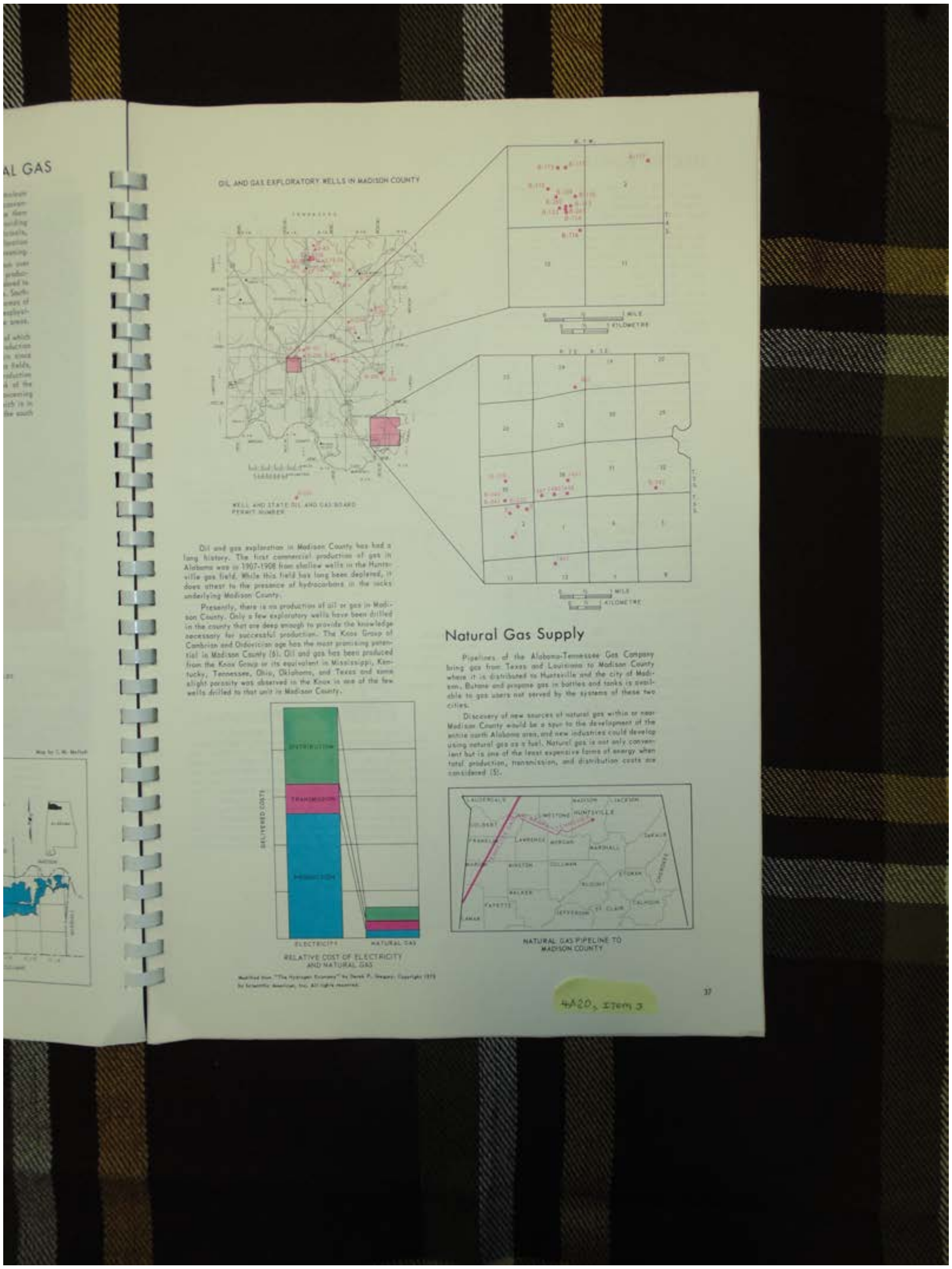
Names:
Petroleum & Natural Gas

Places:
Alabama

Types:
atlas map

Dates:
1975

Frances Cabaniss Roberts Collection: **Series 4, Subseries A, Box 20, Item 3**
Environmental Geology and Hydrology, 1975
Image 40 r04a20-00-003-5103 [Contents](#) [Index](#) [About](#)



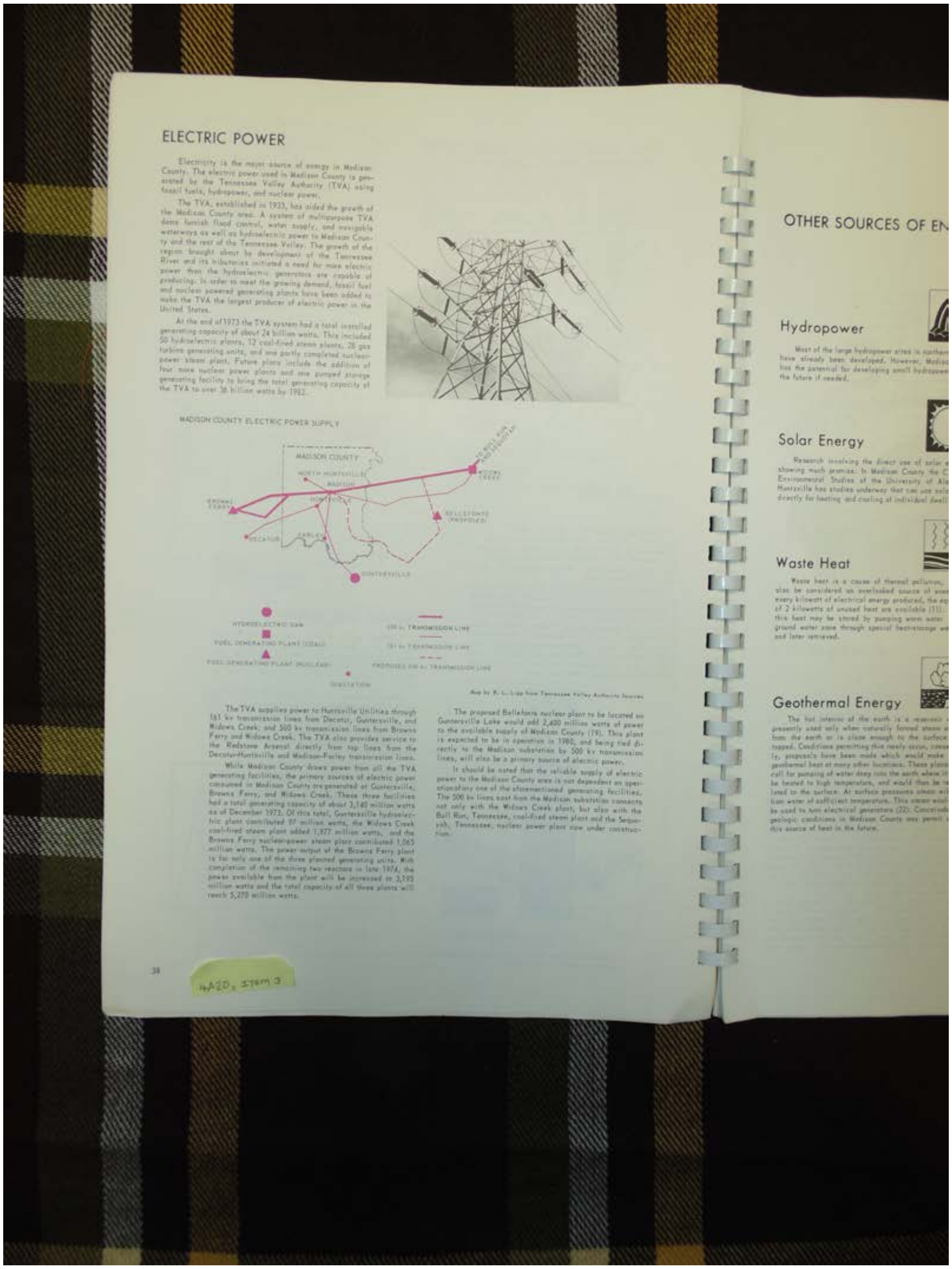
Names:
Natural Gas Supply
Oil & Gas
Exploratory Wells

Places:
Madison Co., AL

Types:
atlas
map

Dates:
1975

Frances Cabaniss Roberts Collection: Series 4, Subseries A, Box 20, Item 3
Environmental Geology and Hydrology, 1975
Image 41 r04a20-00-003-5104 Contents Index About



ELECTRIC POWER

Electricity is the major source of energy in Madison County. The electric power used in Madison County is generated by the Tennessee Valley Authority (TVA) using fossil fuels, hydropower, and nuclear power.

The TVA, established in 1933, has aided the growth of the Madison County area. A system of multipurpose TVA dams furnish flood control, water supply, and navigable waterways as well as hydroelectric power to Madison County and the rest of the Tennessee Valley. The growth of the region brought about by development of the Tennessee River and its tributaries initiated a need for more electric power than the hydroelectric generators are capable of producing. In order to meet the growing demand, fossil fuel and nuclear powered generating plants have been added to make the TVA the largest producer of electric power in the United States.

At the end of 1973 the TVA system had a total installed generating capacity of about 24 billion watts. This included 50 hydroelectric plants, 12 coal-fired steam plants, 28 gas turbine generating units, and one partly completed nuclear-power steam plant. Future plans include the addition of four more nuclear power plants and one pumped storage generating facility to bring the total generating capacity of the TVA to over 36 billion watts by 1982.

MADISON COUNTY ELECTRIC POWER SUPPLY

Map by R. L. Lipe from Tennessee Valley Authority Sources

The TVA supplies power to Huntsville Utilities through 161 kv transmission lines from Decatur, Guntersville, and Widows Creek, and 500 kv transmission lines from Browns Ferry and Widows Creek. The TVA also provides service to the Redstone Arsenal directly from tap lines from the Decatur-Huntsville and Madison-Farley transmission lines.

While Madison County draws power from all the TVA generating facilities, the primary sources of electric power consumed in Madison County are generated at Guntersville, Browns Ferry, and Widows Creek. These three facilities had a total generating capacity of about 3,140 million watts as of December 1973. Of this total, Guntersville hydroelectric plant contributed 97 million watts, the Widows Creek coal-fired steam plant added 1,977 million watts, and the Browns Ferry nuclear-power steam plant contributed 1,065 million watts. The power output of the Browns Ferry plant is for only one of the three planned generating units. With completion of the remaining two reactors in late 1974, the power available from the plant will be increased to 3,195 million watts and the total capacity of all three plants will reach 5,270 million watts.

The proposed Bellefonte nuclear plant to be located on Guntersville Lake would add 2,400 million watts of power to the available supply of Madison County (19). This plant is expected to be in operation in 1980, and being tied directly to the Madison substation by 500 kv transmission lines, will also be a primary source of electric power.

It should be noted that the reliable supply of electric power to the Madison County area is not dependent on operation of any one of the aforementioned generating facilities. The 500 kv lines east from the Madison substation connects not only with the Widows Creek plant, but also with the Bull Run, Tennessee, coal-fired steam plant and the Sequoyah, Tennessee, nuclear power plant now under construction.

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4A20, Item 3

OTHER SOURCES OF EN

Hydropower

Solar Energy

Waste Heat

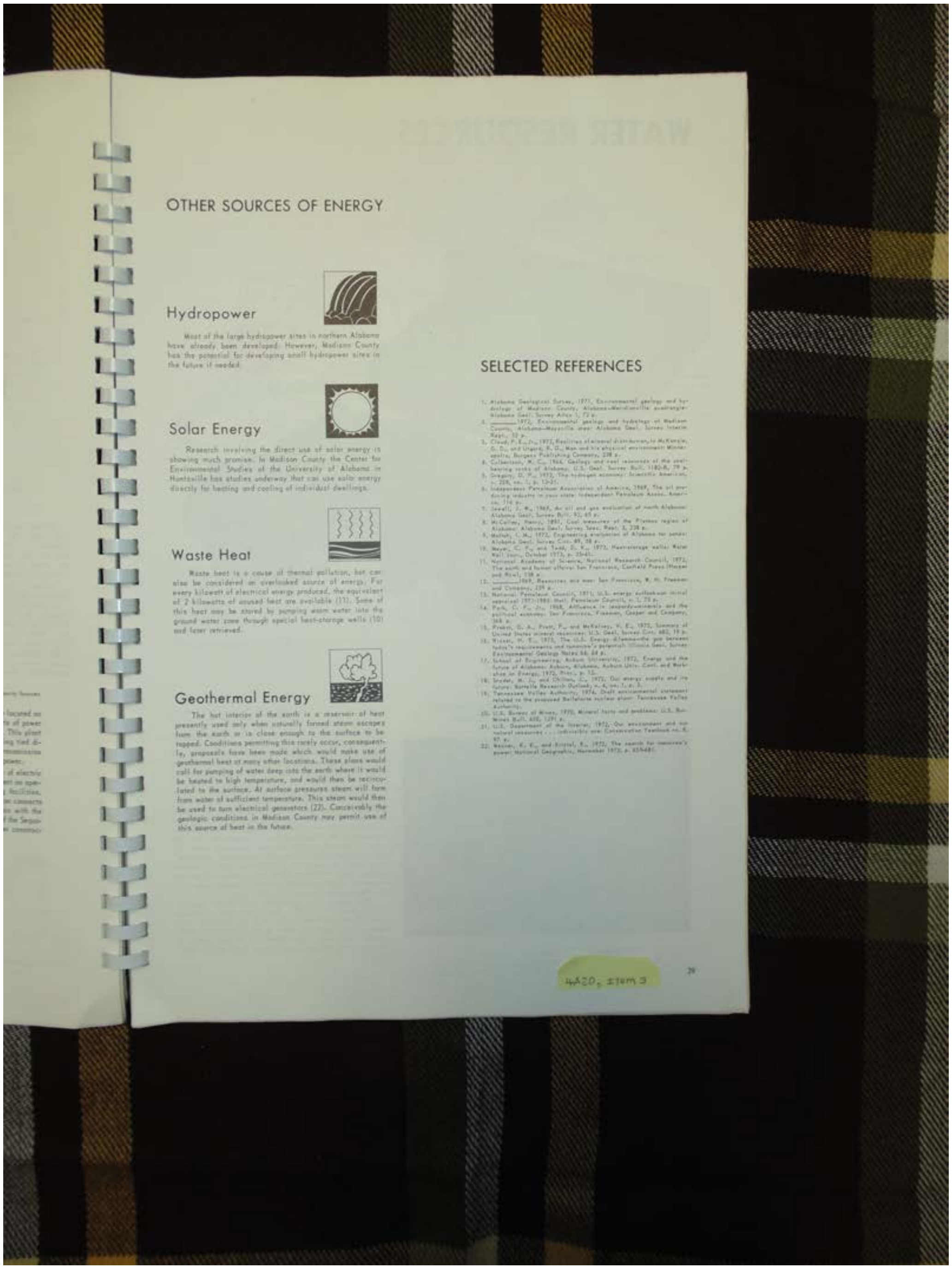
Geothermal Energy

Names:
Electric Power
TVA

Places:
Madison Co., AL

Types:
atlas

Dates:
1975



OTHER SOURCES OF ENERGY

Hydropower

Most of the large hydropower sites in northern Alabama have already been developed. However, Madison County has the potential for developing small hydropower sites in the future if needed.

Solar Energy

Research involving the direct use of solar energy is showing much promise. In Madison County the Center for Environmental Studies of the University of Alabama in Huntsville has studies underway that can use solar energy directly for heating and cooling of individual dwellings.

Waste Heat

Waste heat is a cause of thermal pollution, but can also be considered an overlooked source of energy. For every kilowatt of electrical energy produced, the equivalent of 2 kilowatts of unused heat are available (11). Some of this heat may be stored by pumping warm water into the ground water zone through special heat-storage wells (10) and later retrieved.

Geothermal Energy

The hot interior of the earth is a reservoir of heat presently used only when naturally formed steam escapes from the earth or is close enough to the surface to be tapped. Conditions permitting this rarely occur, consequently, proposals have been made which would make use of geothermal heat at many other locations. These plans would call for pumping of water deep into the earth where it would be heated to high temperature, and would then be recirculated to the surface. At surface pressures steam will form from water of sufficient temperature. This steam would then be used to turn electrical generators (22). Conceivably the geologic conditions in Madison County may permit use of this source of heat in the future.

SELECTED REFERENCES

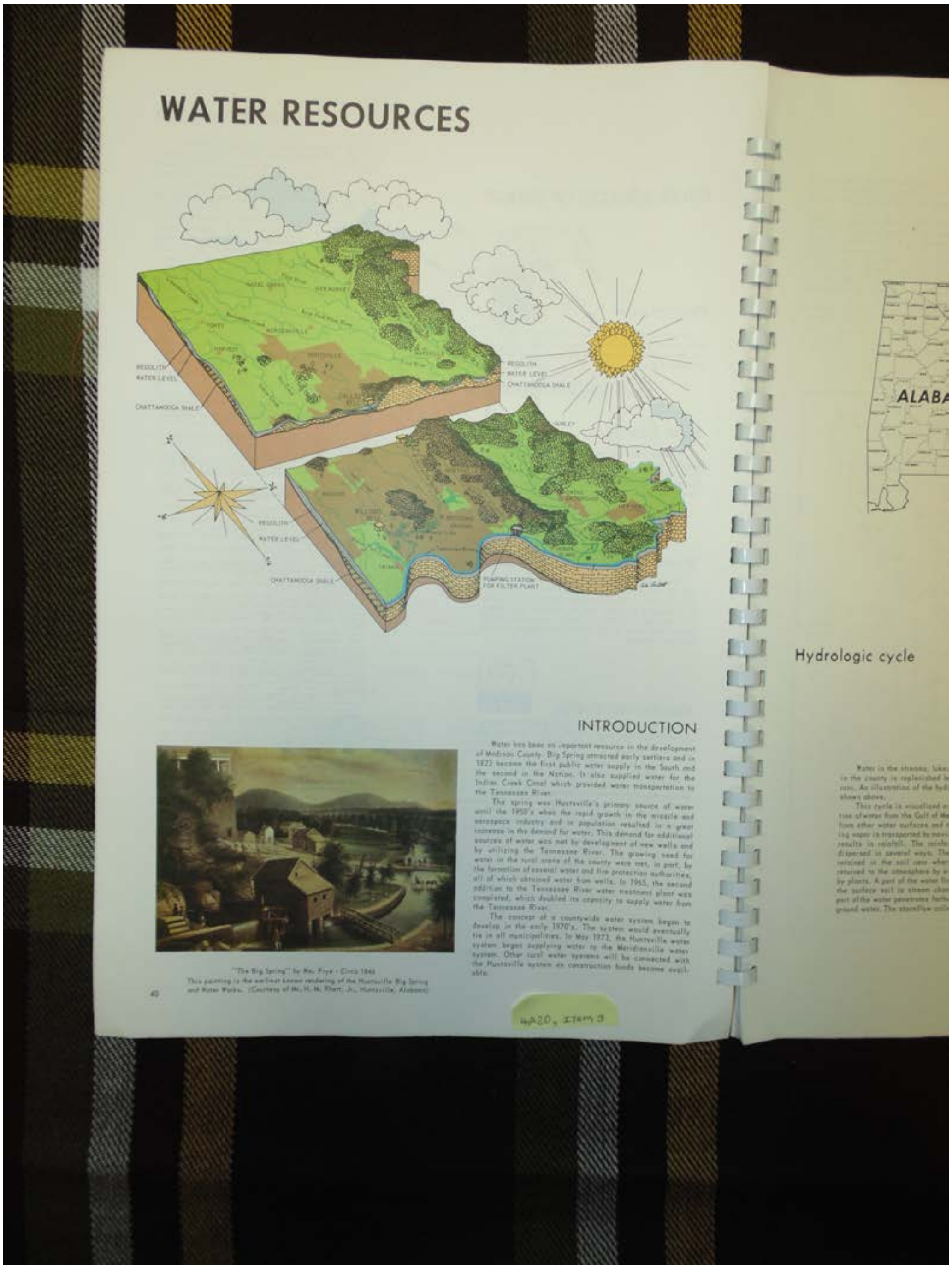
Names:
Sources of Energy

Places:
Madison Co., AL

Types:
atlas chart

Dates:
1975

Frances Cabaniss Roberts Collection: Series 4, Subseries A, Box 20, Item 3
Environmental Geology and Hydrology, 1975
Image 43 r04a20-00-003-5106 Contents Index About



Names:

Big Spring	Meridianville Water System	Tennessee River
Frye, William		Water Resources

Places:

Huntsville, AL	Madison Co., AL

Types:

atlas	atlas	painting	painting

Dates:

1975

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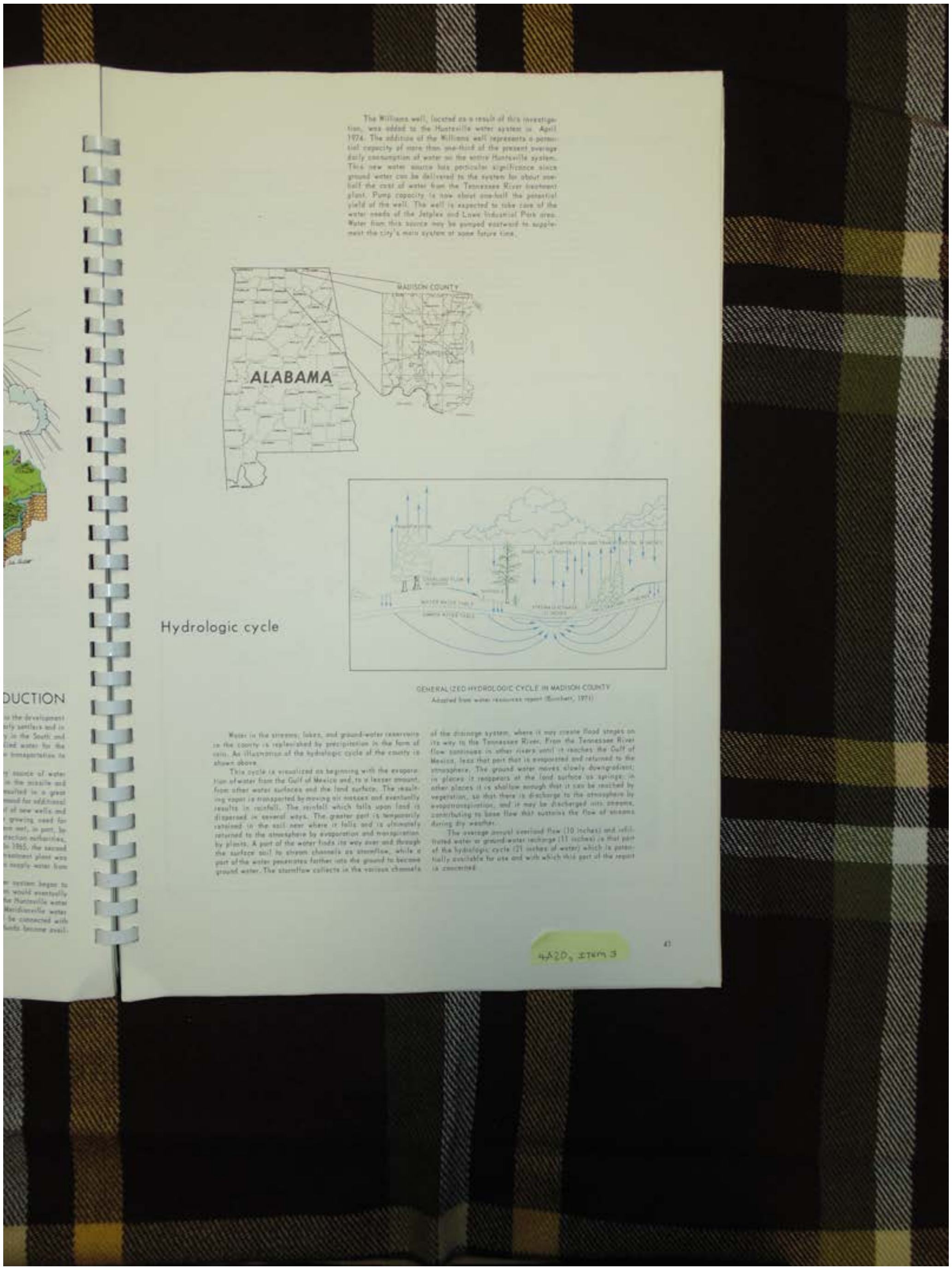
Environmental Geology and Hydrology, 1975
Image 44 r04a20-00-003-5107 Contents Index About

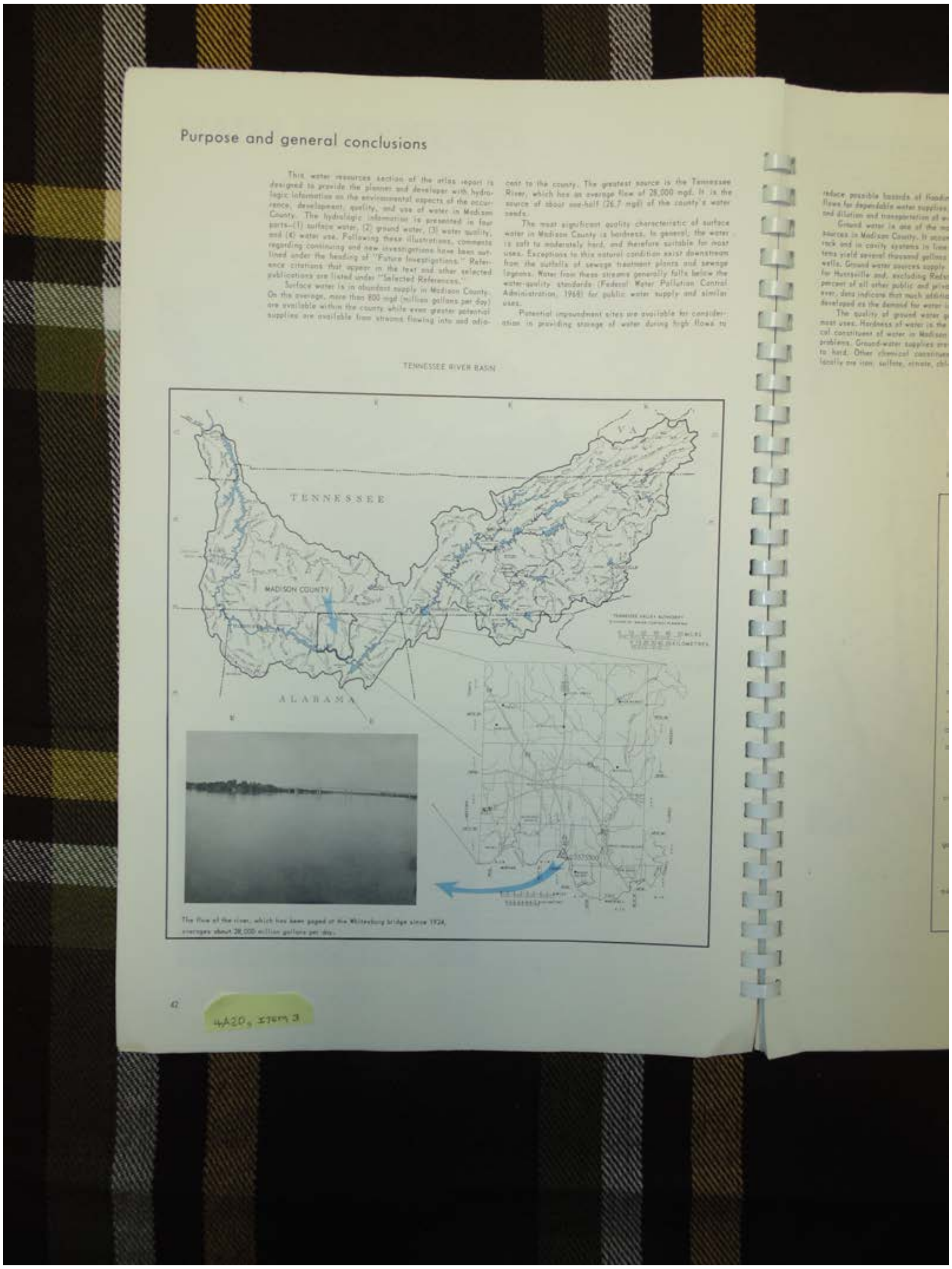


Names:
Hydrolic Cycle

Places:
Madison Co., AL

Types:
atlas diagram

Dates:
1975



Purpose and general conclusions

This water resources section of the atlas report is designed to provide the planner and developer with hydrologic information on the environmental aspects of the occurrence, development, quality, and use of water in Madison County. The hydrologic information is presented in four parts—(1) surface water, (2) ground water, (3) water quality, and (4) water use. Following these illustrations, comments regarding continuing and new investigations have been outlined under the heading of "Future Investigations." Reference citations that appear in the text and other selected publications are listed under "Selected References."

Surface water is in abundant supply in Madison County. On the average, more than 800 mgd (million gallons per day) are available within the county while even greater potential supplies are available from streams flowing into and adjacent to the county. The greatest source is the Tennessee River, which has an average flow of 28,000 mgd. It is the source of about one-half (26.7 mgd) of the county's water needs.

The most significant quality characteristic of surface water in Madison County is hardness. In general, the water is soft to moderately hard, and therefore suitable for most uses. Exceptions to this natural condition exist downstream from the outfalls of sewage treatment plants and sewage lagoons. Water from these streams generally falls below the water-quality standards (Federal Water Pollution Control Administration, 1968) for public water supply and similar uses.

Potential impoundment sites are available for consideration in providing storage of water during high flows to

The flow of the river, which has been gaged at the Whitesburg bridge since 1924, averages about 28,000 million gallons per day.

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Names:
Tennessee River Basin

Places:
Madison Co., AL

Types:
atlas map

Dates:
1975

reduce possible hazards of flooding and to increase base flows for dependable water supplies, recreation, fish habitat, and dilution and transportation of wastes.

Ground water is one of the most important natural resources in Madison County. It occurs in regolith above bedrock and in cavity systems in limestone. Some cavity systems yield several thousand gallons per minute to individual wells. Ground-water sources supply about one-half the water for Huntsville and, excluding Redstone Arsenal, about 100 percent of all other public and private water systems. However, data indicate that much additional ground water can be developed as the demand for water increases.

The quality of ground water generally is suitable for most uses. Hardness of water is the only widespread chemical constituent of water in Madison County that may cause problems. Ground-water supplies are mostly moderately hard to hard. Other chemical constituents that are a problem locally are iron, sulfate, nitrate, chloride, and fluoride.

Basic information available

All water resources basic data collected in Madison County during previous investigations and during this project are listed, or the reference given where data can be found, in the basic data report.

The following illustrations in this section of the report are available for inspection on maps at scale 1:24,000 to planners and developers who need the information in greater detail:

Average flow and median 7-day low flow.
Potential impoundment areas.
Surface drainage.
Flood-prone areas—100-year flood.
Ground-water levels and movement.
Significant wells and springs.

Factors for converting English units to International System (SI) units

The following factors may be used to convert the English units published herein to the International System of Units (SI).

Multiply English Units	By	To obtain SI Units
	Length	
inches (in)	25.4	millimetres (mm)
	.0254	metres (m)
feet (ft)	.3048	metres (m)
miles (mi)	1.609	kilometres (km)
	Area	
acres	4047	square metres (m^2)
	.4047	square hectometre (hm^2)
	.004047	square kilometres (km^2)
square miles (mi^2)	2.590	square kilometres (km^2)
	Volume	
gallons (gal)	3.785	litres (l)
	3.785	cubic decimetres (dm^3)
	3.785×10^{-3}	cubic metres (m^3)
million gallons (10^6 gal)	3785	cubic metres (m^3)
	3.785×10^{-3}	cubic hectometres (hm^3)
cubic feet (ft^3)	28.32	cubic decimetres (dm^3)
	.02832	cubic metres (m^3)
cfs-day (ft^3/s-day)	2447	cubic metres (m^3)
	2.447×10^{-3}	cubic hectometres (hm^3)
acre-feet (acre-ft)	1233	cubic metres (m^3)
	1.233×10^{-3}	cubic hectometres (hm^3)
	1.233×10^{-6}	cubic kilometres (km^3)
	Flow	
cubic feet per second (cfs)	28.32	litres per second (l/s)
	28.32	cubic decimetres per second (dm^3/s)
	.02832	cubic metres per second (m^3/s)
gallons per minute (gpm)	.06309	litres per second (l/s)
	.06309	cubic decimetres per second (dm^3/s)
	6.309×10^{-5}	cubic metres per second (m^3/s)
million gallons per day (mgd)	43.81	cubic decimetres per second (dm^3/s)
	.04381	cubic metres per second (m^3/s)

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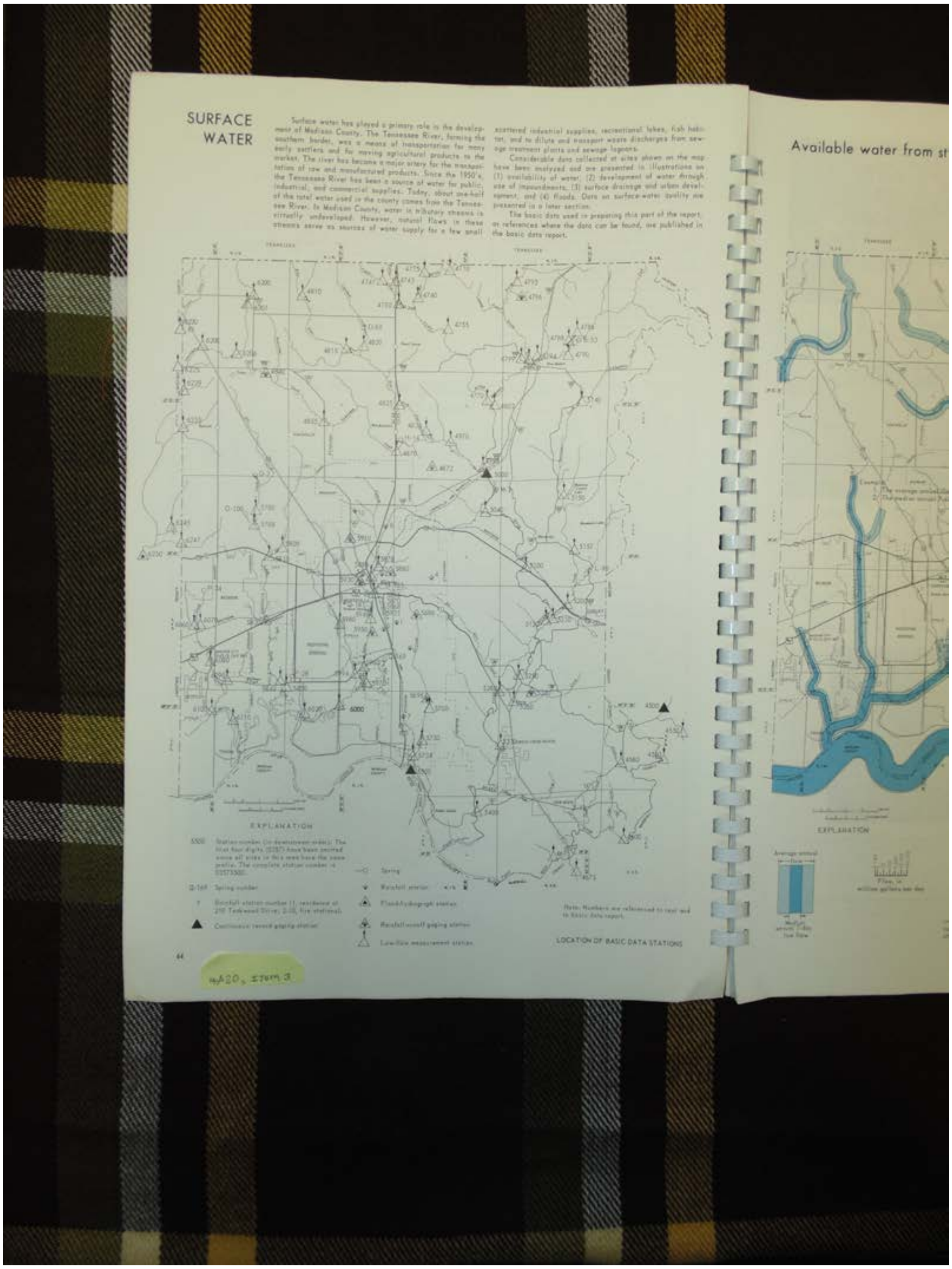
Environmental Geology and Hydrology, 1975
Image 47 r04a20-00-003-5110 Contents Index About



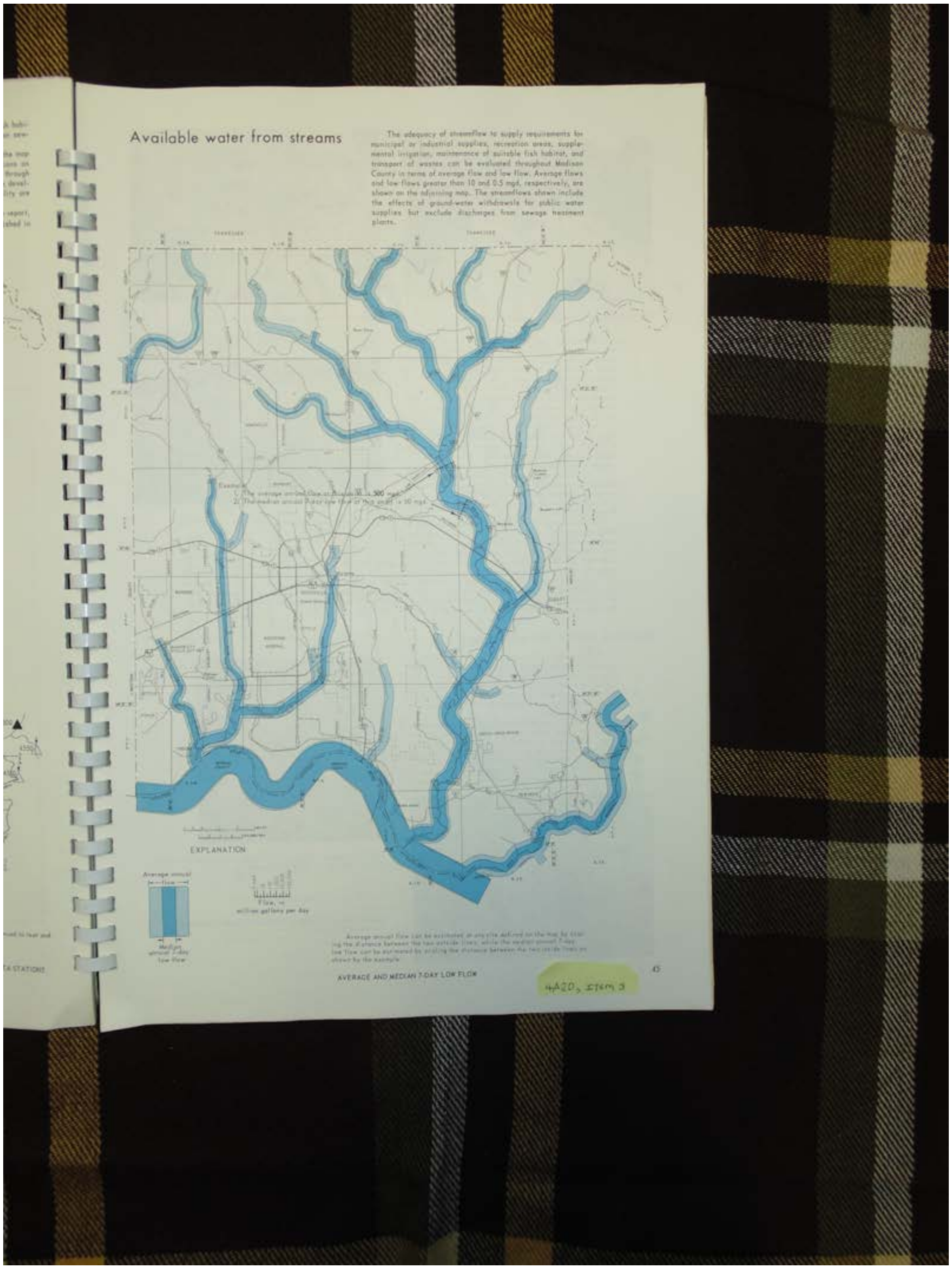
Names:
Surface Water

Places:
Madison Co., AL

Types:
atlas map

Dates:
1975

Frances Cabaniss Roberts Collection: **Series 4, Subseries A, Box 20, Item 3**
Environmental Geology and Hydrology, 1975
Image 48 r04a20-00-003-5111 [Contents](#) [Index](#) [About](#)

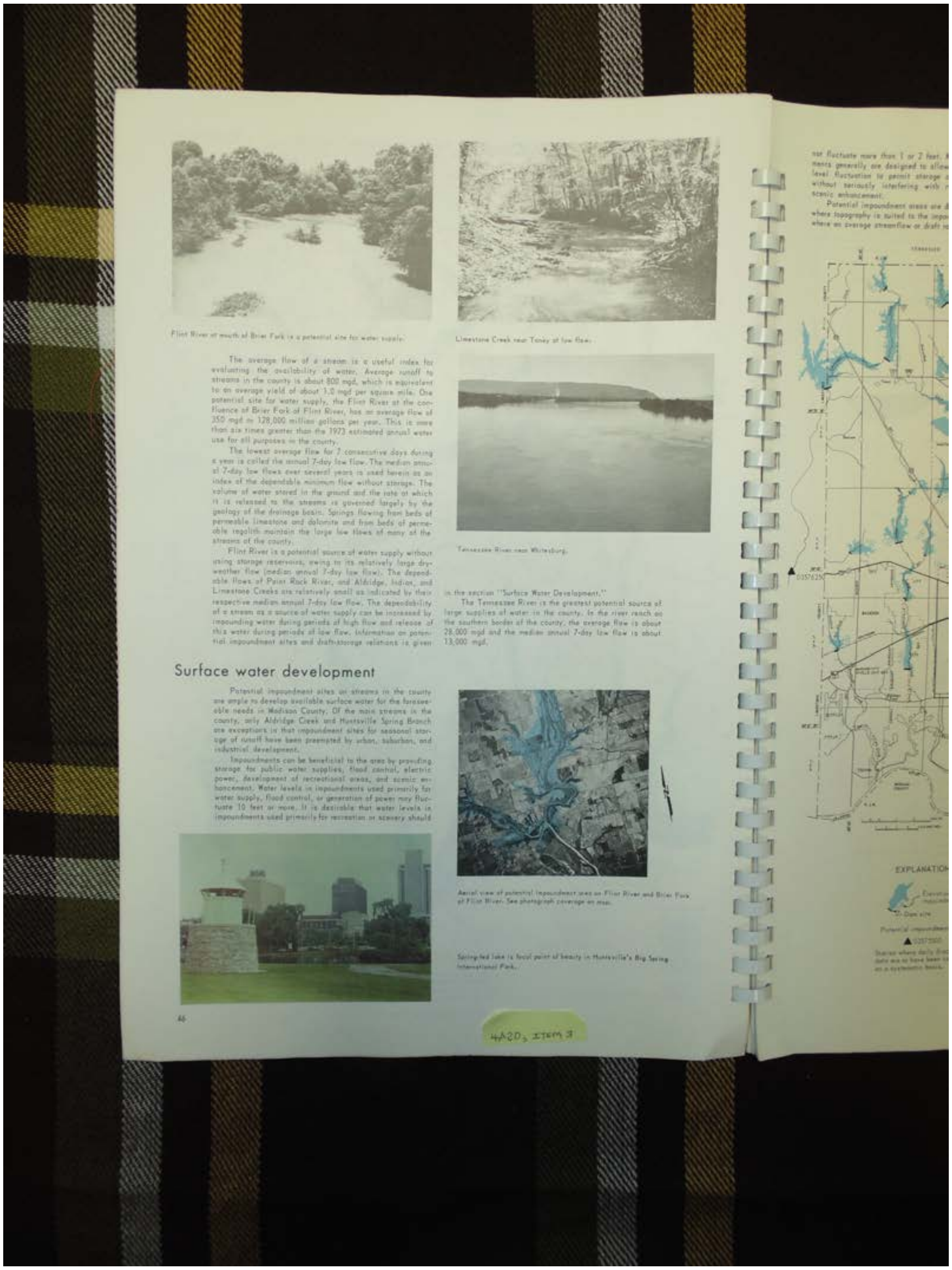


Names:
Streamflows
Water From Streams

Places:
Madison Co., AL

Types:
atlas
map

Dates:
1975



Flint River at mouth of Brier Fork is a potential site for water supply.

The average flow of a stream is a useful index for evaluating the availability of water. Average runoff to streams in the county is about 800 mgd, which is equivalent to an average yield of about 1.0 mgd per square mile. One potential site for water supply, the Flint River at the confluence of Brier Fork of Flint River, has an average flow of 350 mgd or 128,000 million gallons per year. This is more than six times greater than the 1973 estimated annual water use for all purposes in the county.

The lowest average flow for 7 consecutive days during a year is called the annual 7-day low flow. The median annual 7-day low flows over several years is used herein as an index of the dependable minimum flow without storage. The volume of water stored in the ground and the rate at which it is released to the streams is governed largely by the geology of the drainage basin. Springs flowing from beds of permeable limestone and dolomite and from beds of permeable regolith maintain the large low flows of many of the streams of the county.

Flint River is a potential source of water supply without using storage reservoirs, owing to its relatively large dry-weather flow (median annual 7-day low flow). The dependable flows of Paint Rock River, and Aldridge, Indian, and Limestone Creeks are relatively small as indicated by their respective median annual 7-day low flow. The dependability of a stream as a source of water supply can be increased by impounding water during periods of high flow and release of this water during periods of low flow. Information on potential impoundment sites and draft-storage relations is given in the section "Surface Water Development."

Limestone Creek near Toney at low flow.

Tennessee River near Whitesburg.

The Tennessee River is the greatest potential source of large supplies of water in the county. In the river reach on the southern border of the county, the average flow is about 28,000 mgd and the median annual 7-day low flow is about 13,000 mgd.

Surface water development

Potential impoundment sites on streams in the county are ample to develop available surface water for the foreseeable needs in Madison County. Of the main streams in the county, only Aldridge Creek and Huntsville Spring Branch are exceptions in that impoundment sites for seasonal storage of runoff have been preempted by urban, suburban, and industrial development.

Impoundments can be beneficial to the area by providing storage for public water supplies, flood control, electric power, development of recreational areas, and scenic enhancement. Water levels in impoundments used primarily for water supply, flood control, or generation of power may fluctuate 10 feet or more. It is desirable that water levels in impoundments used primarily for recreation or scenery should not fluctuate more than 1 or 2 feet.

Aerial view of potential impoundment area on Flint River and Brier Fork of Flint River. See photograph coverage on map.

Spring-fed lake is focal point of beauty in Huntsville's Big Spring International Park.

46

4A20, Item 3

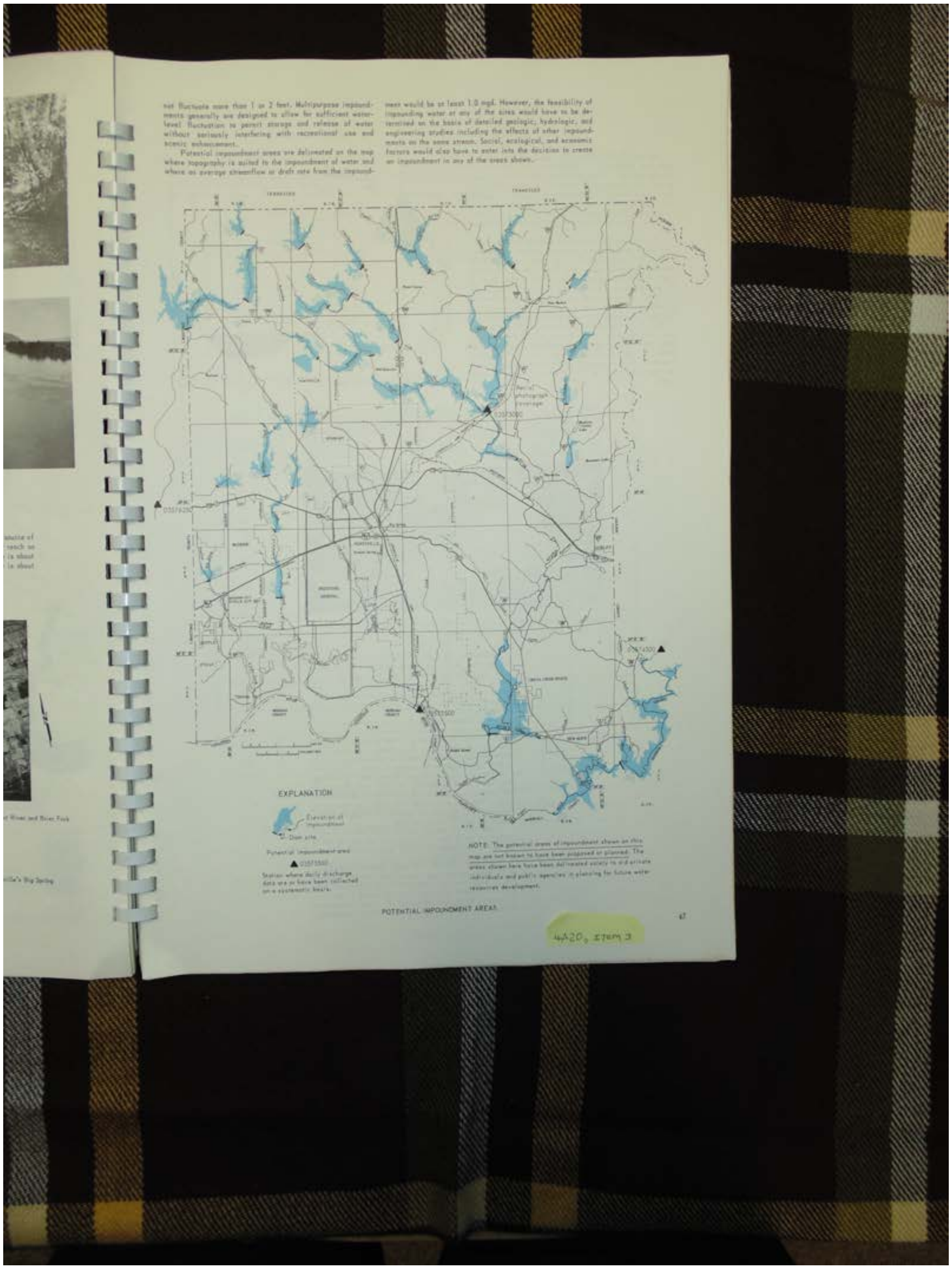
Names:
Flint River
Surface Water Development
Tennessee River

Places:
Madison Co., AL

Types:
atlas
atlas
photographs

Dates:
1975

Frances Cabaniss Roberts Collection: **Series 4, Subseries A, Box 20, Item 3**
Environmental Geology and Hydrology, 1975
Image 50 r04a20-00-003-5113 Contents Index About



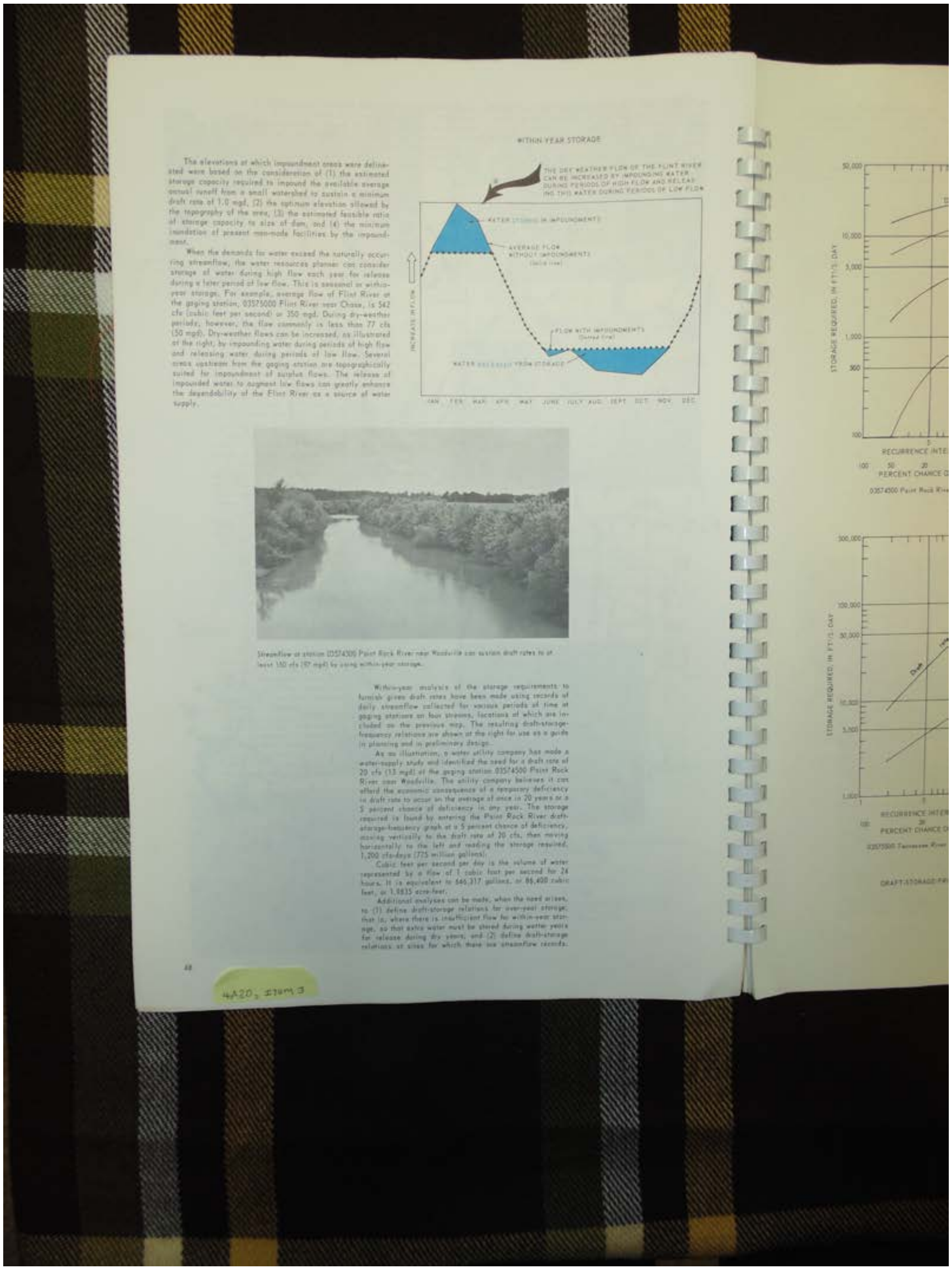
Names:
Impoundments

Places:
Madison Co., AL

Types:
atlas map

Dates:
1975

Frances Cabaniss Roberts Collection: **Series 4, Subseries A, Box 20, Item 3**
Environmental Geology and Hydrology, 1975
Image 51 r04a20-00-003-5114 Contents Index About



The elevations at which impoundment areas were delineated were based on the consideration of (1) the estimated storage capacity required to impound the available average annual runoff from a small watershed to sustain a minimum draft rate of 1.0 mgd, (2) the optimum elevation allowed by the topography of the area, (3) the estimated feasible ratio of storage capacity to size of dam, and (4) the minimum inundation of present man-made facilities by the impoundment.

When the demands for water exceed the naturally occurring streamflow, the water resources planner can consider storage of water during high flow each year for release during a later period of low flow. This is seasonal or within-year storage. For example, average flow of Flint River at the gaging station, 03575000 Flint River near Chase, is 542 cfs (cubic feet per second) or 350 mgd. During dry-weather periods, however, the flow commonly is less than 77 cfs (50 mgd). Dry-weather flows can be increased, as illustrated at the right, by impounding water during periods of high flow and releasing water during periods of low flow. Several areas upstream from the gaging station are topographically suited for impoundment of surplus flows. The release of impounded water to augment low flows can greatly enhance the dependability of the Flint River as a source of water supply.

Streamflow at station 03574500 Paint Rock River near Woodville can sustain draft rates to at least 150 cfs (97 mgd) by using within-year storage.

Within-year analysis of the storage requirements to furnish given draft rates have been made using records of daily streamflow collected for various periods of time at gaging stations on four streams, locations of which are included on the previous map. The resulting draft-storage-frequency relations are shown at the right for use as a guide in planning and in preliminary design.

As an illustration, a water utility company has made a water-supply study and identified the need for a draft rate of 20 cfs (13 mgd) at the gaging station 03574500 Paint Rock River near Woodville. The utility company believes it can afford the economic consequence of a temporary deficiency in draft rate to occur on the average of once in 20 years or a 5 percent chance of deficiency in any year. The storage required is found by entering the Paint Rock River draft-storage-frequency graph at a 5 percent chance of deficiency, moving vertically to the draft rate of 20 cfs, then moving horizontally to the left and reading the storage required, 1,200 cfs-days (775 million gallons).

Cubic feet per second per day is the volume of water represented by a flow of 1 cubic foot per second for 24 hours. It is equivalent to 646,317 gallons, or 86,400 cubic feet, or 1.9835 acre-feet.

Additional analyses can be made, when the need arises, to (1) define draft-storage relations for over-year storage, that is, where there is insufficient flow for within-year storage, so that extra water must be stored during wetter years for release during dry years, and (2) define draft-storage relations at sites for which there are streamflow records.

48

4A20, Item 3

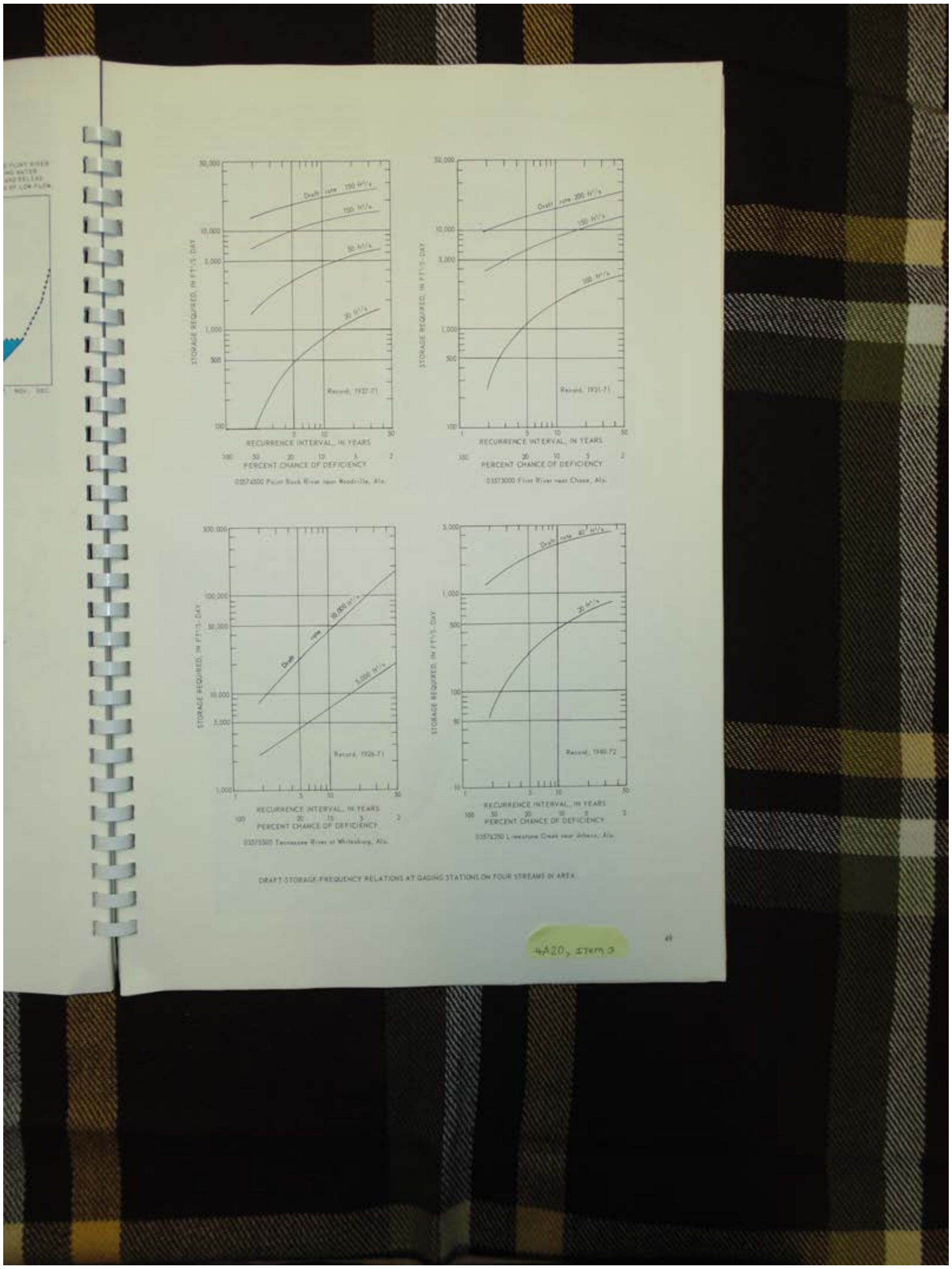
Names:
Impoundments
Paint Rock River

Places:
Jackson Co., AL
Madison Co., AL

Types:
atlas
diagram
photograph

Dates:
1975

Frances Cabaniss Roberts Collection: **Series 4, Subseries A, Box 20, Item 3**
Environmental Geology and Hydrology, 1975
Image 52 r04a20-00-003-5115 Contents Index About

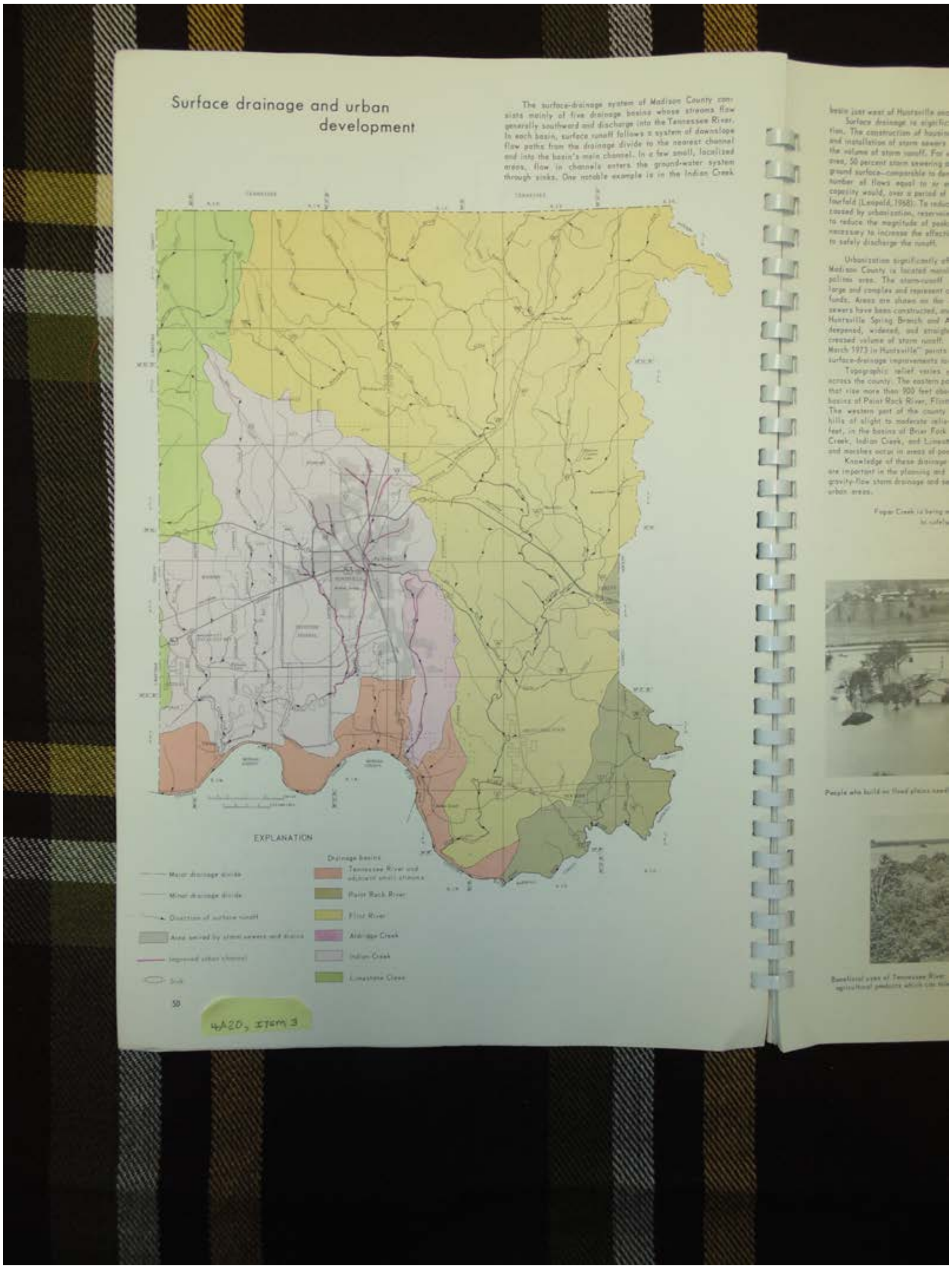


Names:
Impoundments Draft
Storage Frequency

Places:
Madison & Jackson
Co., AL

Types:
diagrams

Dates:
1975

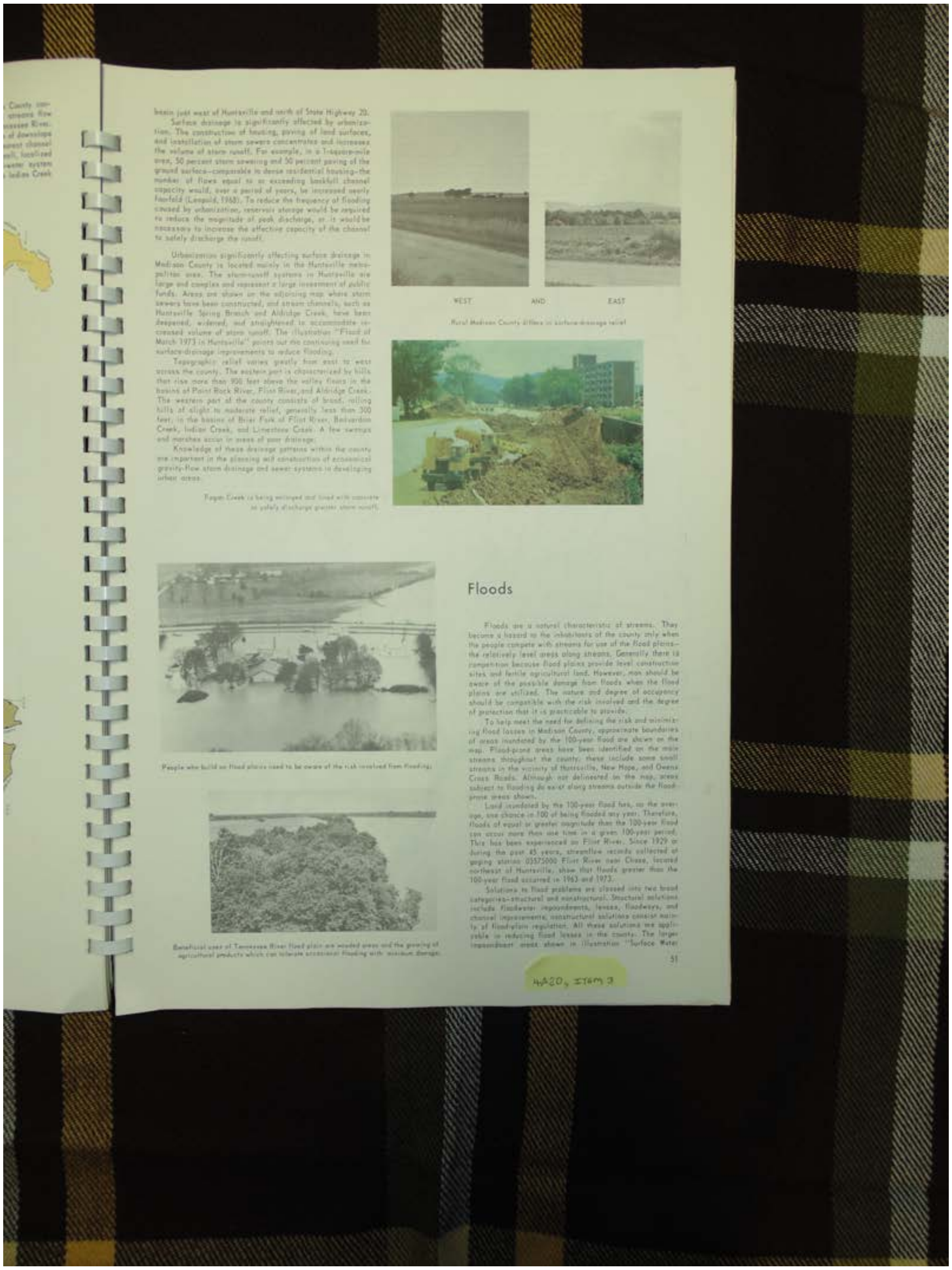


Names:
Surface Drainage &
Urban Development

Places:
Madison Co., AL

Types:
atlas map

Dates:
1975

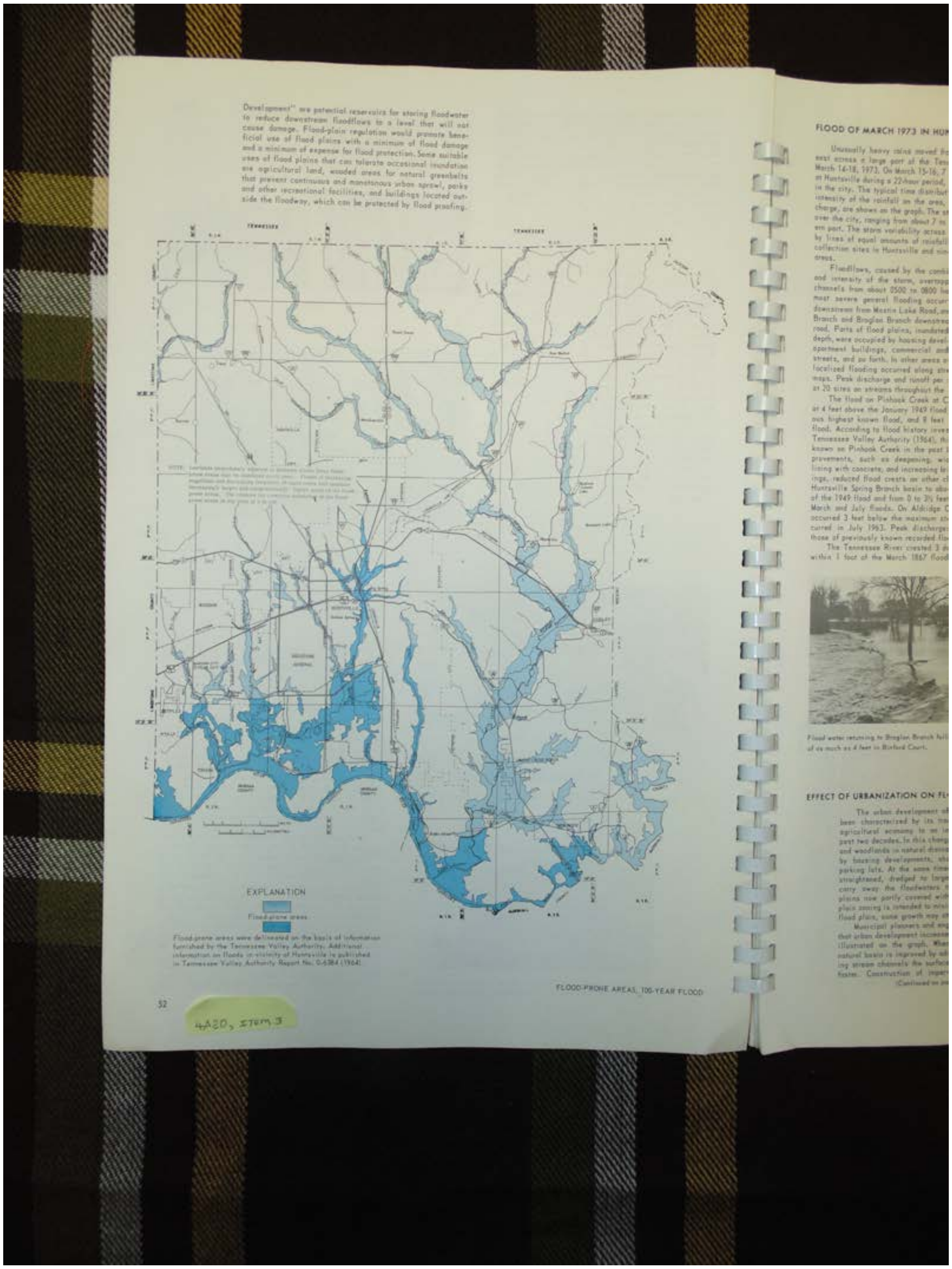


Names:
Floods
Surface Drainage & Urban Development

Places:
Madison Co., AL

Types:
atlas
photographs

Dates:
1975



100 year flood

Names:

Flood Prone Areas

Places:

Madison Co., AL

Types:

atlas map

Dates:

1975

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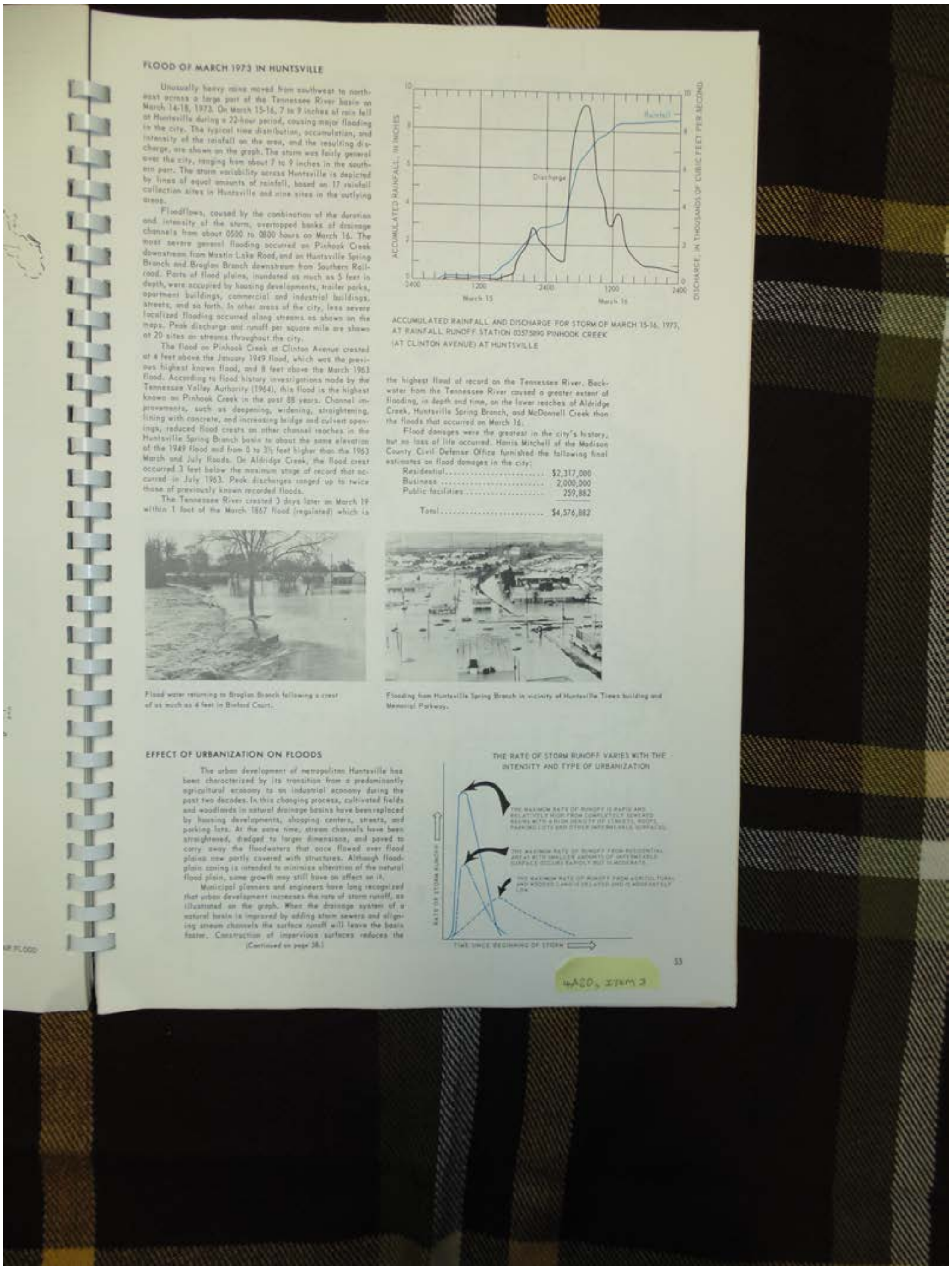
Environmental Geology and Hydrology, 1975
Image 56 r04a20-00-003-5119 Contents Index About



FLOOD OF MARCH 1973 IN HUNTSVILLE

Unusually heavy rains moved from southwest to northeast across a large part of the Tennessee River basin on March 14-18, 1973. On March 15-16, 7 to 9 inches of rain fell at Huntsville during a 22-hour period, causing major flooding in the city. The typical time distribution, accumulation, and intensity of the rainfall on the area, and the resulting discharge, are shown on the graph. The storm was fairly general over the city, ranging from about 7 to 9 inches in the southern part. The storm variability across Huntsville is depicted by lines of equal amounts of rainfall, based on 17 rainfall collection sites in Huntsville and nine sites in the outlying areas.

Floodflows, caused by the combination of the duration and intensity of the storm, overtopped banks of drainage channels from about 0500 to 0800 hours on March 16. The most severe general flooding occurred on Pinhook Creek downstream from Mastin Lake Road, and on Huntsville Spring Branch and Broglan Branch downstream from Southern Railroad. Parts of flood plains, inundated as much as 5 feet in depth, were occupied by housing developments, trailer parks, apartment buildings, commercial and industrial buildings, streets, and so forth. In other areas of the city, less severe localized flooding occurred along streams as shown on the maps. Peak discharge and runoff per square mile are shown at 20 sites on streams throughout the city.

The flood on Pinhook Creek at Clinton Avenue crested at 4 feet above the January 1949 flood, which was the previous highest known flood, and 8 feet above the March 1963 flood. According to flood history investigations made by the Tennessee Valley Authority (1964), this flood is the highest known on Pinhook Creek in the past 88 years. Channel improvements, such as deepening, widening, straightening, lining with concrete, and increasing bridge and culvert openings, reduced flood crests on other channel reaches in the Huntsville Spring Branch basin to about the same elevation of the 1949 flood and from 0 to 3½ feet higher than the 1963 March and July floods. On Aldridge Creek, the flood crest occurred 3 feet below the maximum stage of record that occurred in July 1963. Peak discharges ranged up to twice those of previously known recorded floods.

The Tennessee River crested 3 days later on March 19 within 1 foot of the March 1867 flood (regulated) which is the highest flood of record on the Tennessee River. Backwater from the Tennessee River caused a greater extent of flooding, in depth and time, on the lower reaches of Aldridge Creek, Huntsville Spring Branch, and McDonnell Creek than the floods that occurred on March 16.

Flood damages were the greatest in the city's history, but no loss of life occurred. Harris Mitchell of the Madison County Civil Defense Office furnished the following final estimates on flood damages in the city:

Residential	$2,317,000
Business	2,000,000
Public facilities	259,882
Total	$4,576,882

ACCUMULATED RAINFALL AND DISCHARGE FOR STORM OF MARCH 15-16, 1973, AT RAINFALL RUNOFF STATION 03575890 PINHOOK CREEK (AT CLINTON AVENUE) AT HUNTSVILLE

Flood water returning to Broglan Branch following a crest of as much as 4 feet in Binford Court.

Flooding from Huntsville Spring Branch in vicinity of Huntsville Times building and Memorial Parkway.

EFFECT OF URBANIZATION ON FLOODS

The urban development of metropolitan Huntsville has been characterized by its transition from a predominantly agricultural economy to an industrial economy during the past two decades. In this changing process, cultivated fields and woodlands in natural drainage basins have been replaced by housing developments, shopping centers, streets, and parking lots. At the same time, stream channels have been straightened, dredged to larger dimensions, and paved to carry away the floodwaters that once flowed over flood plains now partly covered with structures. Although flood-plain zoning is intended to minimize alteration of the natural flood plain, some growth may still have an effect on it.

Municipal planners and engineers have long recognized that urban development increases the rate of storm runoff, as illustrated on the graph. When the drainage system of a natural basin is improved by adding storm sewers and aligning stream channels the surface runoff will leave the basin faster. Construction of impervious surfaces reduces the

(Continued on page 38.)

THE RATE OF STORM RUNOFF VARIES WITH THE INTENSITY AND TYPE OF URBANIZATION

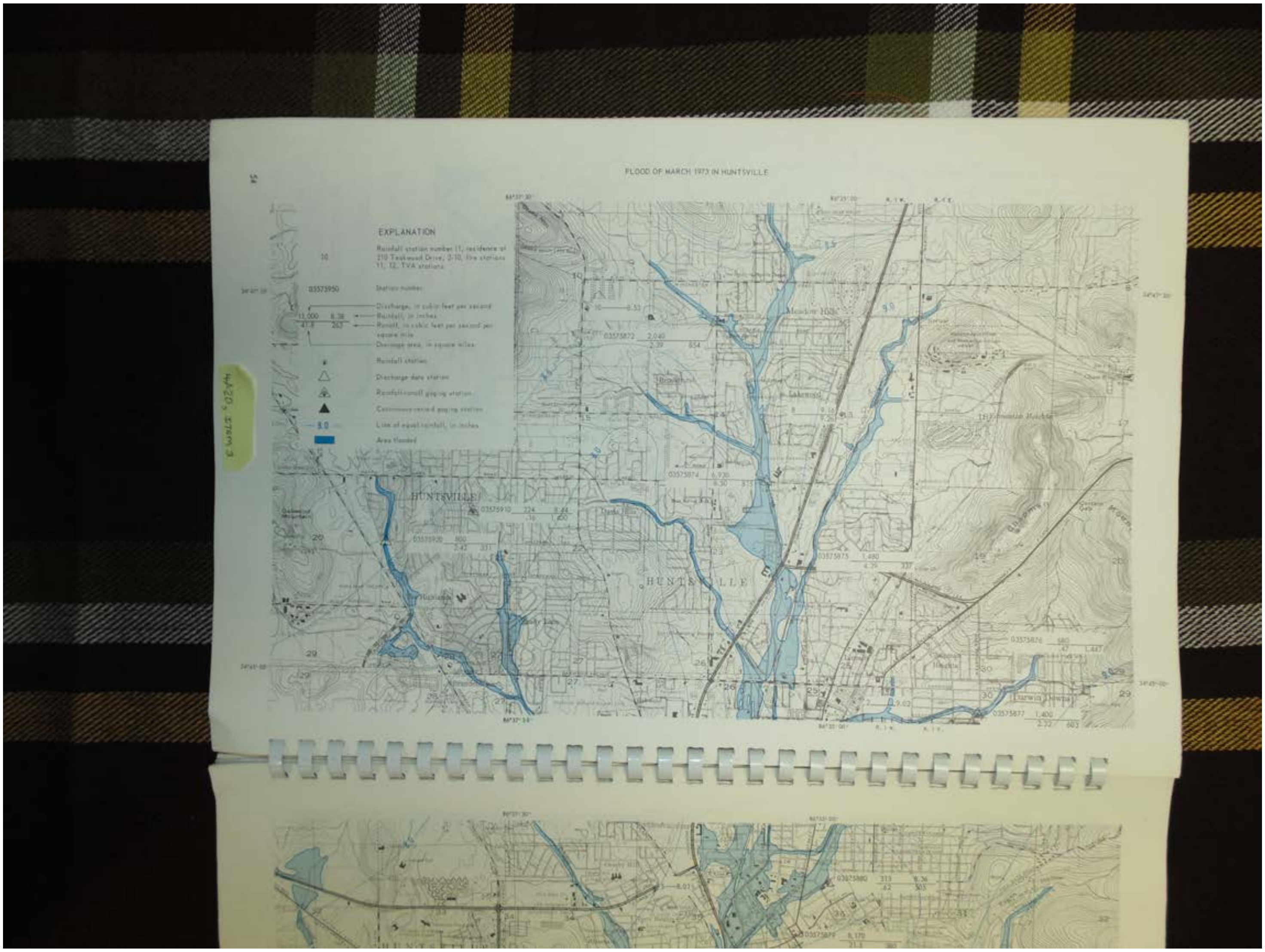
4A20, Item 3

Names:
Flood of March 1973 Urbanization Effect on Floods

Places:
Huntsville, AL

Types:
atlas diagram atlas photographs

Dates:
1973 1975



p. 1

Names:
Flood of March 1973

Places:
Huntsville, AL

Types:
atlas map

Dates:
1973

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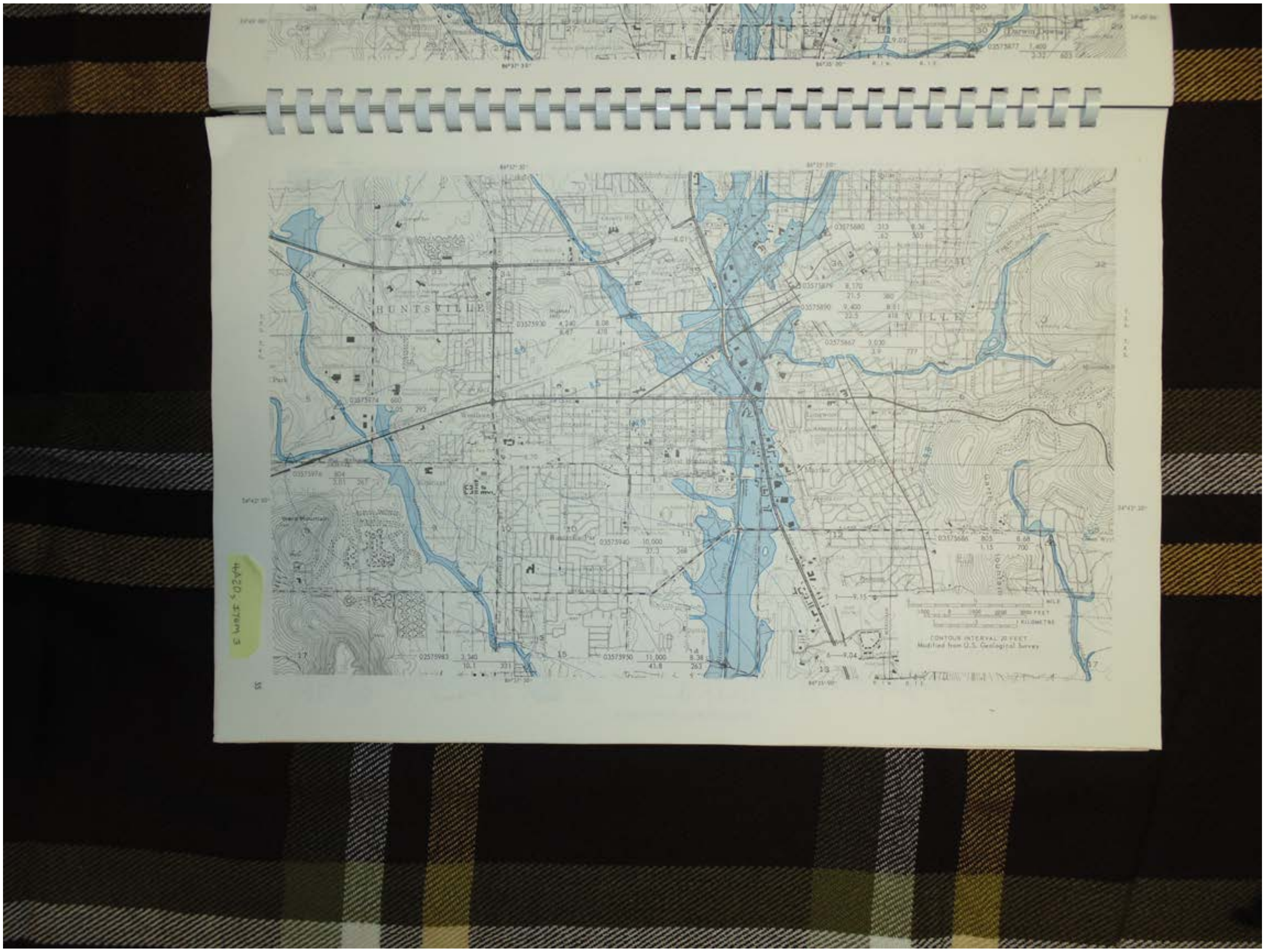
Environmental Geology and Hydrology, 1975
Image 58 r04a20-00-003-5121 Contents Index About



p. 2

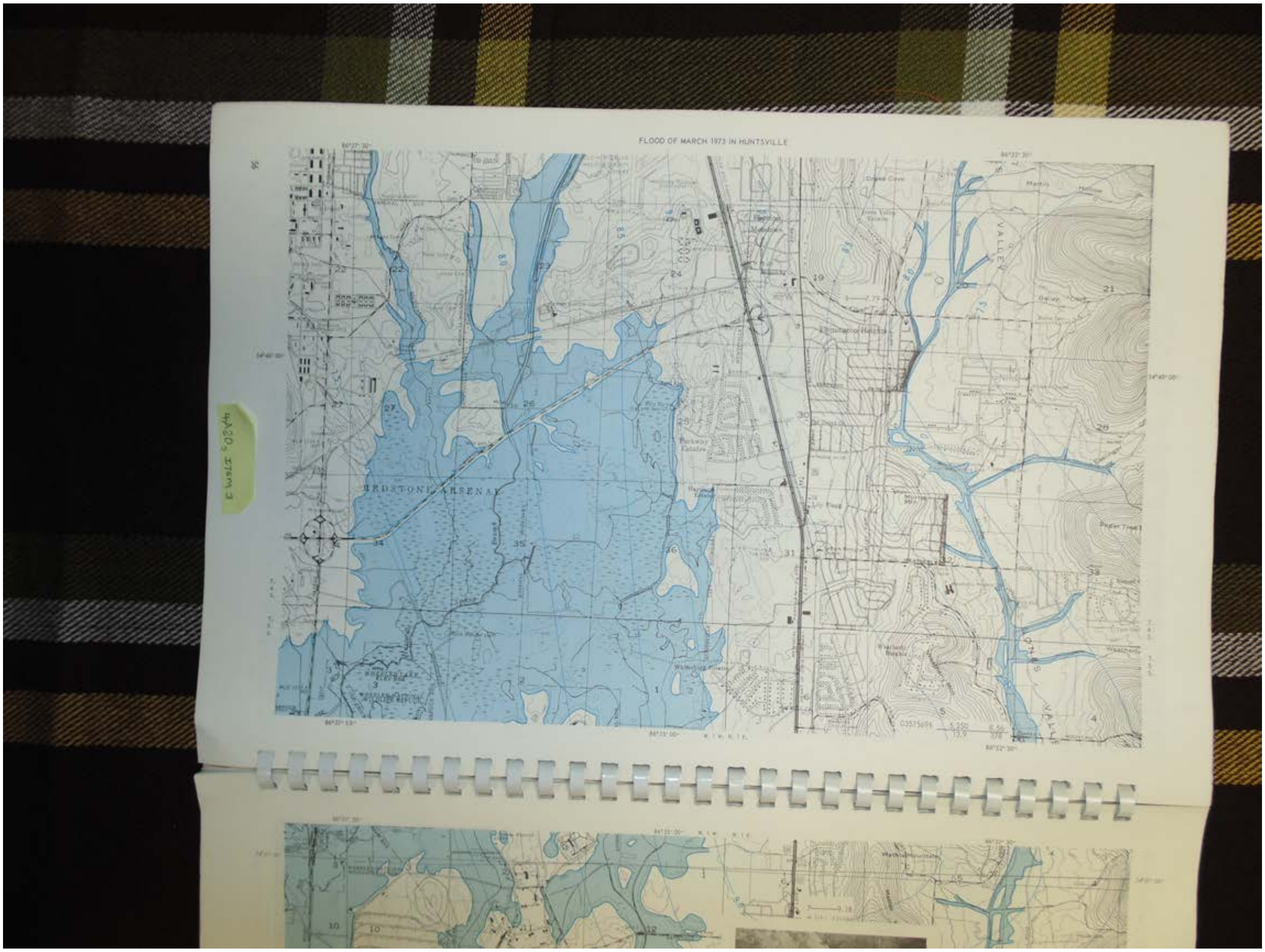
Names:
Flood of March 1973

Places:
Huntsville, AL

Types:
atlas map

Dates:
1973

Frances Cabaniss Roberts Collection: Series 4, Subseries A, Box 20, Item 3
Environmental Geology and Hydrology, 1975
Image 59 r04a20-00-003-5122



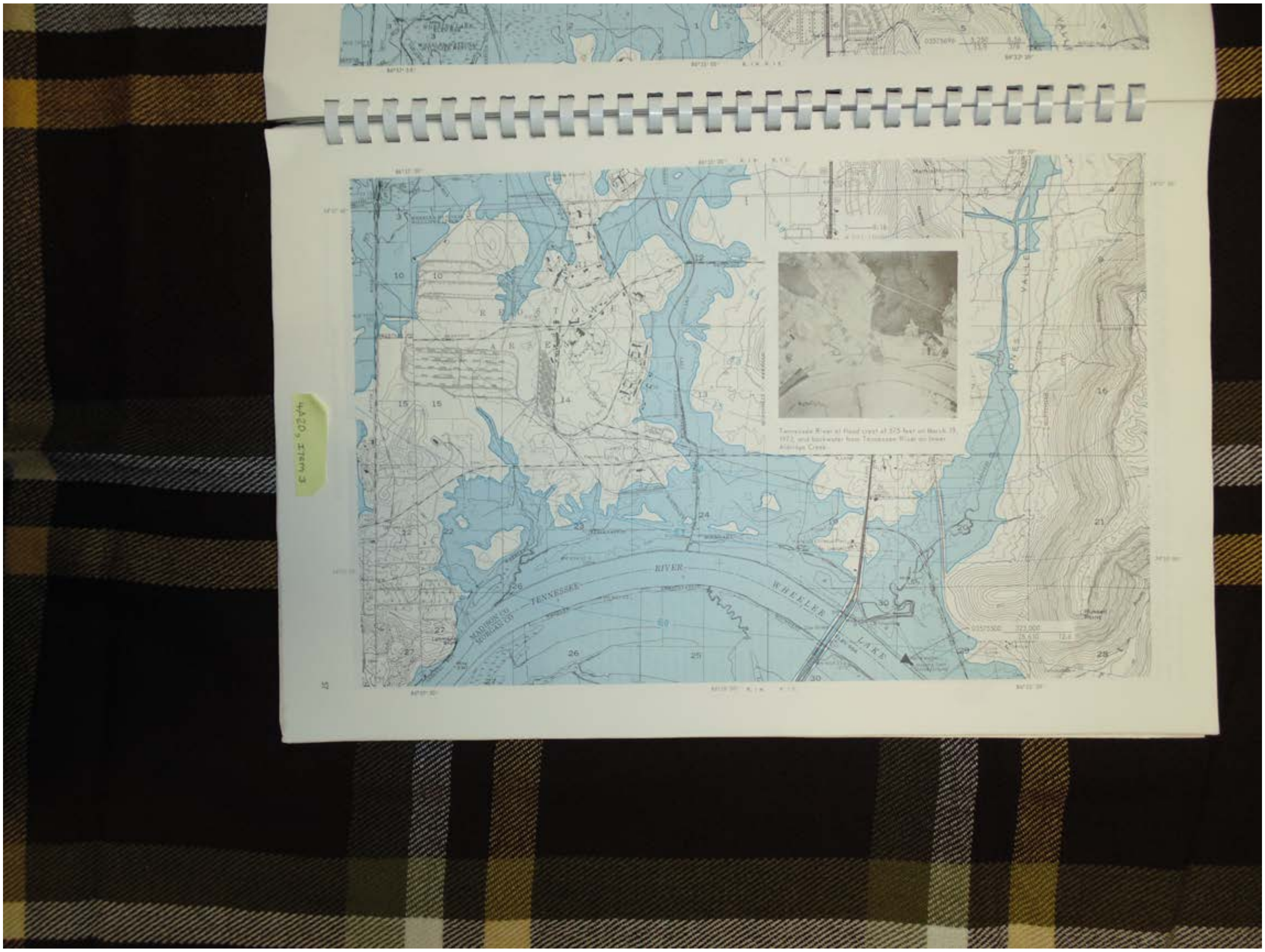
p. 3

Names:
Flood of March 1973

Places:
Huntsville, AL

Types:
atlas
map

Dates:
1973



p. 4

Names:
Flood of March 1973

Places:
Huntsville, AL

Types:
atlas map

Dates:
1973

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Environmental Geology and Hydrology, 1975
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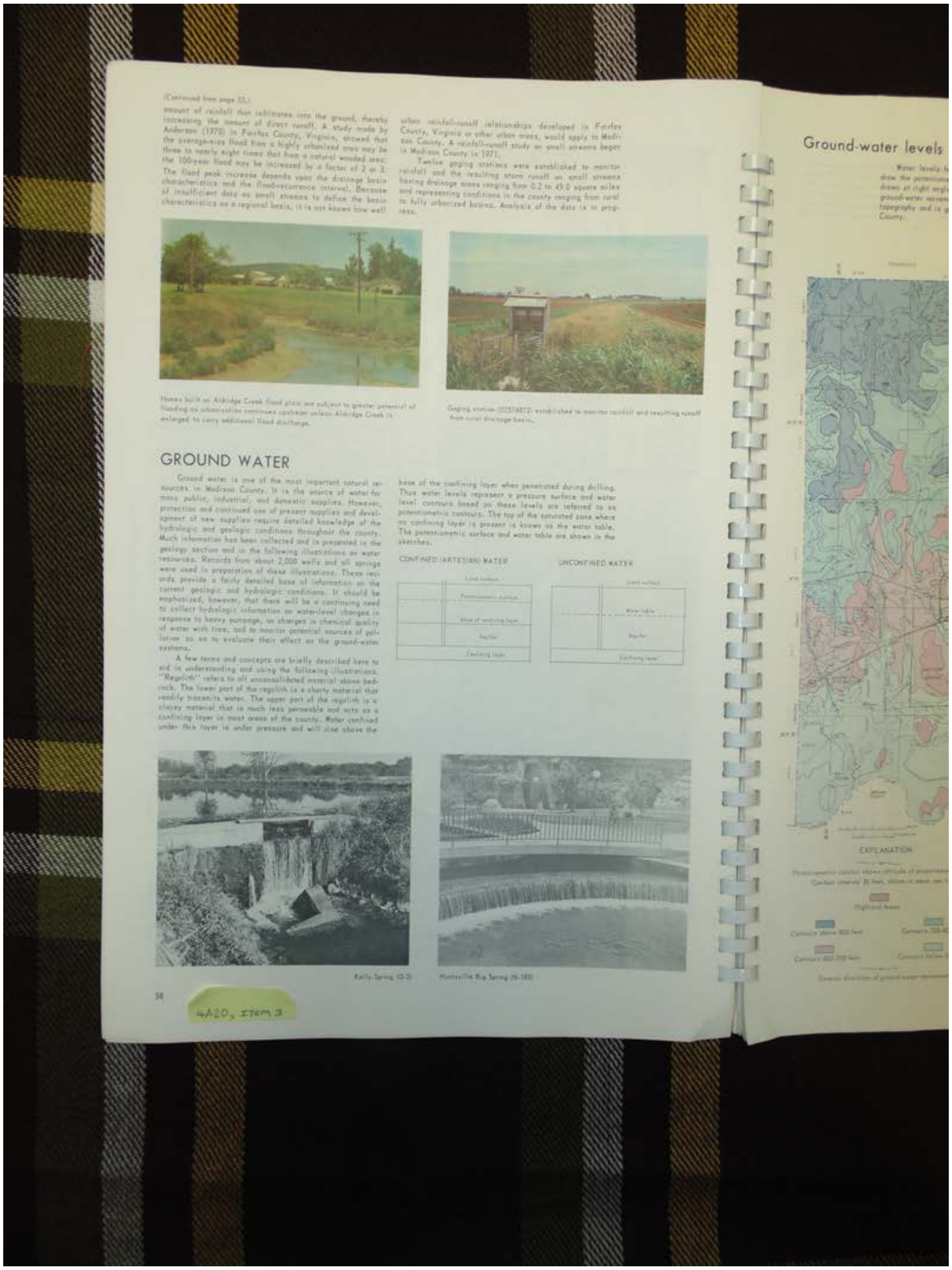

(Continued from page 53.)

amount of rainfall that infiltrates into the ground, thereby increasing the amount of direct runoff. A study made by Anderson (1970) in Fairfax County, Virginia, showed that the average-size flood from a highly urbanized area may be three to nearly eight times that from a natural wooded area; the 100-year flood may be increased by a factor of 2 or 3. The flood peak increase depends upon the drainage basin characteristics and the flood-recurrence interval. Because of insufficient data on small streams to define the basin characteristics on a regional basis, it is not known how well urban rainfall-runoff relationships developed in Fairfax County, Virginia or other urban areas, would apply to Madison County. A rainfall-runoff study on small streams began in Madison County in 1971.

Twelve gaging stations were established to monitor rainfall and the resulting storm runoff on small streams having drainage areas ranging from 0.2 to 49.0 square miles and representing conditions in the county ranging from rural to fully urbanized basins. Analysis of the data is in progress.

Homes built on Aldridge Creek flood plain are subject to greater potential of flooding as urbanization continues upstream unless Aldridge Creek is enlarged to carry additional flood discharge.

Gaging station (02574872) established to monitor rainfall and resulting runoff from rural drainage basin.

GROUND WATER

Ground water is one of the most important natural resources in Madison County. It is the source of water for many public, industrial, and domestic supplies. However, protection and continued use of present supplies and development of new supplies require detailed knowledge of the hydrologic and geologic conditions throughout the county. Much information has been collected and is presented in the geology section and in the following illustrations on water resources. Records from about 2,000 wells and all springs were used in preparation of these illustrations. These records provide a fairly detailed base of information on the current geologic and hydrologic conditions. It should be emphasized, however, that there will be a continuing need to collect hydrologic information on water-level changes in response to heavy pumpage, on changes in chemical quality of water with time, and to monitor potential sources of pollution so as to evaluate their effect on the ground-water systems.

A few terms and concepts are briefly described here to aid in understanding and using the following illustrations. "Regolith" refers to all unconsolidated material above bedrock. The lower part of the regolith is a cherty material that readily transmits water. The upper part of the regolith is a clayey material that is much less permeable and acts as a confining layer in most areas of the county. Water confined under this layer is under pressure and will rise above the base of the confining layer when penetrated during drilling. Thus water levels represent a pressure surface and water level contours based on these levels are referred to as potentiometric contours. The top of the saturated zone where no confining layer is present is known as the water table. The potentiometric surface and water table are shown in the sketches.

CONFINED (ARTESIAN) WATER

UNCONFINED WATER

Kelly Spring (0-3)

Huntsville Big Spring (N-185)

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4A20, Item 3

Ground-water levels

Names:
Ground Water

Places:
Madison Co., AL

Types:
atlas photographs

Dates:
1975

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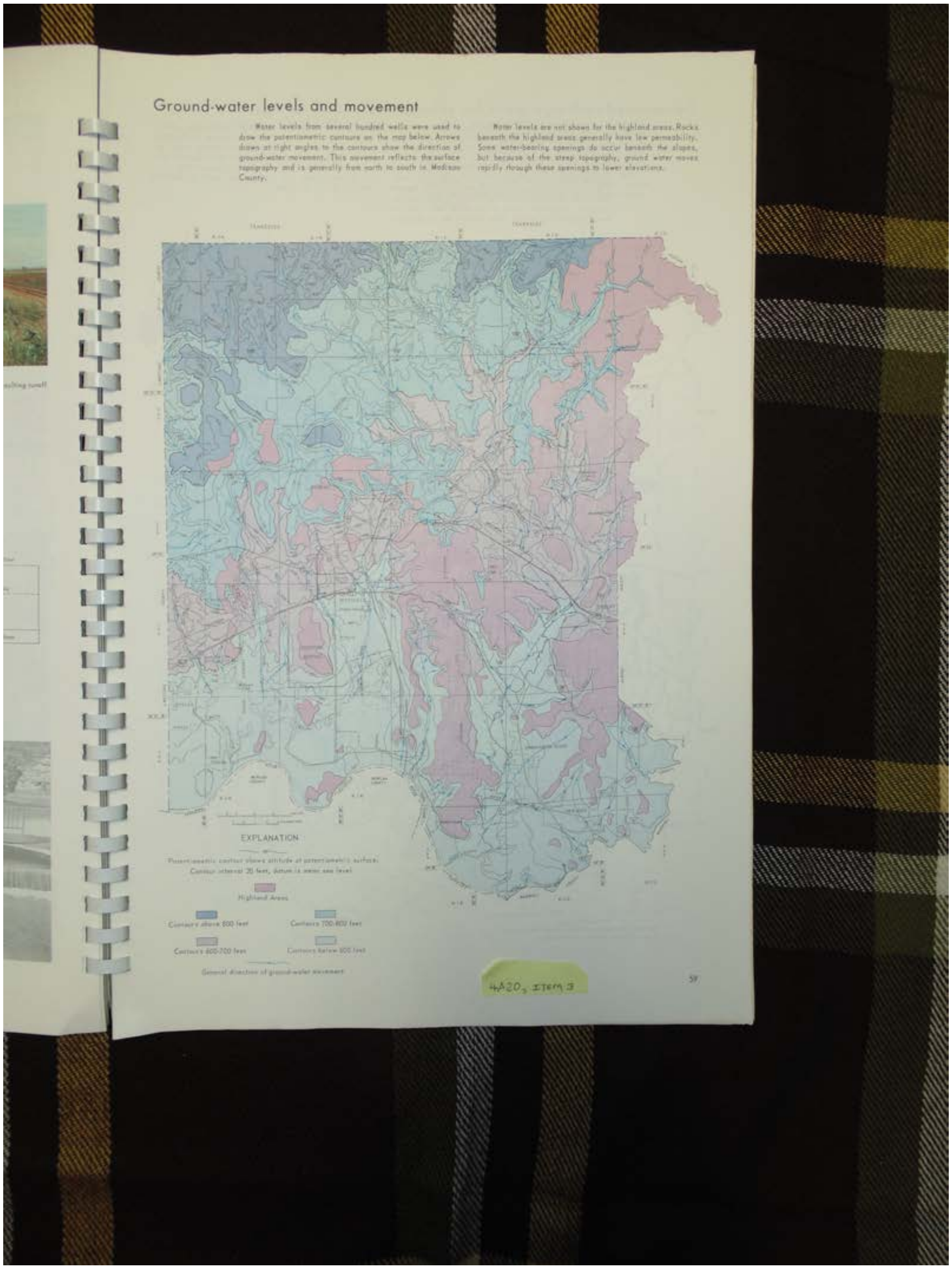
Environmental Geology and Hydrology, 1975
Image 62 r04a20-00-003-5125 [Contents](#) [Index](#) [About](#)



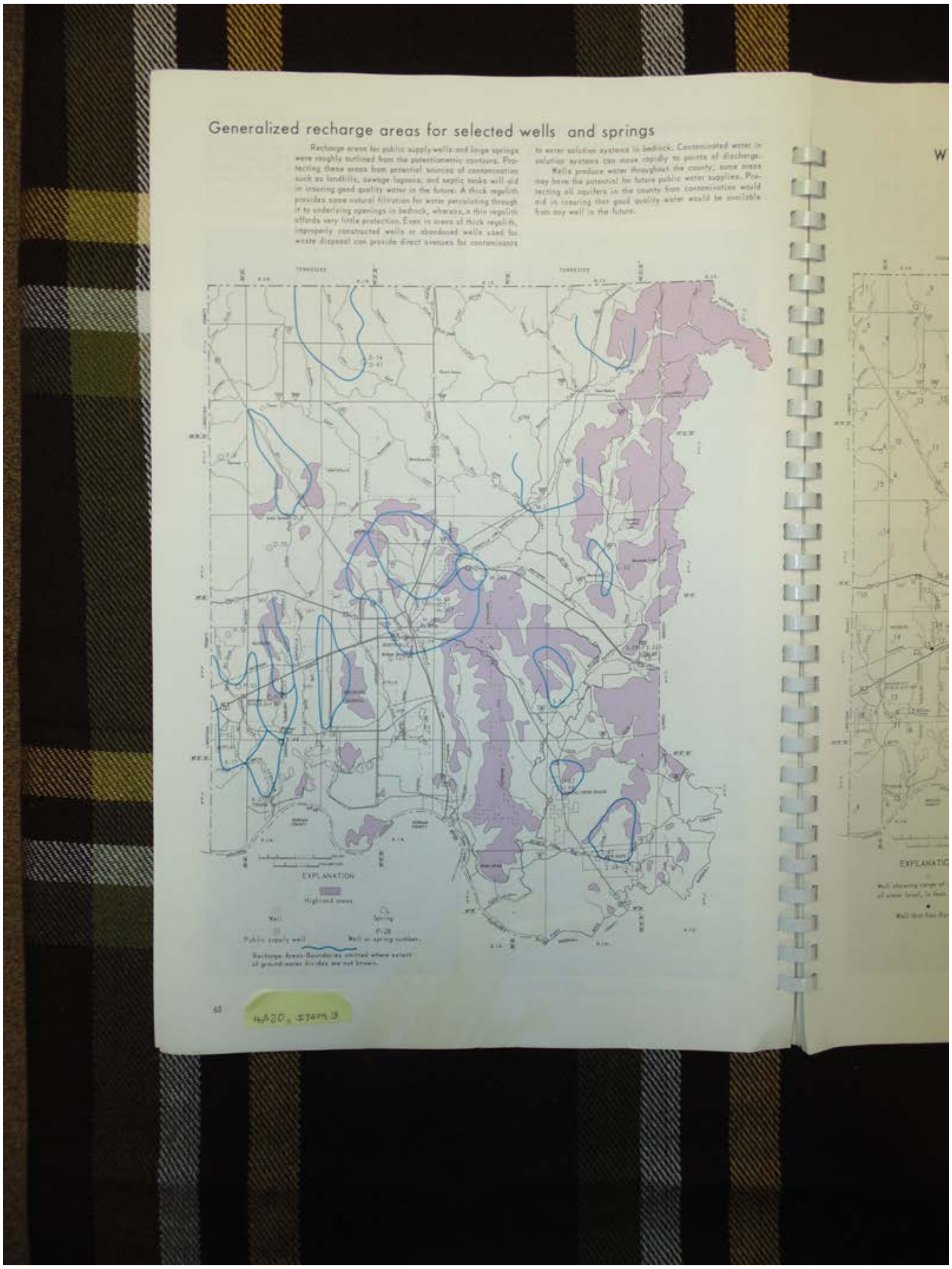
Names:
Ground Water Levels
& Movement

Places:
Madison Co., AL

Types:
atlas map

Dates:
1975

Frances Cabaniss Roberts Collection: **Series 4, Subseries A, Box 20, Item 3**
Environmental Geology and Hydrology, 1975
Image 63 r04a20-00-003-5126 [Contents](#) [Index](#) [About](#)



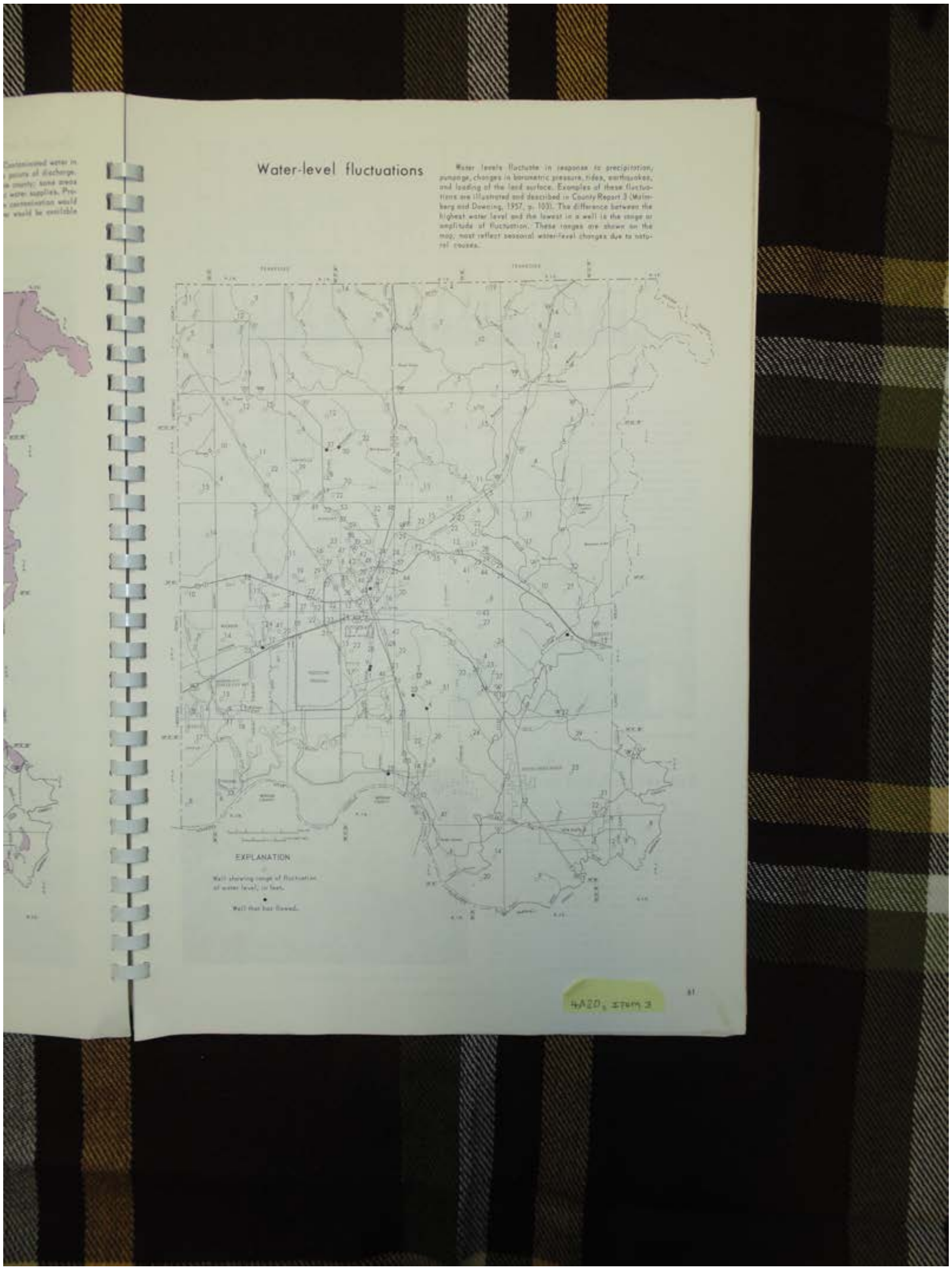
Names:
Recharge Areas for Public Supply Wells & Springs

Places:
Madison Co., AL

Types:
atlas map

Dates:
1975

Frances Cabaniss Roberts Collection: **Series 4, Subseries A, Box 20, Item 3**
Environmental Geology and Hydrology, 1975
Image 64 r04a20-00-003-5127 Contents Index About



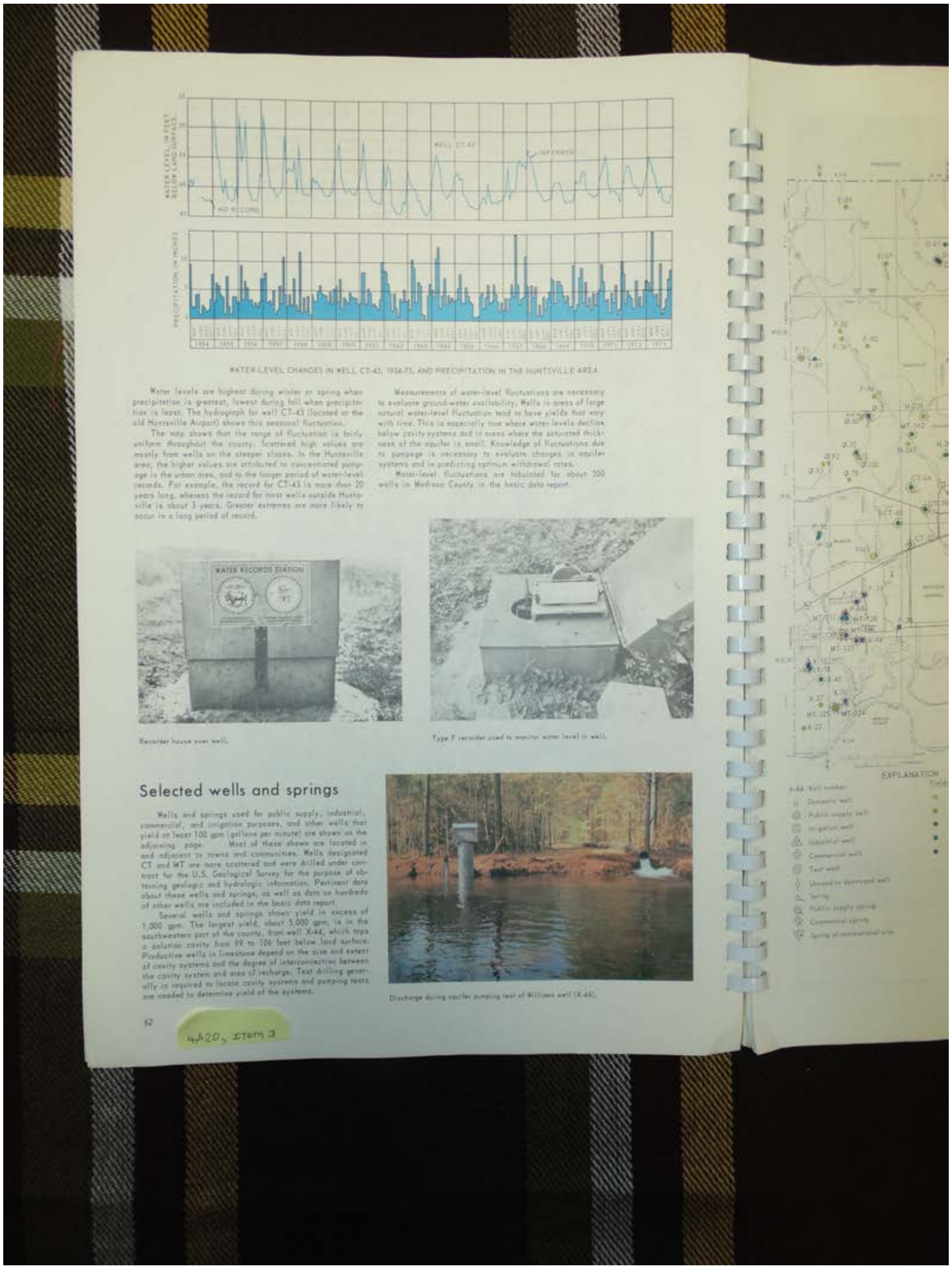
Names:
Water Level
Fluctuations

Places:
Madison Co., AL

Types:
atlas map

Dates:
1975

Frances Cabaniss Roberts Collection: Series 4, Subseries A, Box 20, Item 3
Environmental Geology and Hydrology, 1975
Image 65 r04a20-00-003-5128 Contents Index About



Names:

Precipitation in the Huntsville Area | Selected Wells & Springs | Water Level Changes Williams Well

Places:

Madison Co., AL

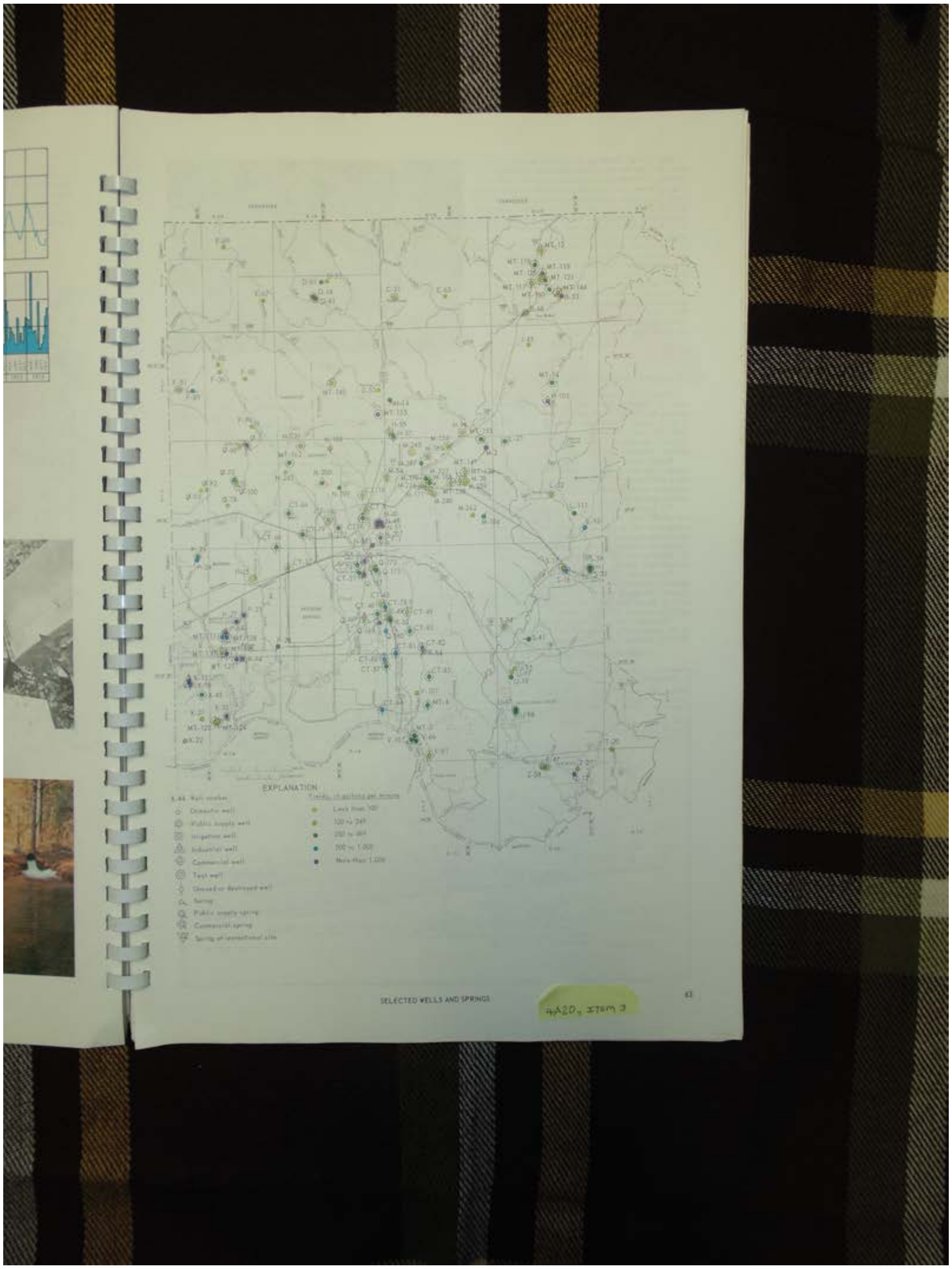
Types:

atlas | photographs | diagram | photograph

Dates:

1975

Frances Cabaniss Roberts Collection: **Series 4, Subseries A, Box 20, Item 3**
Environmental Geology and Hydrology, 1975
Image 66 r04a20-00-003-5129 Contents Index About



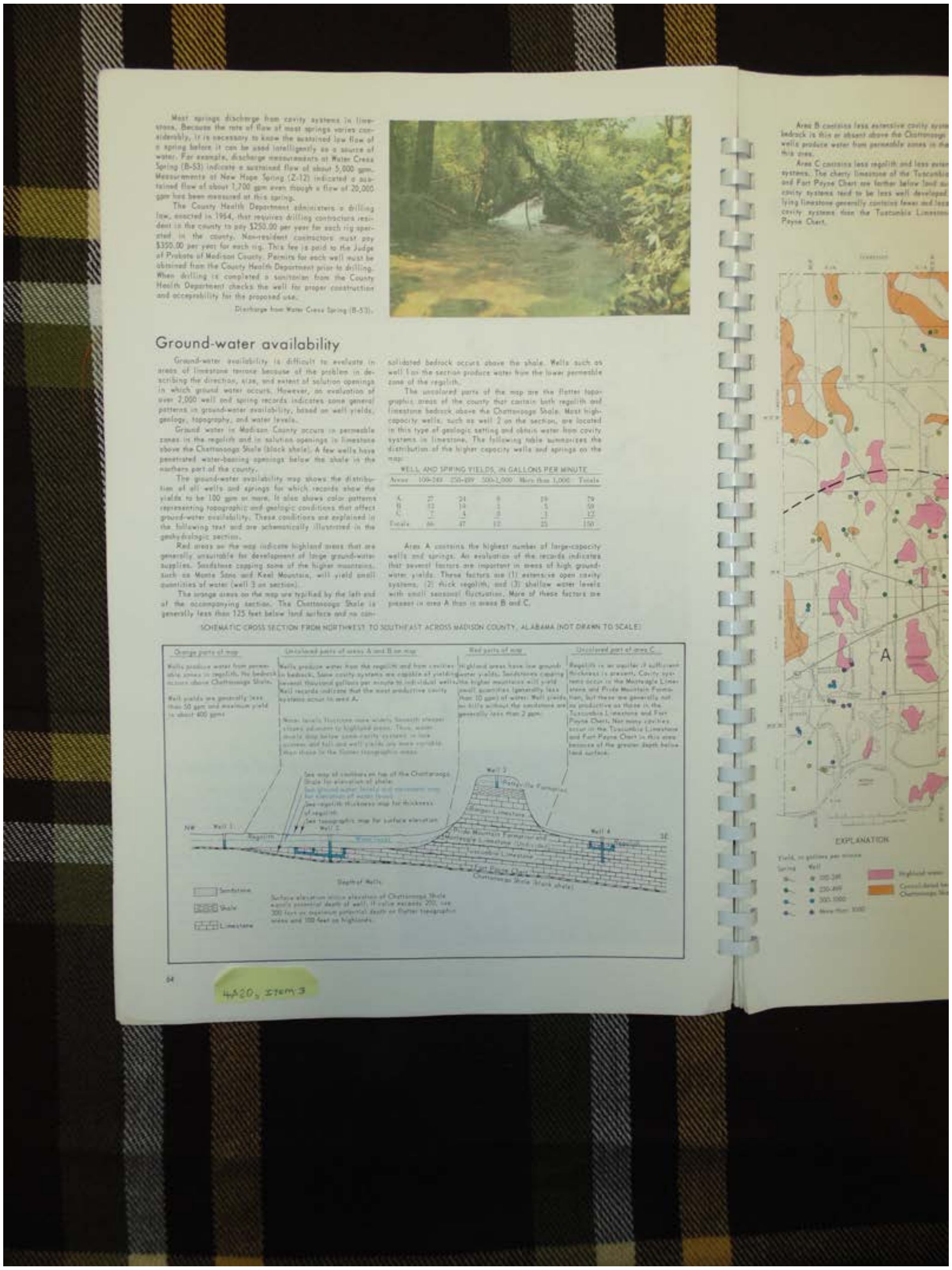
Names:
Selected Wells & Springs

Places:
Madison Co., AL

Types:
map

Dates:
1975

Frances Cabaniss Roberts Collection: **Series 4, Subseries A, Box 20, Item 3**
Environmental Geology and Hydrology, 1975
Image 67 r04a20-00-003-5130 Contents Index About



Most springs discharge from cavity systems in limestone. Because the rate of flow of most springs varies considerably, it is necessary to know the sustained low flow of a spring before it can be used intelligently as a source of water. For example, discharge measurements at Water Cress Spring (B-53) indicate a sustained flow of about 5,000 gpm. Measurements at New Hope Spring (Z-12) indicated a sustained flow of about 1,700 gpm even though a flow of 20,000 gpm has been measured at this spring.

The County Health Department administers a drilling law, enacted in 1964, that requires drilling contractors resident in the county to pay $250.00 per year for each rig operated in the county. Non-resident contractors must pay $350.00 per year for each rig. This fee is paid to the Judge of Probate of Madison County. Permits for each well must be obtained from the County Health Department prior to drilling. When drilling is completed a sanitarian from the County Health Department checks the well for proper construction and acceptability for the proposed use.

Discharge from Water Cress Spring (B-53).

Ground-water availability

Ground-water availability is difficult to evaluate in areas of limestone terrane because of the problem in describing the direction, size, and extent of solution openings in which ground water occurs. However, an evaluation of over 2,000 well and spring records indicates some general patterns in ground-water availability, based on well yields, geology, topography, and water levels.

Ground water in Madison County occurs in permeable zones in the regolith and in solution openings in limestone above the Chattanooga Shale (black shale). A few wells have penetrated water-bearing openings below the shale in the northern part of the county.

The ground-water availability map shows the distribution of all wells and springs for which records show the yields to be 100 gpm or more. It also shows color patterns representing topographic and geologic conditions that affect ground-water availability. These conditions are explained in the following text and are schematically illustrated in the geohydrologic section.

Red areas on the map indicate highland areas that are generally unsuitable for development of large ground-water supplies. Sandstone capping some of the higher mountains, such as Monte Sano and Keel Mountain, will yield small quantities of water (well 3 on section).

The orange areas on the map are typified by the left end of the accompanying section. The Chattanooga Shale is generally less than 125 feet below land surface and no consolidated bedrock occurs above the shale. Wells such as well 1 on the section produce water from the lower permeable zone of the regolith.

The uncolored parts of the map are the flatter topographic areas of the county that contain both regolith and limestone bedrock above the Chattanooga Shale. Most high-capacity wells, such as well 2 on the section, are located in this type of geologic setting and obtain water from cavity systems in limestone. The following table summarizes the distribution of the higher capacity wells and springs on the map:

WELL AND SPRING YIELDS, IN GALLONS PER MINUTE

Areas	100-249	250-499	500-1,000	More than 1,000	Totals
A	27	24	8	19	79
B	32	19	1	5	59
C	7	4	3	1	12
Totals	66	47	12	25	150

Area A contains the highest number of large-capacity wells and springs. An evaluation of the records indicates that several factors are important in areas of high ground-water yields. These factors are (1) extensive open cavity systems, (2) thick regolith, and (3) shallow water levels with small seasonal fluctuation. More of these factors are present in area A than in areas B and C.

SCHEMATIC CROSS SECTION FROM NORTHWEST TO SOUTHEAST ACROSS MADISON COUNTY, ALABAMA (NOT DRAWN TO SCALE)

Orange parts of map: Wells produce water from permeable zones in regolith. No bedrock occurs above Chattanooga Shale. Well yields are generally less than 50 gpm and maximum yield is about 400 gpm.

Uncolored parts of areas A and B on map: Wells produce water from the regolith and from cavities in bedrock. Some cavity systems are capable of yielding several thousand gallons per minute to individual wells. Well records indicate that the most productive cavity systems occur in area A.

Red parts of map: Highland areas have low ground-water yields. Sandstones capping the higher mountains will yield small quantities (generally less than 10 gpm) of water. Well yields on hills without the sandstone are generally less than 2 gpm.

Uncolored part of area C: Regolith is an aquifer if sufficient thickness is present. Cavity systems occur in the Monteagle Limestone and Pride Mountain Formation, but these are generally not as productive as those in the Tuscumbia Limestone and Fort Payne Chert. Not many cavities occur in the Tuscumbia Limestone and Fort Payne Chert in this area because of the greater depth below land surface.

See map of contours on top of the Chattanooga Shale for elevation of shale.
See ground-water levels and movement map for elevation of water level.
See regolith thickness map for thickness of regolith.
See topographic map for surface elevation.

NW Well 1 Regolith Well 2 Water level Well 3 Pottsville Formation Bangor Limestone Pride Mountain Formation and Monteagle Limestone (Undivided) Tuscumbia Limestone Fort Payne Chert Chattanooga Shale (black shale) Well 4 SE

Depth of Wells: Surface elevation minus elevation of Chattanooga Shale equals potential depth of well. If value exceeds 200, use 200 feet as maximum potential depth on flatter topographic areas and 100 feet on highlands.

Sandstone
Shale
Limestone

64

4A20, Item 3

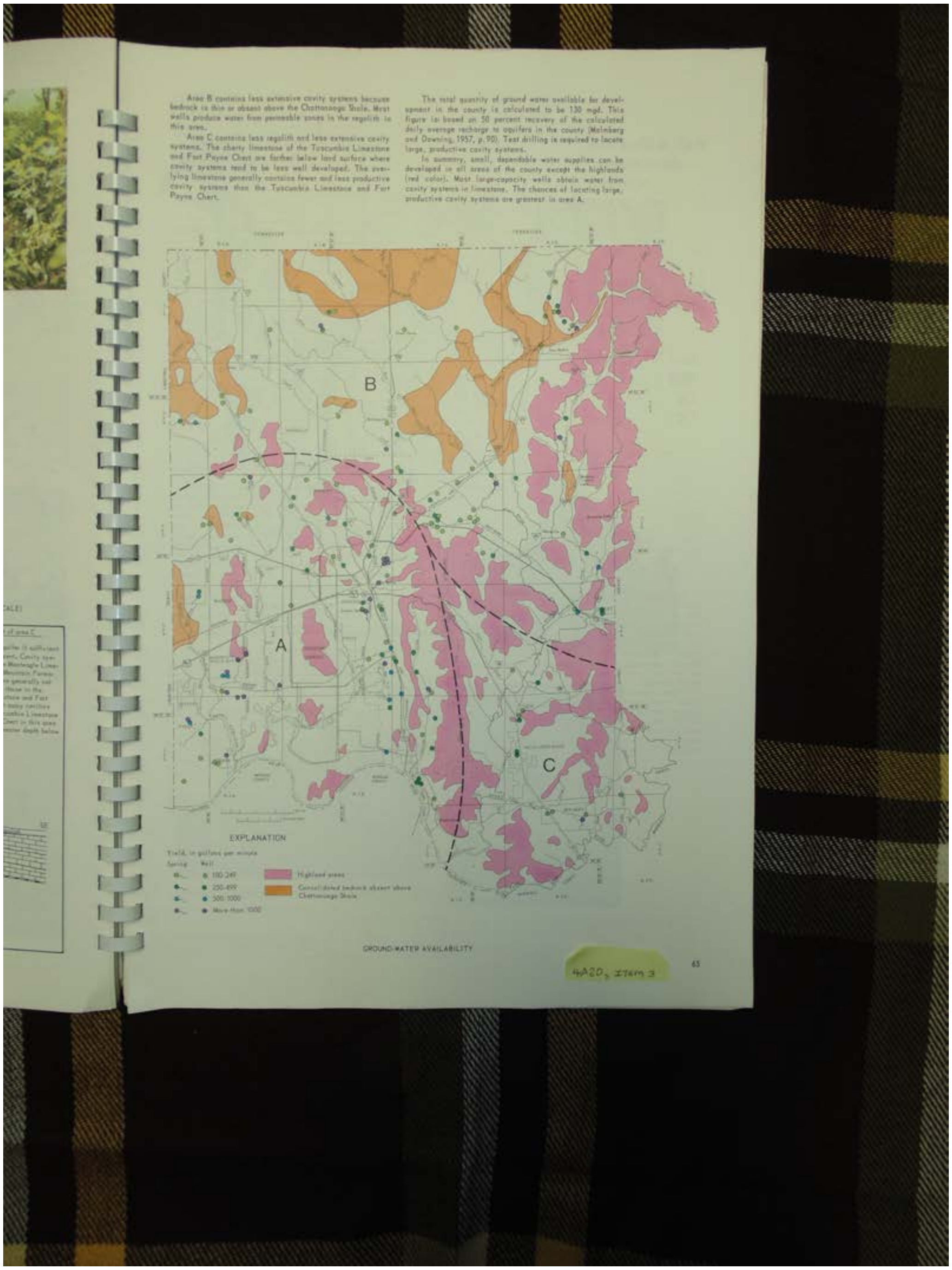
Names:
Ground Water Availability

Places:
Madison Co., AL

Types:
atlas diagram

Dates:
1975

Frances Cabaniss Roberts Collection: Series 4, Subseries A, Box 20, Item 3
Environmental Geology and Hydrology, 1975
Image 68 r04a20-00-003-5131 Contents Index About



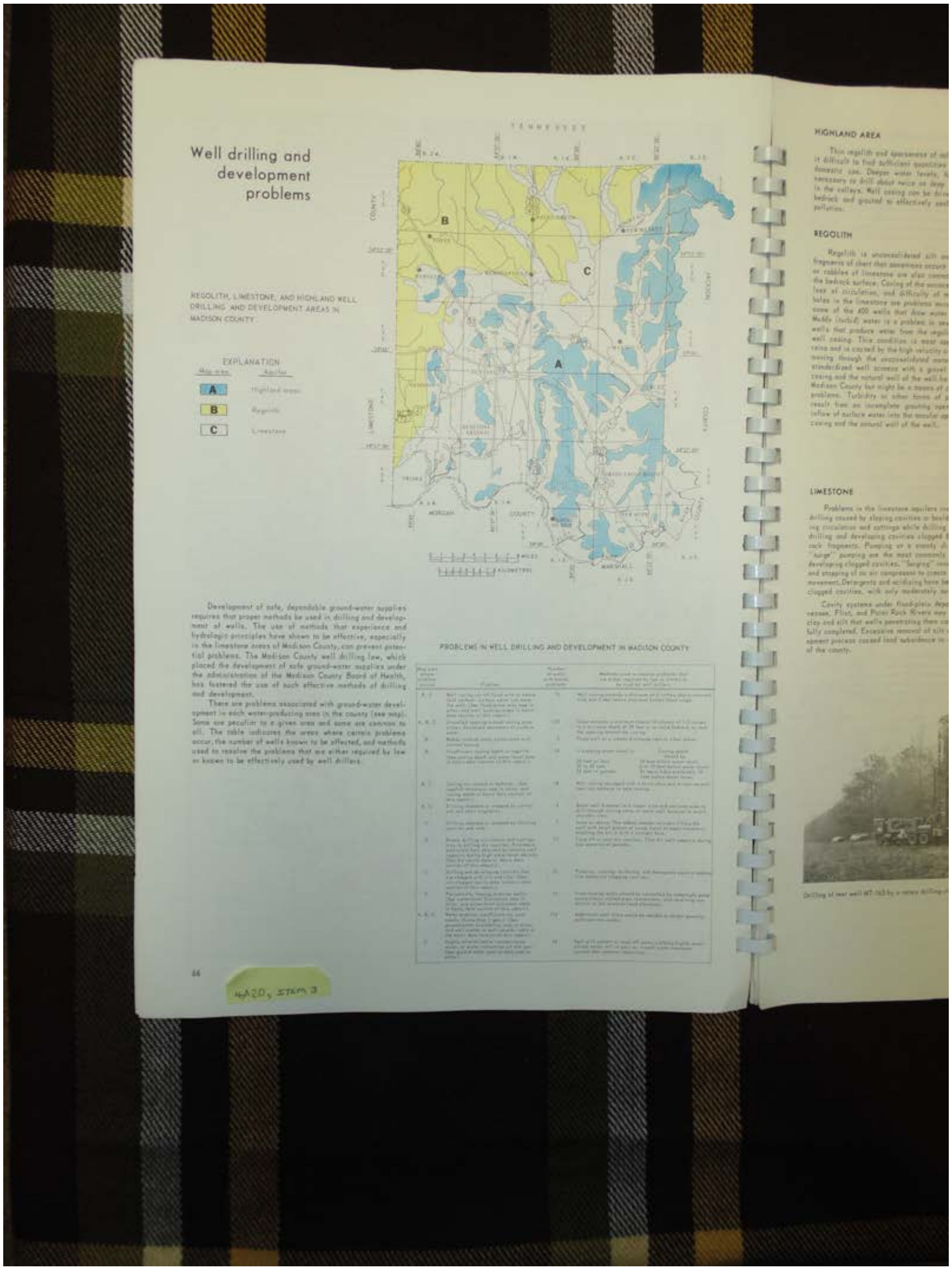
Names:
Ground Water
Availability

Places:
Madison Co., AL

Types:
atlas map

Dates:
1975

Frances Cabaniss Roberts Collection: Series 4, Subseries A, Box 20, Item 3
Environmental Geology and Hydrology, 1975
Image 69 r04a20-00-003-5132 Contents Index About

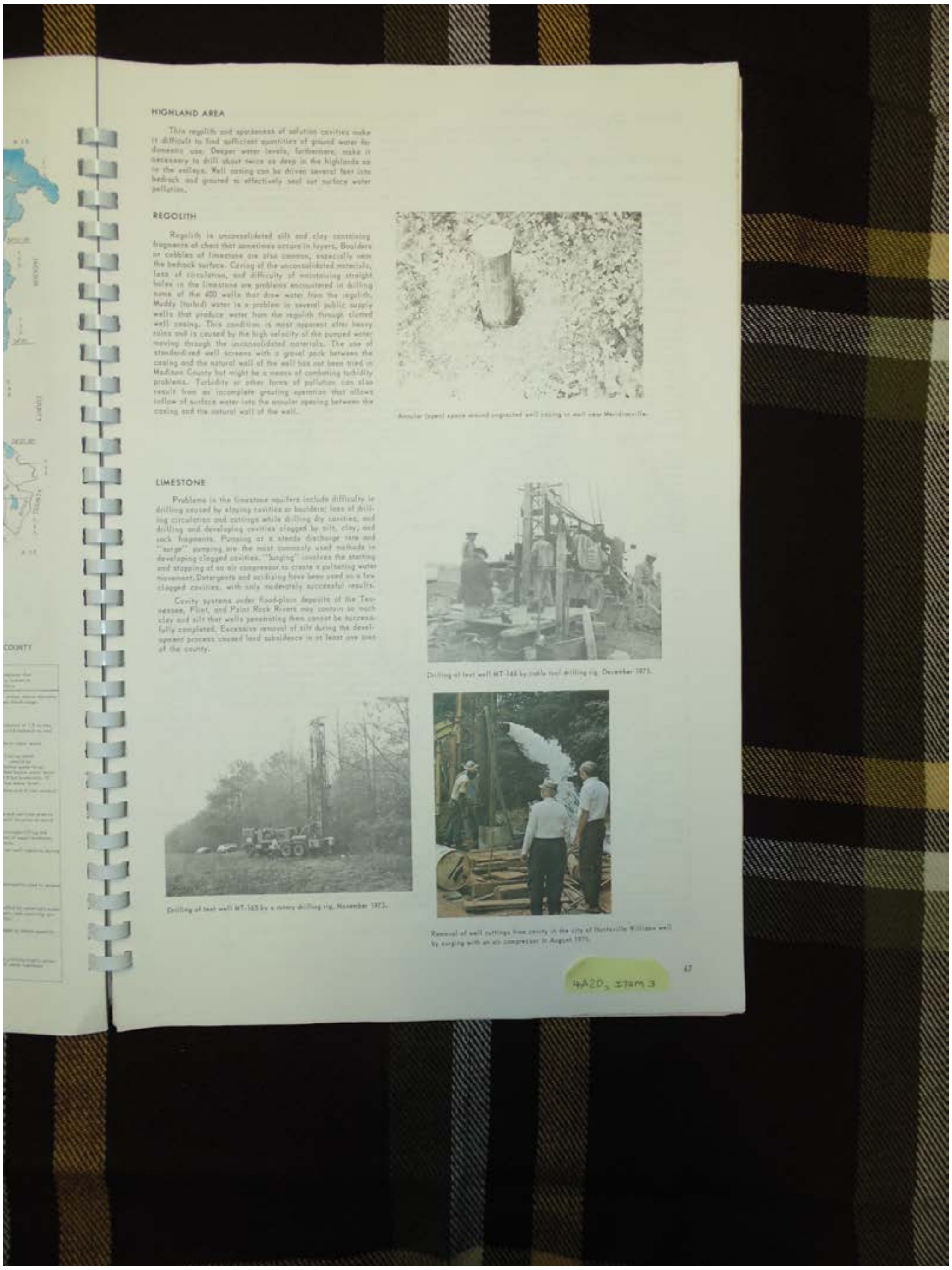


Names:
Well Drilling & Development
Problems

Places:
Madison Co., AL

Types:
atlas
map

Dates:
1975



HIGHLAND AREA

This regolith and sparseness of solution cavities make it difficult to find sufficient quantities of ground water for domestic use. Deeper water levels, furthermore, make it necessary to drill about twice as deep in the highlands as in the valleys. Well casing can be driven several feet into bedrock and grouted to effectively seal out surface water pollution.

REGOLITH

Regolith is unconsolidated silt and clay containing fragments of chert that sometimes occurs in layers. Boulders or cobbles of limestone are also common, especially near the bedrock surface. Caving of the unconsolidated materials, loss of circulation, and difficulty of maintaining straight holes in the limestone are problems encountered in drilling some of the 400 wells that draw water from the regolith. Muddy (turbid) water is a problem in several public supply wells that produce water from the regolith through slotted well casing. This condition is most apparent after heavy rains and is caused by the high velocity of the pumped water moving through the unconsolidated materials. The use of standardized well screens with a gravel pack between the casing and the natural wall of the well has not been tried in Madison County but might be a means of combating turbidity problems. Turbidity or other forms of pollution can also result from an incomplete grouting operation that allows inflow of surface water into the annular opening between the casing and the natural wall of the well.

Annular (open) space around ungrouted well casing in well near Meridianville.

LIMESTONE

Problems in the limestone aquifers include difficulty in drilling caused by sloping cavities or boulders; loss of drilling circulation and cuttings while drilling dry cavities; and drilling and developing cavities clogged by silt, clay, and rock fragments. Pumping at a steady discharge rate and "surge" pumping are the most commonly used methods in developing clogged cavities. "Surging" involves the starting and stopping of an air compressor to create a pulsating water movement. Detergents and acidizing have been used on a few clogged cavities, with only moderately successful results.

Cavity systems under flood-plain deposits of the Tennessee, Flint, and Paint Rock Rivers may contain so much clay and silt that wells penetrating them cannot be successfully completed. Excessive removal of silt during the development process caused land subsidence in at least one area of the county.

Drilling of test well MT-144 by cable tool drilling rig, December 1973.

Drilling of test well MT-163 by a rotary drilling rig, November 1973.

Removal of well cuttings from cavity in the city of Huntsville Williams well by surging with an air compressor in August 1973.

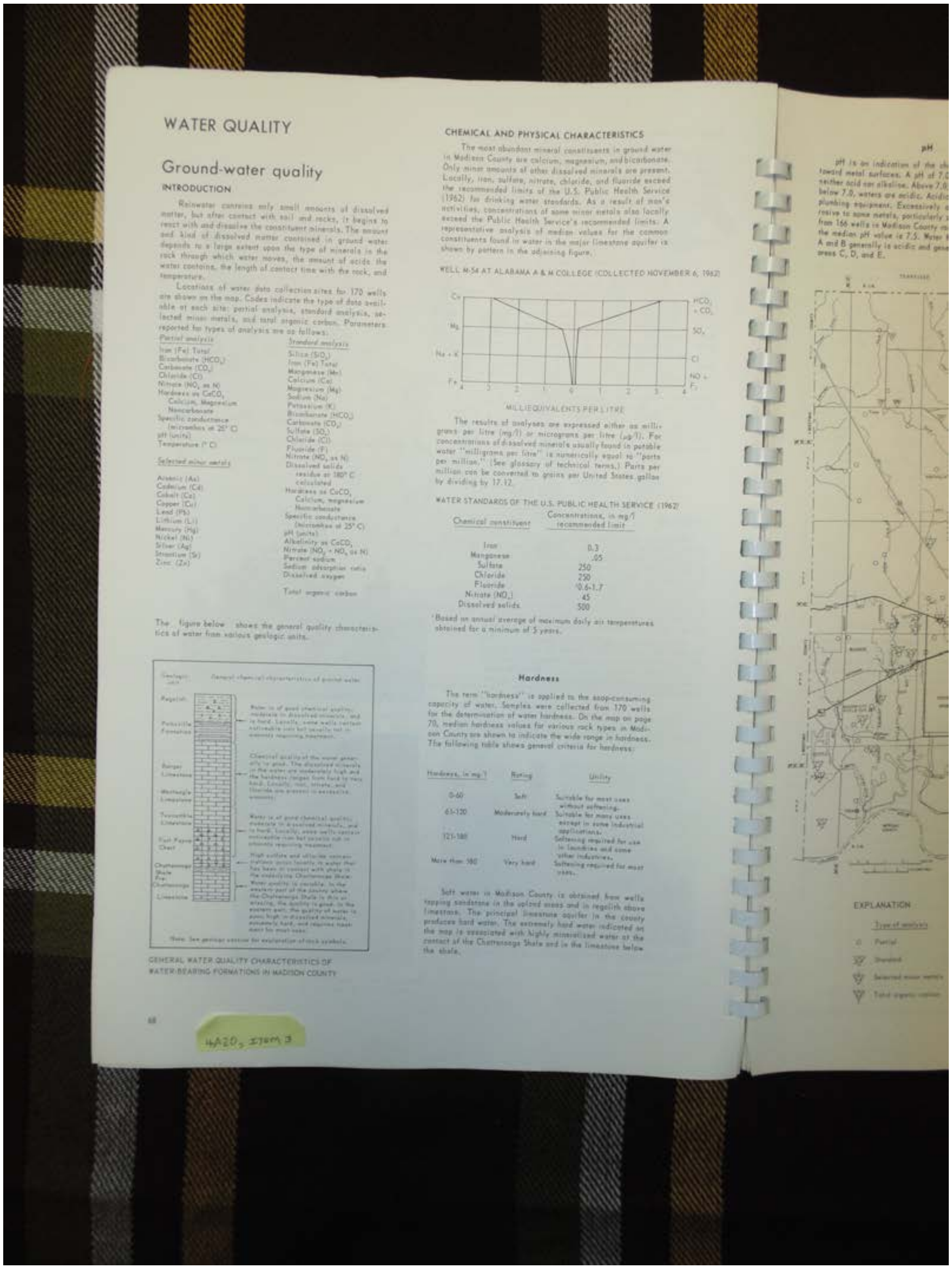
4A20, ITEM 3

Names:
Highland Area water Limestone aquifers Regolith water

Places:
Madison Co., AL

Types:
atlas photograph

Dates:
1975



WATER QUALITY

Ground-water quality

INTRODUCTION

Rainwater contains only small amounts of dissolved matter, but after contact with soil and rocks, it begins to react with and dissolve the constituent minerals. The amount and kind of dissolved matter contained in ground water depends to a large extent upon the type of minerals in the rock through which water moves, the amount of acids the water contains, the length of contact time with the rock, and temperature.

Locations of water data collection sites for 170 wells are shown on the map. Codes indicate the type of data available at each site: partial analysis, standard analysis, selected minor metals, and total organic carbon. Parameters reported for types of analysis are as follows:

Partial analysis
Iron (Fe) Total
Bicarbonate (HCO_3)
Carbonate (CO_3)
Chloride (Cl)
Nitrate (NO_3 as N)
Hardness as $CaCO_3$
Calcium, Magnesium
Noncarbonate
Specific conductance
(micromhos at 25° C)
pH (units)
Temperature (° C)

Selected minor metals
Arsenic (As)
Cadmium (Cd)
Cobalt (Co)
Copper (Cu)
Lead (Pb)
Lithium (Li)
Mercury (Hg)
Nickel (Ni)
Silver (Ag)
Strontium (Sr)
Zinc (Zn)

Standard analysis
Silica (SiO_2)
Iron (Fe) Total
Manganese (Mn)
Calcium (Ca)
Magnesium (Mg)
Sodium (Na)
Potassium (K)
Bicarbonate (HCO_3)
Carbonate (CO_3)
Sulfate (SO_4)
Chloride (Cl)
Fluoride (F)
Nitrate (NO_3 as N)
Dissolved solids
residue at 180° C
calculated
Hardness as $CaCO_3$
Calcium, magnesium
Noncarbonate
Specific conductance
(micromhos at 25° C)
pH (units)
Alkalinity as $CaCO_3$
Nitrate ($NO_2 + NO_3$ as N)
Percent sodium
Sodium adsorption ratio
Dissolved oxygen

Total organic carbon

The figure below shows the general quality characteristics of water from various geologic units.

GENERAL WATER QUALITY CHARACTERISTICS OF WATER-BEARING FORMATIONS IN MADISON COUNTY

CHEMICAL AND PHYSICAL CHARACTERISTICS

The most abundant mineral constituents in ground water in Madison County are calcium, magnesium, and bicarbonate. Only minor amounts of other dissolved minerals are present. Locally, iron, sulfate, nitrate, chloride, and fluoride exceed the recommended limits of the U.S. Public Health Service (1962) for drinking water standards. As a result of man's activities, concentrations of some minor metals also locally exceed the Public Health Service's recommended limits. A representative analysis of median values for the common constituents found in water in the major limestone aquifer is shown by pattern in the adjoining figure.

WELL M-54 AT ALABAMA A & M COLLEGE (COLLECTED NOVEMBER 6, 1962)

MILLIEQUIVALENTS PER LITRE

The results of analyses are expressed either as milligrams per litre (mg/l) or micrograms per litre (µg/l). For concentrations of dissolved minerals usually found in potable water "milligrams per litre" is numerically equal to "parts per million." (See glossary of technical terms.) Parts per million can be converted to grains per United States gallon by dividing by 17.12.

WATER STANDARDS OF THE U.S. PUBLIC HEALTH SERVICE (1962)

Chemical constituent	Concentrations, in mg/l recommended limit
Iron	0.3
Manganese	.05
Sulfate	250
Chloride	250
Fluoride	[1]0.6-1.7
Nitrate (NO_3)	45
Dissolved solids	500

[1]Based on annual average of maximum daily air temperatures obtained for a minimum of 5 years.

Hardness

The term "hardness" is applied to the soap-consuming capacity of water. Samples were collected from 170 wells for the determination of water hardness. On the map on page 70, median hardness values for various rock types in Madison County are shown to indicate the wide range in hardness. The following table shows general criteria for hardness:

Hardness, in mg/l	Rating	Utility
0-60	Soft	Suitable for most uses without softening.
61-120	Moderately hard	Suitable for many uses except in some industrial applications.
121-180	Hard	Softening required for use in laundries and some other industries.
More than 180	Very hard	Softening required for most uses.

Soft water in Madison County is obtained from wells tapping sandstone in the upland areas and in regolith above limestone. The principal limestone aquifer in the county produces hard water. The extremely hard water indicated on the map is associated with highly mineralized water at the contact of the Chattanooga Shale and in the limestone below the shale.

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4A20, Item 3

Names:
Chemical & Physical Characteristics of
Ground Water
Ground Water Quality

Places:
Madison Co., AL

Types:
atlas
diagram

Dates:
1975

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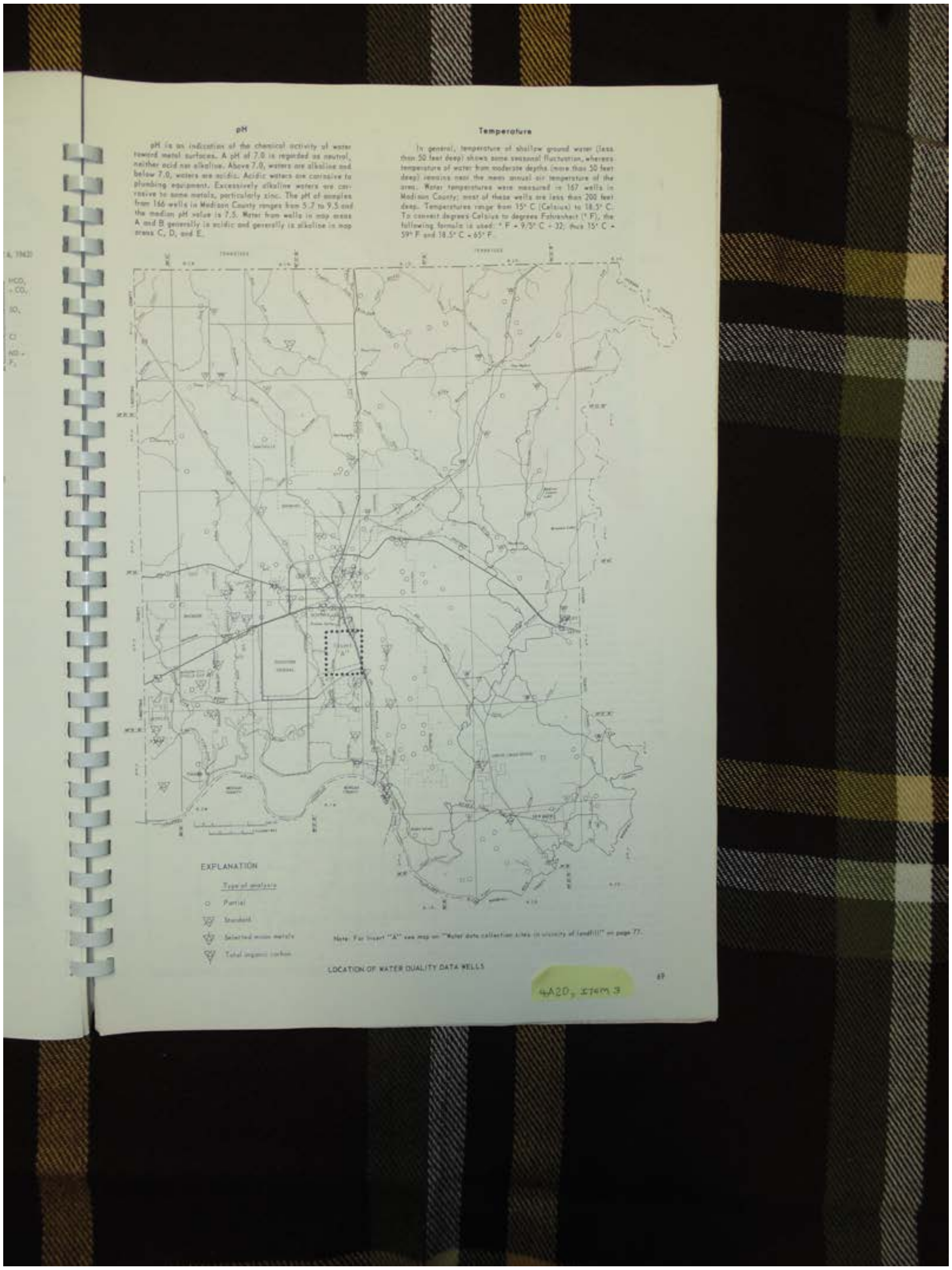
Environmental Geology and Hydrology, 1975
Image 72 r04a20-00-003-5135 [Contents](#) [Index](#) [About](#)



pH

pH is an indication of the chemical activity of water toward metal surfaces. A pH of 7.0 is regarded as neutral, neither acid nor alkaline. Above 7.0, waters are alkaline and below 7.0, waters are acidic. Acidic waters are corrosive to plumbing equipment. Excessively alkaline waters are corrosive to some metals, particularly zinc. The pH of samples from 166 wells in Madison County ranges from 5.7 to 9.5 and the median pH value is 7.5. Water from wells in map areas A and B generally is acidic and generally is alkaline in map areas C, D, and E.

Temperature

In general, temperature of shallow ground water (less than 50 feet deep) shows some seasonal fluctuation, whereas temperature of water from moderate depths (more than 50 feet deep) remains near the mean annual air temperature of the area. Water temperatures were measured in 167 wells in Madison County; most of these wells are less than 200 feet deep. Temperatures range from 15° C (Celsius) to 18.5° C. To convert degrees Celsius to degrees Fahrenheit (° F), the following formula is used: ° F = 9/5° C + 32; thus 15° C = 59° F and 18.5° C = 65° F.

Note: For insert "A" see map on "Water data collection sites in vicinity of landfill" on page 77.

LOCATION OF WATER QUALITY DATA WELLS

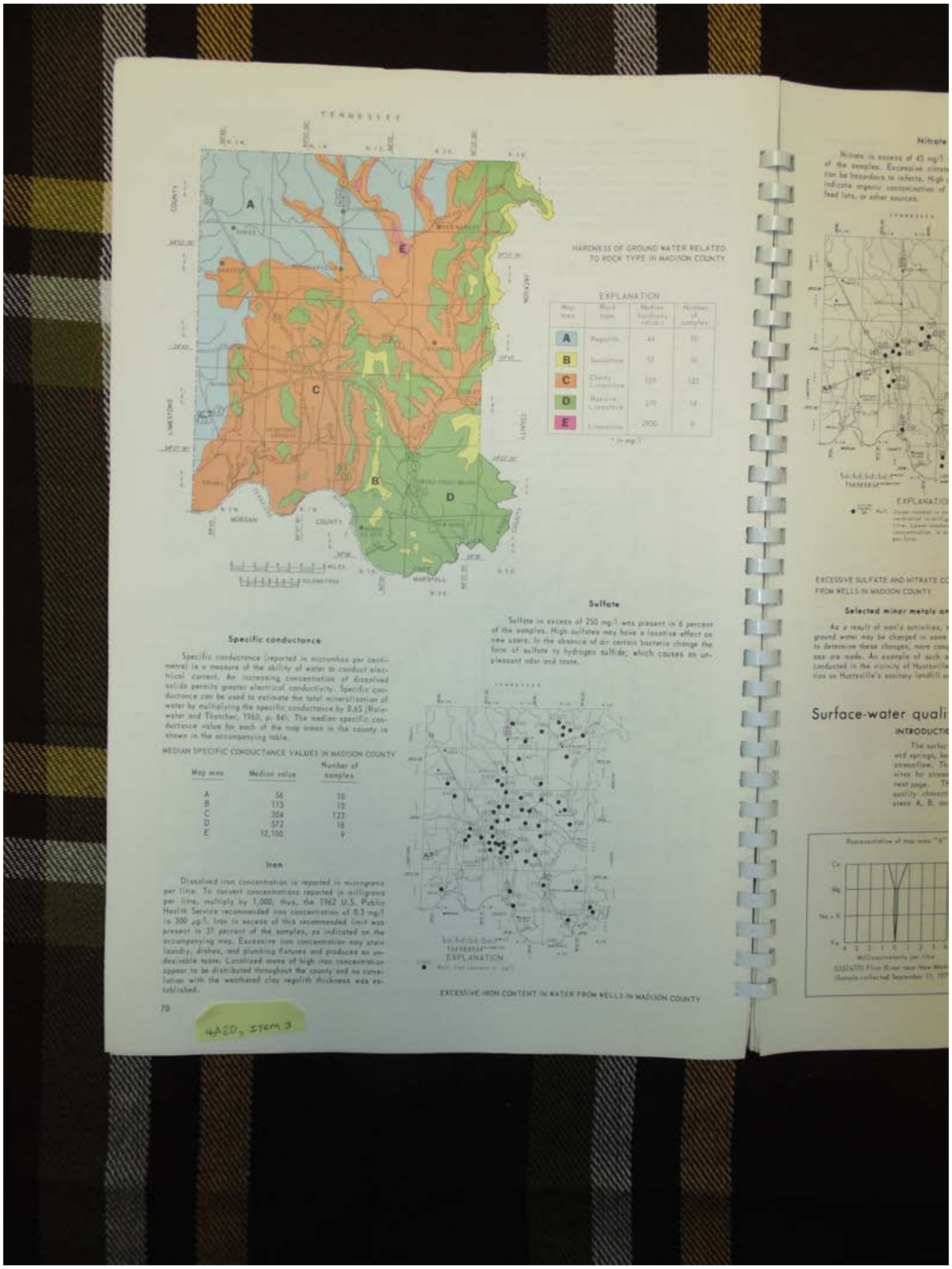
4A20, Item 3

Names:
Water Data Collection Sites
Water Temperature

Places:
Madison Co., AL

Types:
atlas
atlas
map

Dates:
1975



Specific conductance

Specific conductance (reported in micromhos per centimetre) is a measure of the ability of water to conduct electrical current. An increasing concentration of dissolved solids permits greater electrical conductivity. Specific conductance can be used to estimate the total mineralization of water by multiplying the specific conductance by 0.65 (Rainwater and Thatcher, 1960, p. 84). The median specific conductance value for each of the map areas in the county is shown in the accompanying table.

MEDIAN SPECIFIC CONDUCTANCE VALUES IN MADISON COUNTY

Map area	Median value	Number of samples
A	56	10
B	113	10
C	304	123
D	572	18
E	12,100	9

Iron

Dissolved iron concentration is reported in micrograms per litre. To convert concentrations reported in milligrams per litre, multiply by 1,000; thus, the 1962 U.S. Public Health Service recommended iron concentration of 0.3 mg/l is 300 µg/l. Iron in excess of this recommended limit was present in 31 percent of the samples, as indicated on the accompanying map. Excessive iron concentration may stain laundry, dishes, and plumbing fixtures and produces an undesirable taste. Localized areas of high iron concentration appear to be distributed throughout the county and no correlation with the weathered clay regolith thickness was established.

Sulfate

Sulfate in excess of 250 mg/l was present in 6 percent of the samples. High sulfates may have a laxative effect on new users. In the absence of air certain bacteria change the form of sulfate to hydrogen sulfide, which causes an unpleasant odor and taste.

70

4A20, Item 3

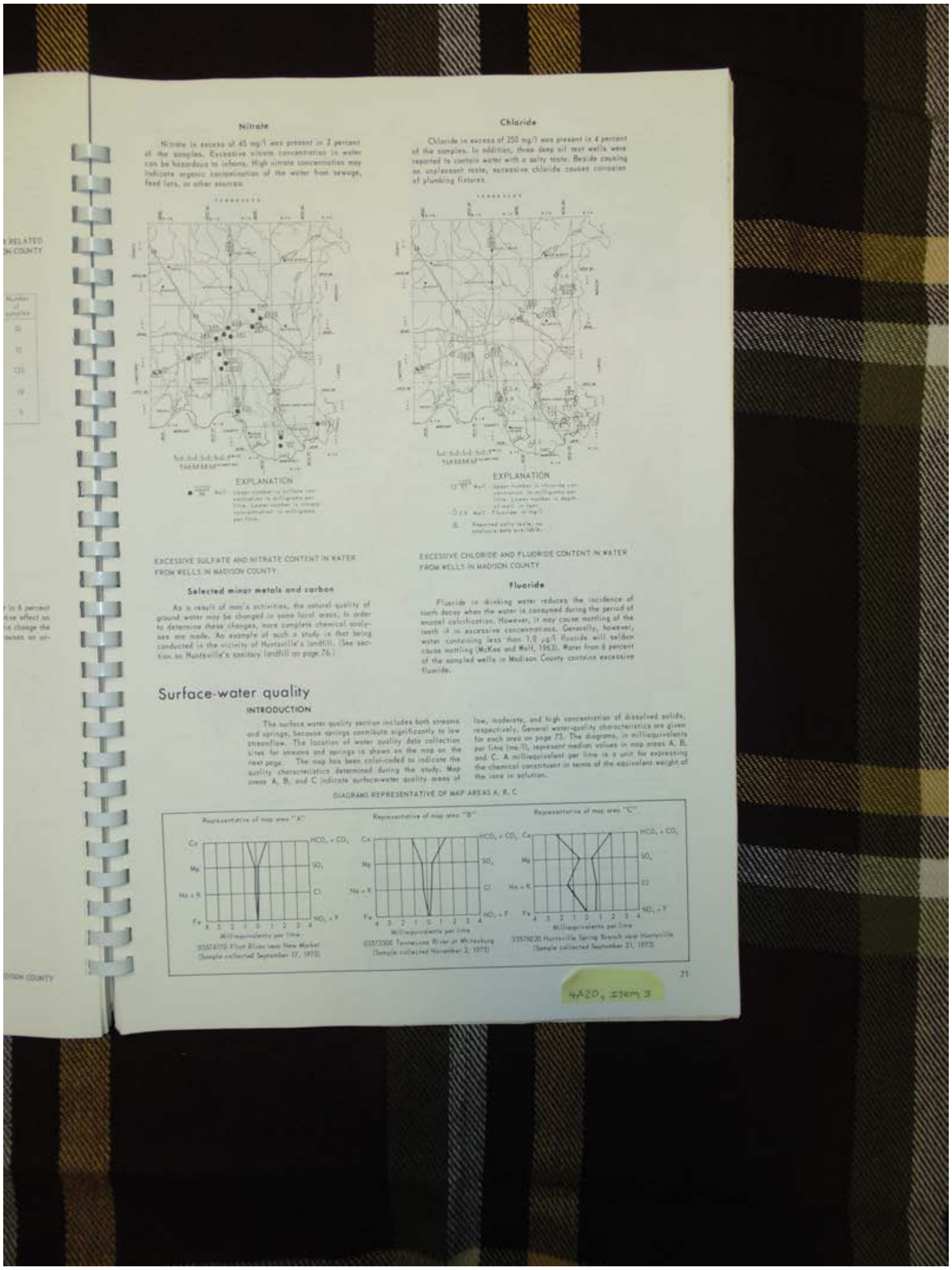
Names:
Hardness of Ground Water
Iron & Sulfates in Wells

Places:
Madison Co., AL

Types:
atlas
map

Dates:
1975

Frances Cabaniss Roberts Collection: Series 4, Subseries A, Box 20, Item 3
Environmental Geology and Hydrology, 1975



Nitrate

Nitrate in excess of 45 mg/l was present in 2 percent of the samples. Excessive nitrate concentration in water can be hazardous to infants. High nitrate concentration may indicate organic contamination of the water from sewage, feed lots, or other sources.

EXPLANATION

EXCESSIVE SULFATE AND NITRATE CONTENT IN WATER FROM WELLS IN MADISON COUNTY

Selected minor metals and carbon

As a result of man's activities, the natural quality of ground water may be changed in some local areas. In order to determine these changes, more complete chemical analyses are made. An example of such a study is that being conducted in the vicinity of Huntsville's landfill. (See section on Huntsville's sanitary landfill on page 76.)

Chloride

Chloride in excess of 250 mg/l was present in 4 percent of the samples. In addition, three deep oil test wells were reported to contain water with a salty taste. Beside causing an unpleasant taste, excessive chloride causes corrosion of plumbing fixtures.

EXPLANATION

EXCESSIVE CHLORIDE AND FLUORIDE CONTENT IN WATER FROM WELLS IN MADISON COUNTY

Fluoride

Fluoride in drinking water reduces the incidence of tooth decay when the water is consumed during the period of enamel calcification. However, it may cause mottling of the teeth if in excessive concentrations. Generally, however, water containing less than 1.0 µg/l fluoride will seldom cause mottling (McKee and Wolf, 1963). Water from 6 percent of the sampled wells in Madison County contains excessive fluoride.

Surface-water quality

INTRODUCTION

The surface water quality section includes both streams and springs, because springs contribute significantly to low streamflow. The location of water quality data collection sites for streams and springs is shown on the map on the next page. The map has been color-coded to indicate the quality characteristics determined during the study. Map areas A, B, and C indicate surface-water quality areas of low, moderate, and high concentration of dissolved solids, respectively. General water-quality characteristics are given for each area on page 73. The diagrams, in milliequivalents per litre (me/l), represent median values in map areas A, B, and C. A milliequivalent per litre is a unit for expressing the chemical constituent in terms of the equivalent weight of the ions in solution.

DIAGRAMS REPRESENTATIVE OF MAP AREAS A, B, C

Representative of map area "A"
Milliequivalents per litre
03574770 Flint River near New Market
(Sample collected September 17, 1973)

Representative of map area "B"
Milliequivalents per litre
03575500 Tennessee River at Whitesburg
(Sample collected November 2, 1973)

Representative of map area "C"
Milliequivalents per litre
03576020 Huntsville Spring Branch near Huntsville
(Sample collected September 21, 1973)

71

4A20, Item 3

Names:

Sulfates, Nitrate & Chloride in Wells

Surface Water Quality

Places:

Madison Co., AL

Types:

atlas

diagrams

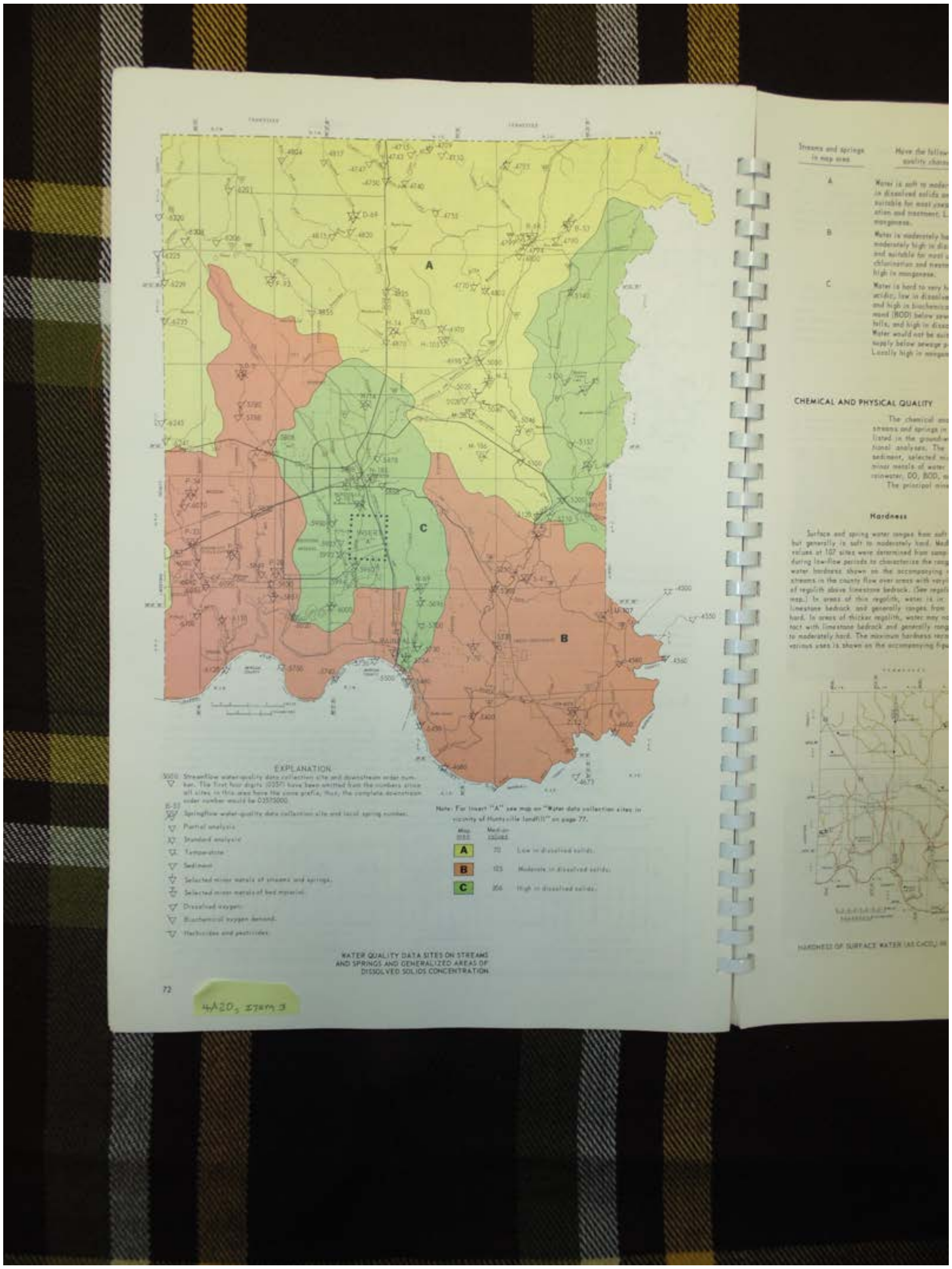
atlas

maps

Dates:

1975

Frances Cabaniss Roberts Collection: Series 4, Subseries A, Box 20, Item 3
Environmental Geology and Hydrology, 1975
Image 75 r04a20-00-003-5138 Contents Index About

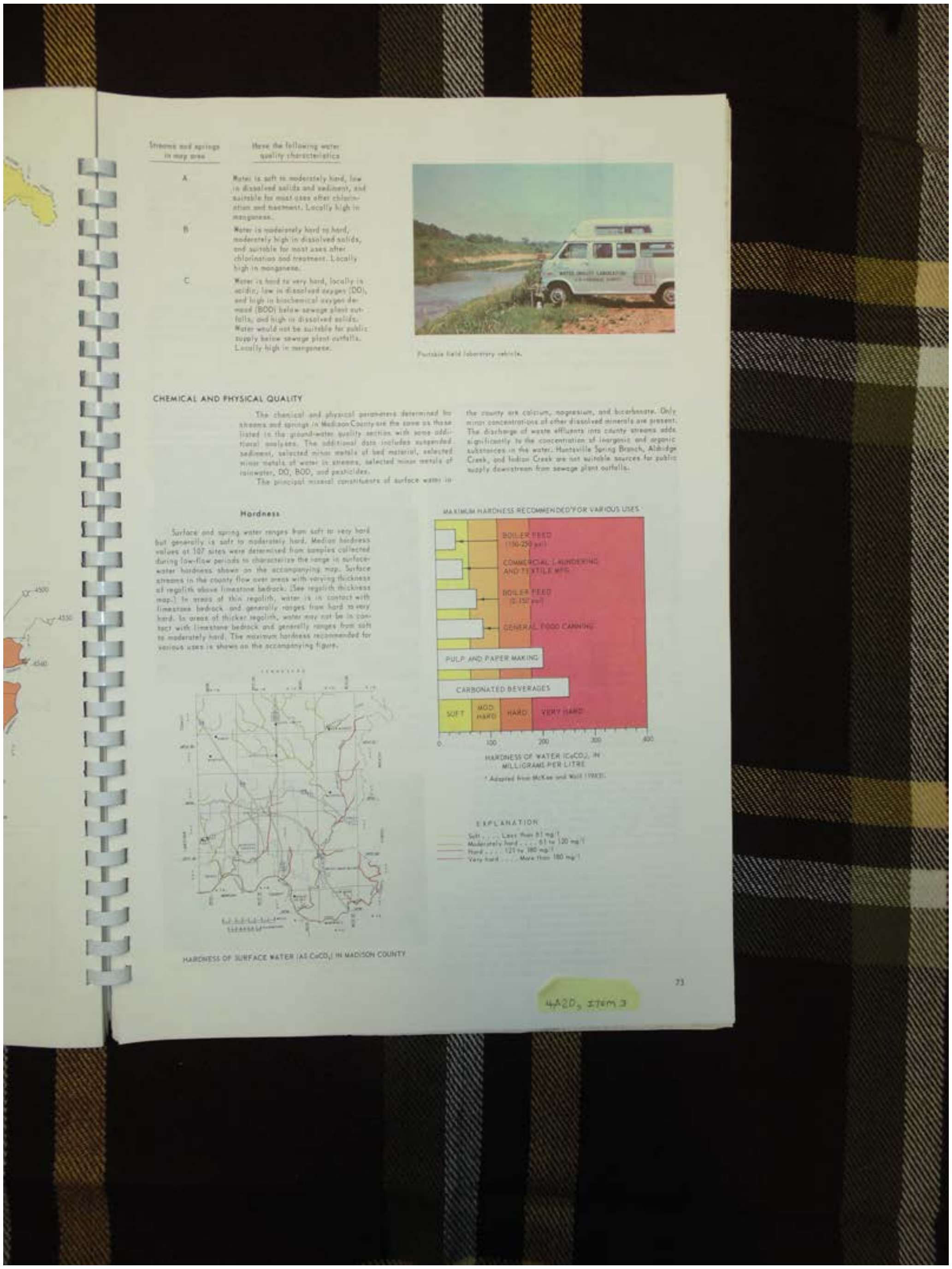


Names:
Water Quality Data Sites

Places:
Madison Co., AL

Types:
atlas map

Dates:
1975



Streams and springs in map area	Have the following water quality characteristics
A	Water is soft to moderately hard, low in dissolved solids and sediment, and suitable for most uses after chlorination and treatment. Locally high in manganese.
B	Water is moderately hard to hard, moderately high in dissolved solids, and suitable for most uses after chlorination and treatment. Locally high in manganese.
C	Water is hard to very hard, locally is acidic, low in dissolved oxygen (DO), and high in biochemical oxygen demand (BOD) below sewage plant outfalls, and high in dissolved solids. Water would not be suitable for public supply below sewage plant outfalls. Locally high in manganese.

Portable field laboratory vehicle.

CHEMICAL AND PHYSICAL QUALITY

The chemical and physical parameters determined for streams and springs in Madison County are the same as those listed in the ground-water quality section with some additional analyses. The additional data includes suspended sediment, selected minor metals of bed material, selected minor metals of water in streams, selected minor metals of rainwater, DO, BOD, and pesticides.

The principal mineral constituents of surface water in the county are calcium, magnesium, and bicarbonate. Only minor concentrations of other dissolved minerals are present. The discharge of waste effluents into county streams adds significantly to the concentration of inorganic and organic substances in the water. Huntsville Spring Branch, Aldridge Creek, and Indian Creek are not suitable sources for public supply downstream from sewage plant outfalls.

Hardness

Surface and spring water ranges from soft to very hard but generally is soft to moderately hard. Median hardness values at 107 sites were determined from samples collected during low-flow periods to characterize the range in surface-water hardness shown on the accompanying map. Surface streams in the county flow over areas with varying thickness of regolith above limestone bedrock. (See regolith thickness map.) In areas of thin regolith, water is in contact with limestone bedrock and generally ranges from hard to very hard. In areas of thicker regolith, water may not be in contact with limestone bedrock and generally ranges from soft to moderately hard. The maximum hardness recommended for various uses is shown on the accompanying figure.

HARDNESS OF SURFACE WATER (AS $CaCO_3$) IN MADISON COUNTY

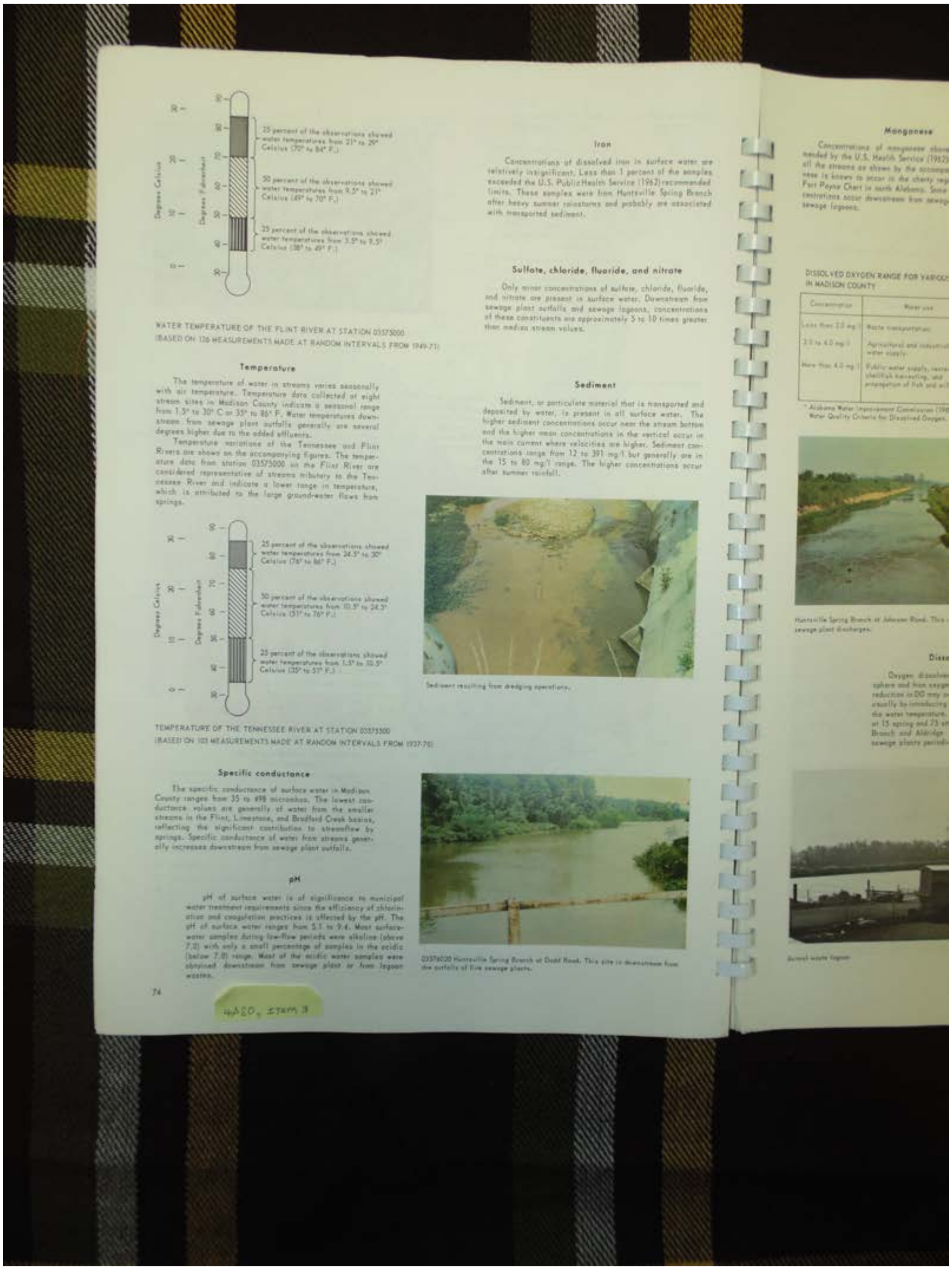
4A20, Item 3

Names:
Chemical & Physical Quality of Water

Places:
Madison Co., AL

Types:
atlas diagram

Dates:
1975



25 percent of the observations showed water temperatures from 21° to 29° Celsius (70° to 84° F.)

50 percent of the observations showed water temperatures from 9.5° to 21° Celsius (49° to 70° F.)

25 percent of the observations showed water temperatures from 3.5° to 9.5° Celsius (38° to 49° F.)

WATER TEMPERATURE OF THE FLINT RIVER AT STATION 03575000
(BASED ON 126 MEASUREMENTS MADE AT RANDOM INTERVALS FROM 1949-71)

Temperature

The temperature of water in streams varies seasonally with air temperature. Temperature data collected at eight stream sites in Madison County indicate a seasonal range from 1.5° to 30° C or 35° to 86° F. Water temperatures downstream from sewage plant outfalls generally are several degrees higher due to the added effluents.

Temperature variations of the Tennessee and Flint Rivers are shown on the accompanying figures. The temperature data from station 03575000 on the Flint River are considered representative of streams tributary to the Tennessee River and indicate a lower range in temperature, which is attributed to the large ground-water flows from springs.

25 percent of the observations showed water temperatures from 24.5° to 30° Celsius (76° to 86° F.)

50 percent of the observations showed water temperatures from 10.5° to 24.5° Celsius (51° to 76° F.)

25 percent of the observations showed water temperatures from 1.5° to 10.5° Celsius (35° to 51° F.)

TEMPERATURE OF THE TENNESSEE RIVER AT STATION 03575500
(BASED ON 103 MEASUREMENTS MADE AT RANDOM INTERVALS FROM 1937-70)

Specific conductance

The specific conductance of surface water in Madison County ranges from 35 to 498 micromhos. The lowest conductance values are generally of water from the smaller streams in the Flint, Limestone, and Bradford Creek basins, reflecting the significant contribution to streamflow by springs. Specific conductance of water from streams generally increases downstream from sewage plant outfalls.

pH

pH of surface water is of significance to municipal water treatment requirements since the efficiency of chlorination and coagulation practices is affected by the pH. The pH of surface water ranges from 5.1 to 9.4. Most surface-water samples during low-flow periods were alkaline (above 7.0) with only a small percentage of samples in the acidic (below 7.0) range. Most of the acidic water samples were obtained downstream from sewage plant or from lagoon wastes.

Iron

Concentrations of dissolved iron in surface water are relatively insignificant. Less than 1 percent of the samples exceeded the U.S. Public Health Service (1962) recommended limits. These samples were from Huntsville Spring Branch after heavy summer rainstorms and probably are associated with transported sediment.

Sulfate, chloride, fluoride, and nitrate

Only minor concentrations of sulfate, chloride, fluoride, and nitrate are present in surface water. Downstream from sewage plant outfalls and sewage lagoons, concentrations of these constituents are approximately 5 to 10 times greater than median stream values.

Sediment

Sediment, or particulate material that is transported and deposited by water, is present in all surface water. The higher sediment concentrations occur near the stream bottom and the higher mean concentrations in the vertical occur in the main current where velocities are higher. Sediment concentrations range from 12 to 391 mg/l but generally are in the 15 to 80 mg/l range. The higher concentrations occur after summer rainfall.

Sediment resulting from dredging operations.

03576020 Huntsville Spring Branch at Dodd Road. This site is downstream from the outfalls of five sewage plants.

4A20, Item 3

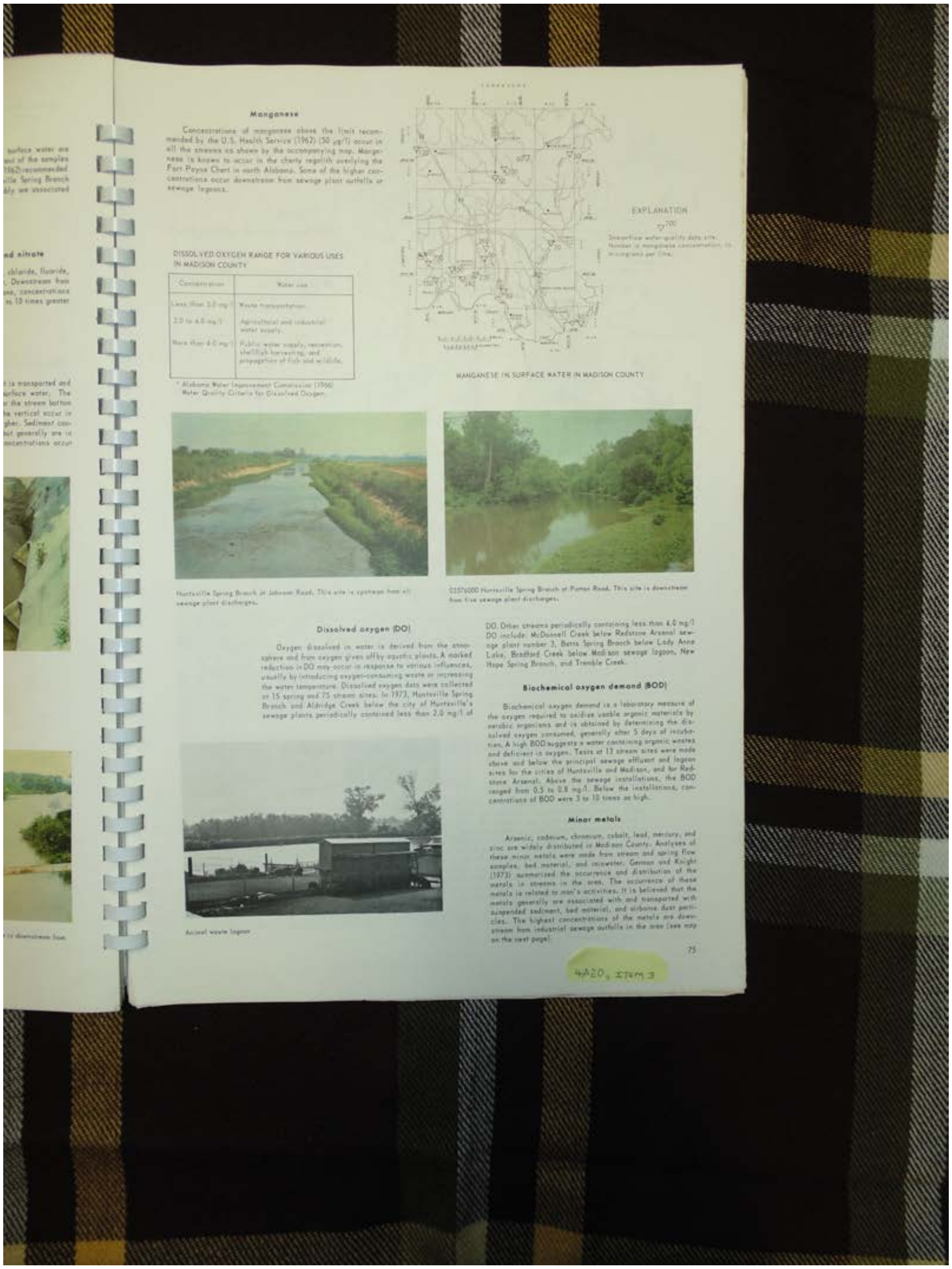
Names:
Chemical & Physical Quality of Surface Water

Places:
Madison Co., AL

Types:
atlas
diagrams

Dates:
1975

Frances Cabaniss Roberts Collection: Series 4, Subseries A, Box 20, Item 3
Environmental Geology and Hydrology, 1975
Image 78 r04a20-00-003-5141 Contents Index About



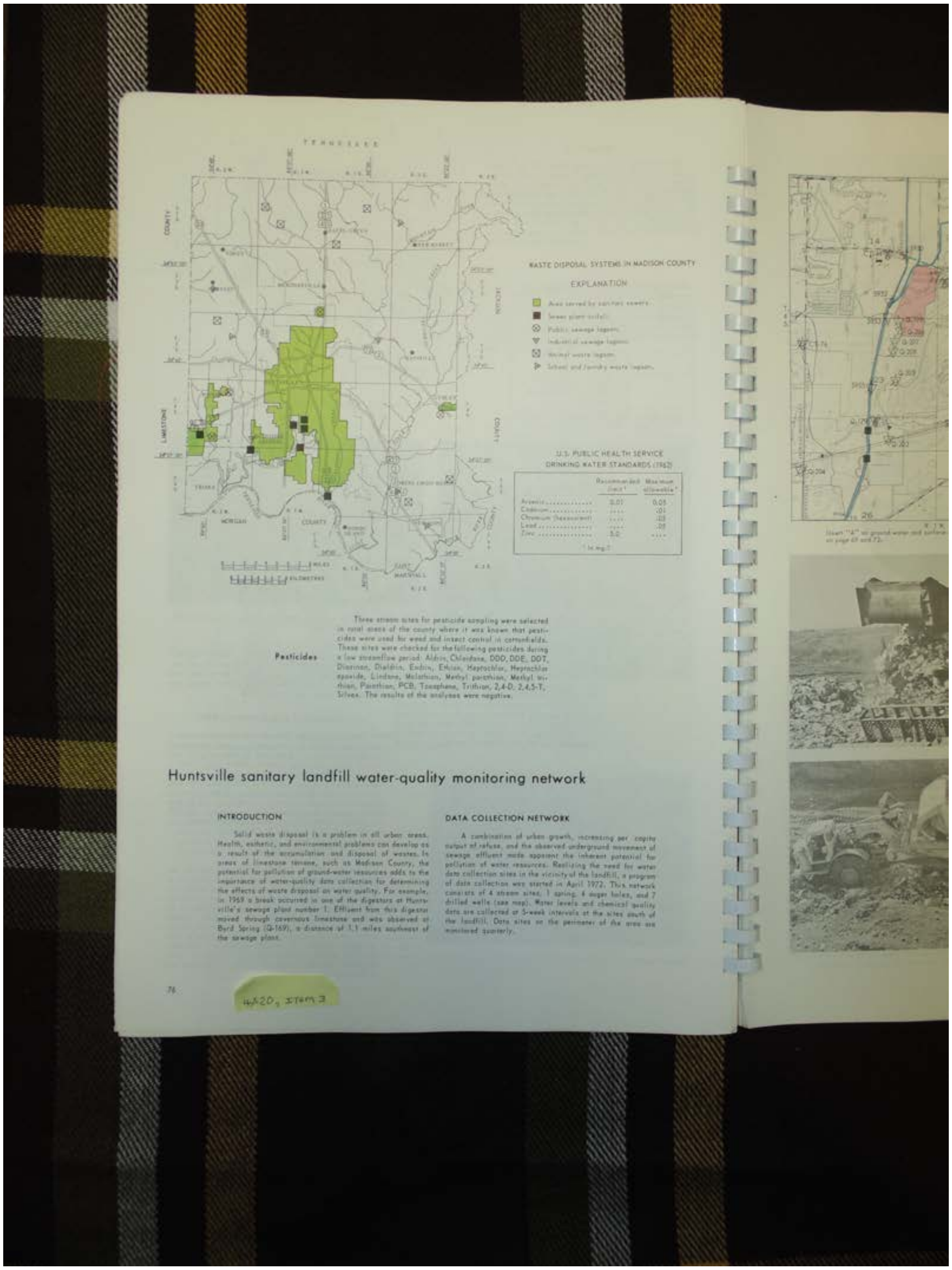
Names:
Chemical & Physical Quality of Surface Water

Places:
Madison Co., AL

Types:
atlas
diagram

Dates:
1975

Frances Cabaniss Roberts Collection: Series 4, Subseries A, Box 20, Item 3
Environmental Geology and Hydrology, 1975
Image 79 r04a20-00-003-5142 Contents Index About



WASTE DISPOSAL SYSTEMS IN MADISON COUNTY

EXPLANATION

U.S. PUBLIC HEALTH SERVICE DRINKING WATER STANDARDS (1962)

Pesticides

Three stream sites for pesticide sampling were selected in rural areas of the county where it was known that pesticides were used for weed and insect control in cottonfields. These sites were checked for the following pesticides during a low streamflow period: Aldrin, Chlordane, DDD, DDE, DDT, Diazinon, Dieldrin, Endrin, Ethion, Heptachlor, Heptachlor epoxide, Lindane, Malathion, Methyl parathion, Methyl trithion, Parathion, PCB, Toxaphene, Trithion, 2,4-D, 2,4,5-T, Silvex. The results of the analyses were negative.

Huntsville sanitary landfill water-quality monitoring network

INTRODUCTION

Solid waste disposal is a problem in all urban areas. Health, esthetic, and environmental problems can develop as a result of the accumulation and disposal of wastes. In areas of limestone terrane, such as Madison County, the potential for pollution of ground-water resources adds to the importance of water-quality data collection for determining the effects of waste disposal on water quality. For example, in 1969 a break occurred in one of the digestors at Huntsville's sewage plant number 1. Effluent from this digestor moved through cavernous limestone and was observed at Byrd Spring (Q-169), a distance of 1.1 miles southeast of the sewage plant.

DATA COLLECTION NETWORK

A combination of urban growth, increasing per capita output of refuse, and the observed underground movement of sewage effluent made apparent the inherent potential for pollution of water resources. Realizing the need for water data collection sites in the vicinity of the landfill, a program of data collection was started in April 1972. This network consists of 4 stream sites, 1 spring, 4 auger holes, and 7 drilled wells (see map). Water levels and chemical quality data are collected at 5-week intervals at the sites south of the landfill. Data sites on the perimeter of the area are monitored quarterly.

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4A20, Item 3

Names:

Sanitary Landfill Data Collection | Network | Sanitary Landfill Water Quality | Monitoring

Places:

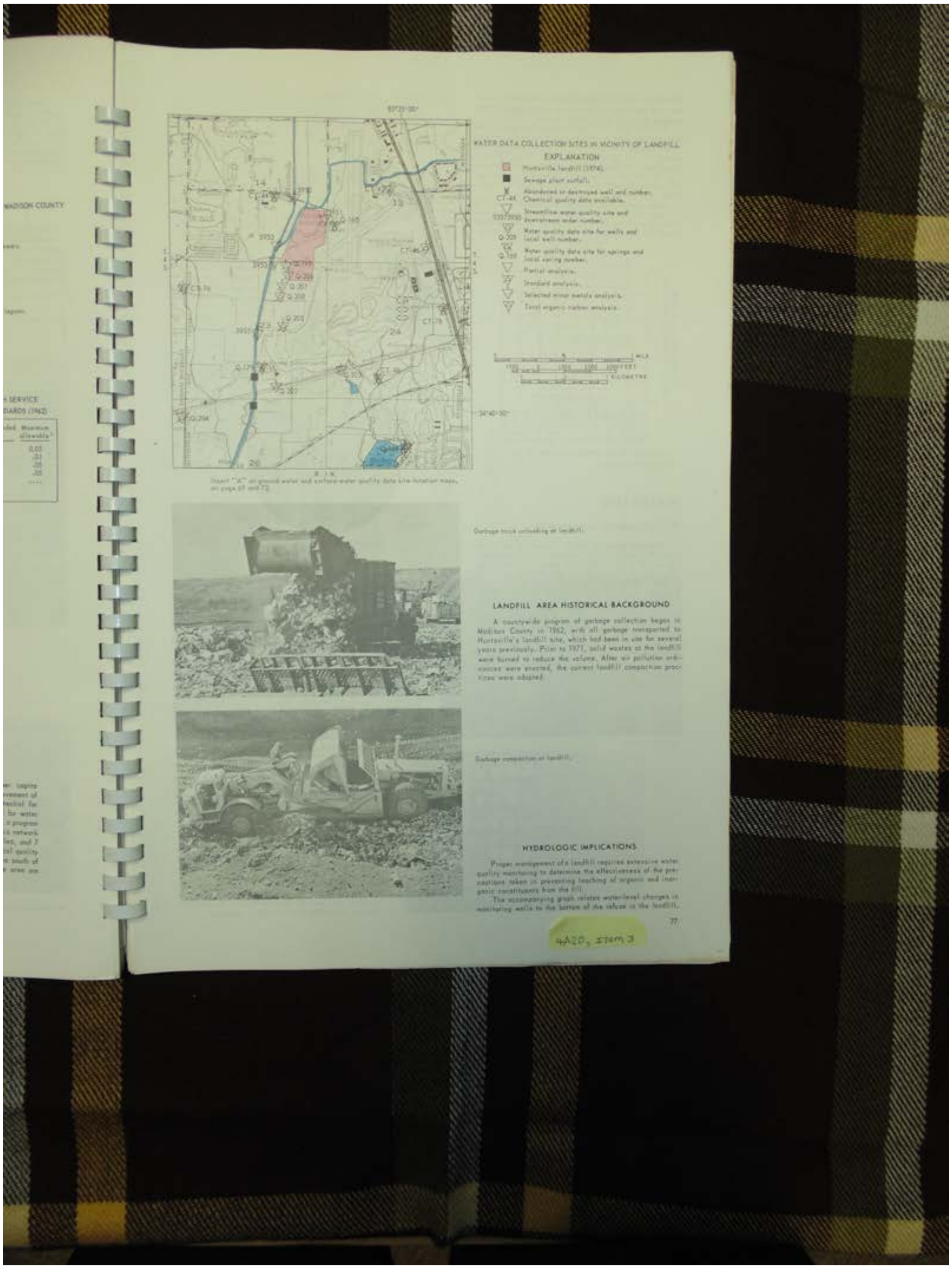
Madison Co., AL

Types:

atlas | map

Dates:

1975



WATER DATA COLLECTION SITES IN VICINITY OF LANDFILL

EXPLANATION

Huntsville landfill (1974).
Sewage plant outfall.
Abandoned or destroyed well and number. Chemical quality data available.
Streamflow water quality site and downstream order number.
Water quality data site for wells and local well number.
Water quality data site for springs and local spring number.
Partial analysis.
Standard analysis.
Selected minor metals analysis.
Total organic carbon analysis.

Garbage truck unloading at landfill.

LANDFILL AREA HISTORICAL BACKGROUND

A countywide program of garbage collection began in Madison County in 1962, with all garbage transported to Huntsville's landfill site, which had been in use for several years previously. Prior to 1971, solid wastes at the landfill were burned to reduce the volume. After air pollution ordinances were enacted, the current landfill compaction practices were adopted.

Garbage compaction at landfill.

HYDROLOGIC IMPLICATIONS

Proper management of a landfill requires extensive water quality monitoring to determine the effectiveness of the precautions taken in preventing leaching of organic and inorganic constituents from the fill.
The accompanying graph relates water-level changes in monitoring wells to the bottom of the refuse in the landfill.

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4A20, Item 3

Names:
Sanitary Landfill
Sites
Data Collection

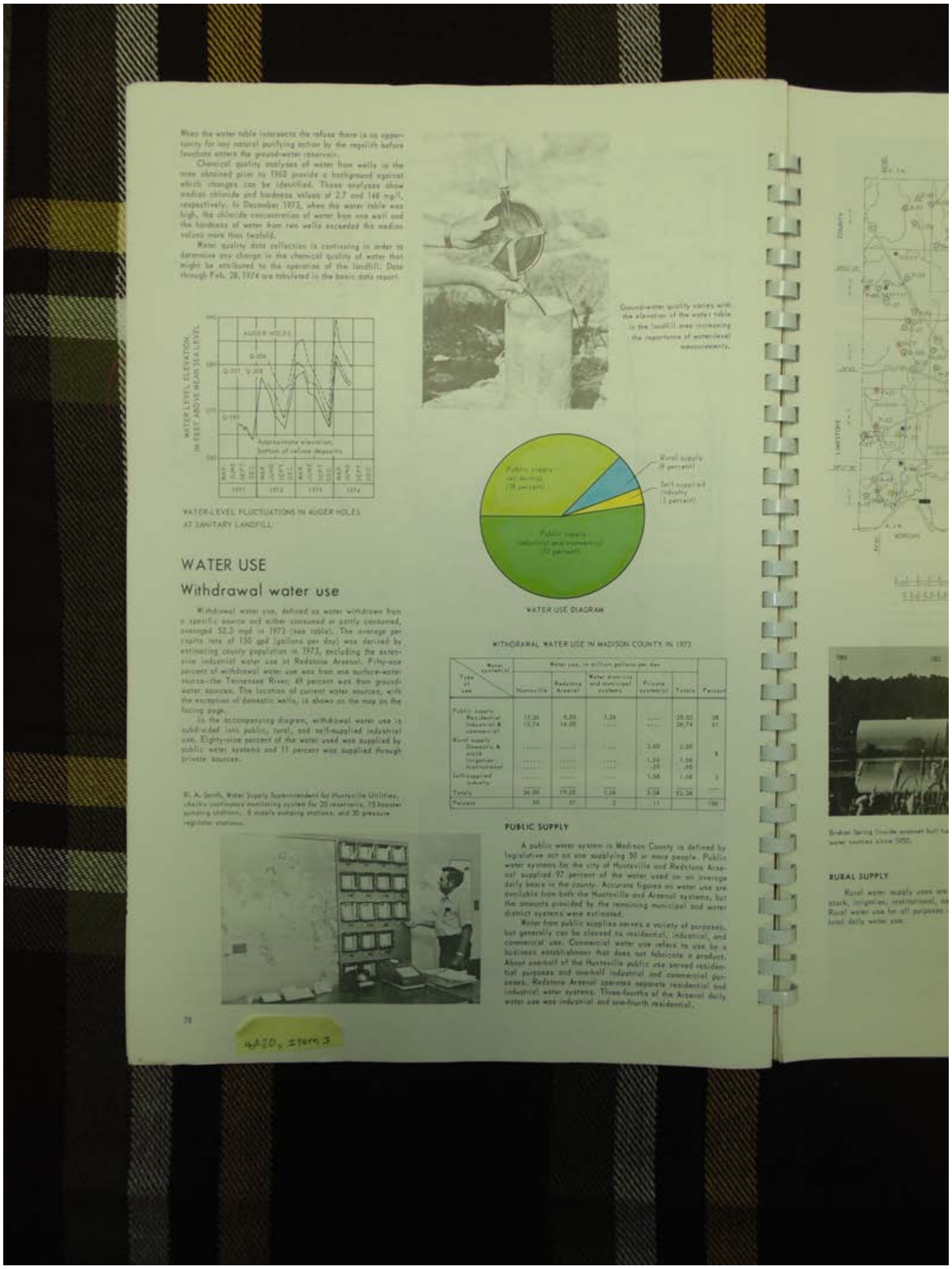
Places:
Madison Co., AL

Types:
map
photographs

Dates:
1975

Frances Cabaniss Roberts Collection: Series 4, Subseries A, Box 20, Item 3
Environmental Geology and Hydrology, 1975

Image 81 r04a20-00-003-5144 [Contents](#) [Index](#) [About](#)



When the water table intersects the refuse there is no opportunity for any natural purifying action by the regolith before leachate enters the ground-water reservoir.

Chemical quality analyses of water from wells in the area obtained prior to 1960 provide a background against which changes can be identified. Those analyses show median chloride and hardness values of 2.7 and 146 mg/l, respectively. In December 1973, when the water table was high, the chloride concentration of water from one well and the hardness of water from two wells exceeded the median values more than twofold.

Water quality data collection is continuing in order to determine any change in the chemical quality of water that might be attributed to the operation of the landfill. Data through Feb. 28, 1974 are tabulated in the basic data report.

WATER-LEVEL FLUCTUATIONS IN AUGER HOLES AT SANITARY LANDFILL

Ground-water quality varies with the elevation of the water table in the landfill area increasing the importance of water-level measurements.

WATER USE DIAGRAM

WATER USE

Withdrawal water use

Withdrawal water use, defined as water withdrawn from a specific source and either consumed or partly consumed, averaged 52.3 mgd in 1973 (see table). The average per capita rate of 130 gpd (gallons per day) was derived by estimating county population in 1973, excluding the extensive industrial water use at Redstone Arsenal. Fifty-one percent of withdrawal water use was from one surface-water source—the Tennessee River; 49 percent was from ground-water sources. The location of current water sources, with the exception of domestic wells, is shown on the map on the facing page.

In the accompanying diagram, withdrawal water use is subdivided into public, rural, and self-supplied industrial use. Eighty-nine percent of the water used was supplied by public water systems and 11 percent was supplied through private sources.

WITHDRAWAL WATER USE IN MADISON COUNTY IN 1973

Type of use / Water system(s)	Water use, in million gallons per day					Percent
	Huntsville	Redstone Arsenal	Water districts and municipal systems	Private system(s)	Totals	
Public supply						
Residential	[illegible]	[illegible]	[illegible]	-----	[illegible]	38
Industrial & commercial	13.74	14.00	-----	-----	[illegible]	[illegible]
Rural supply						
Domestic & stock	-----	-----	-----	3.00	[illegible]	8
Irrigation	-----	-----	-----	1.50	1.50	
Institutional	-----	-----	-----	.30	.30	
Self-supplied industry	-----	-----	-----	[illegible]	[illegible]	3
Totals	[illegible]	[illegible]	[illegible]	5.34	52.34	
Percent	[illegible]	37	2	11		100

R. A. Smith, Water Supply Superintendent for Huntsville Utilities, checks continuous monitoring system for 20 reservoirs, 15 booster pumping stations, 6 supply pumping stations, and 20 pressure regulator stations.

PUBLIC SUPPLY

A public water system in Madison County is defined by legislative act as one supplying 50 or more people. Public water systems for the city of Huntsville and Redstone Arsenal supplied 97 percent of the water used on an average daily basis in the county. Accurate figures on water use are available from both the Huntsville and Arsenal systems, but the amounts provided by the remaining municipal and water district systems were estimated.

Water from public supplies serves a variety of purposes, but generally can be classed as residential, industrial, and commercial use. Commercial water use refers to use by a business establishment that does not fabricate a product. About one-half of the Huntsville public use served residential purposes and one-half industrial and commercial purposes. Redstone Arsenal operates separate residential and industrial water systems. Three-fourths of the Arsenal daily water use was industrial and one-fourth residential.

4A20, Item 3

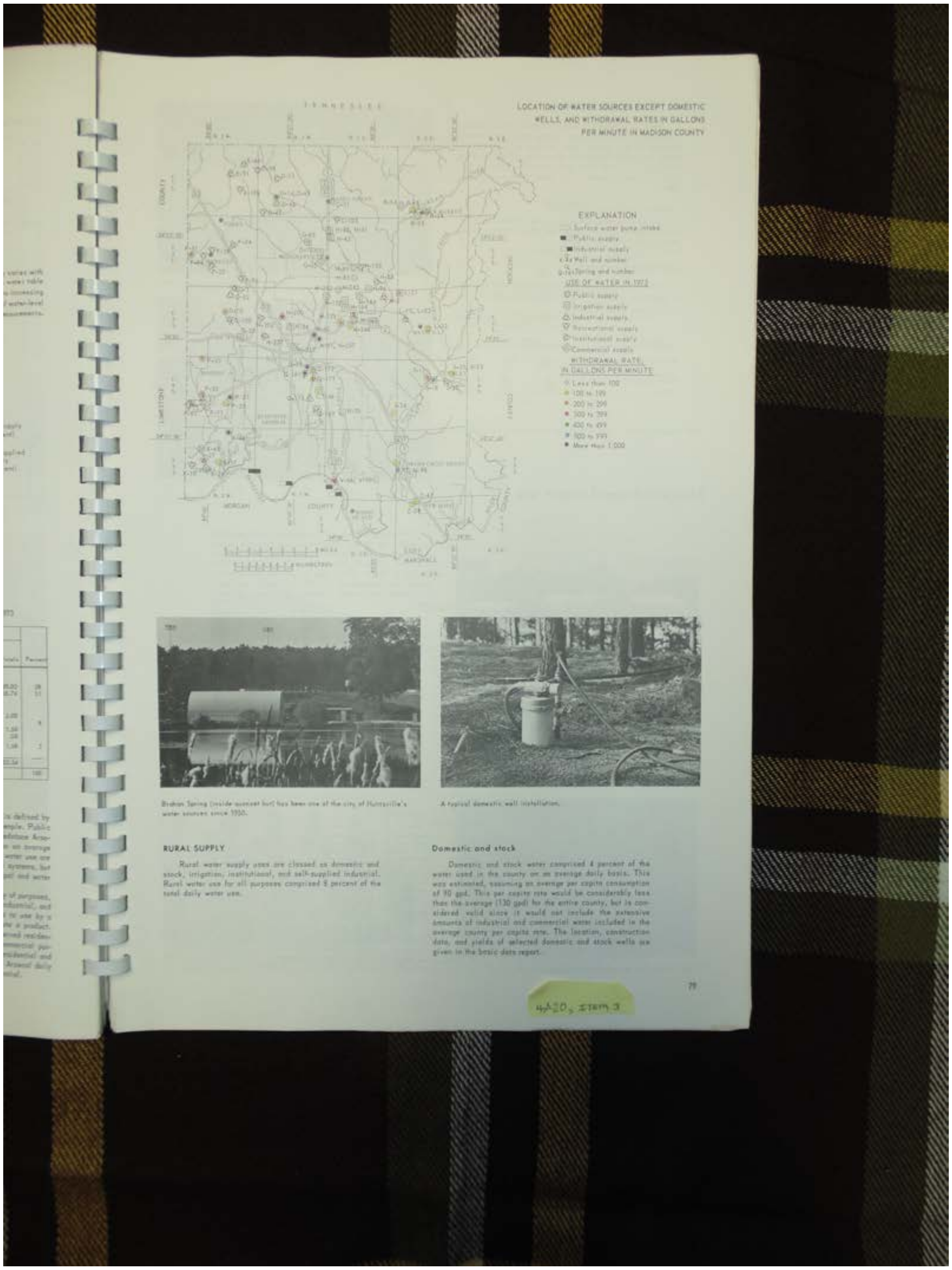
Names:
- Public Supply Water Use
- Withdrawal Water Use

Places:
- Madison Co., AL

Types:
- atlas
- diagrams
- atlas
- photograph

Dates:
- 1975

Frances Cabaniss Roberts Collection: Series 4, Subseries A, Box 20, Item 3
Environmental Geology and Hydrology, 1975
Image 82 r04a20-00-003-5145 Contents Index About



Brahan Spring (inside quonset hut) has been one of the city of Huntsville's water sources since 1930.

A typical domestic well installation.

RURAL SUPPLY

Rural water supply uses are classed as domestic and stock, irrigation, institutional, and self-supplied industrial. Rural water use for all purposes comprised 5 percent of the total daily water use.

Domestic and stock

Domestic and stock water comprised 4 percent of the water used in the county on an average daily basis. This was estimated, assuming an average per capita consumption of 90 gpd. This per capita rate would be considerably less than the average (130 gpd) for the entire county, but is considered valid since it would not include the extensive amounts of industrial and commercial water included in the average county per capita rate. The location, construction data, and yields of selected domestic and stock wells are given in the basic data report.

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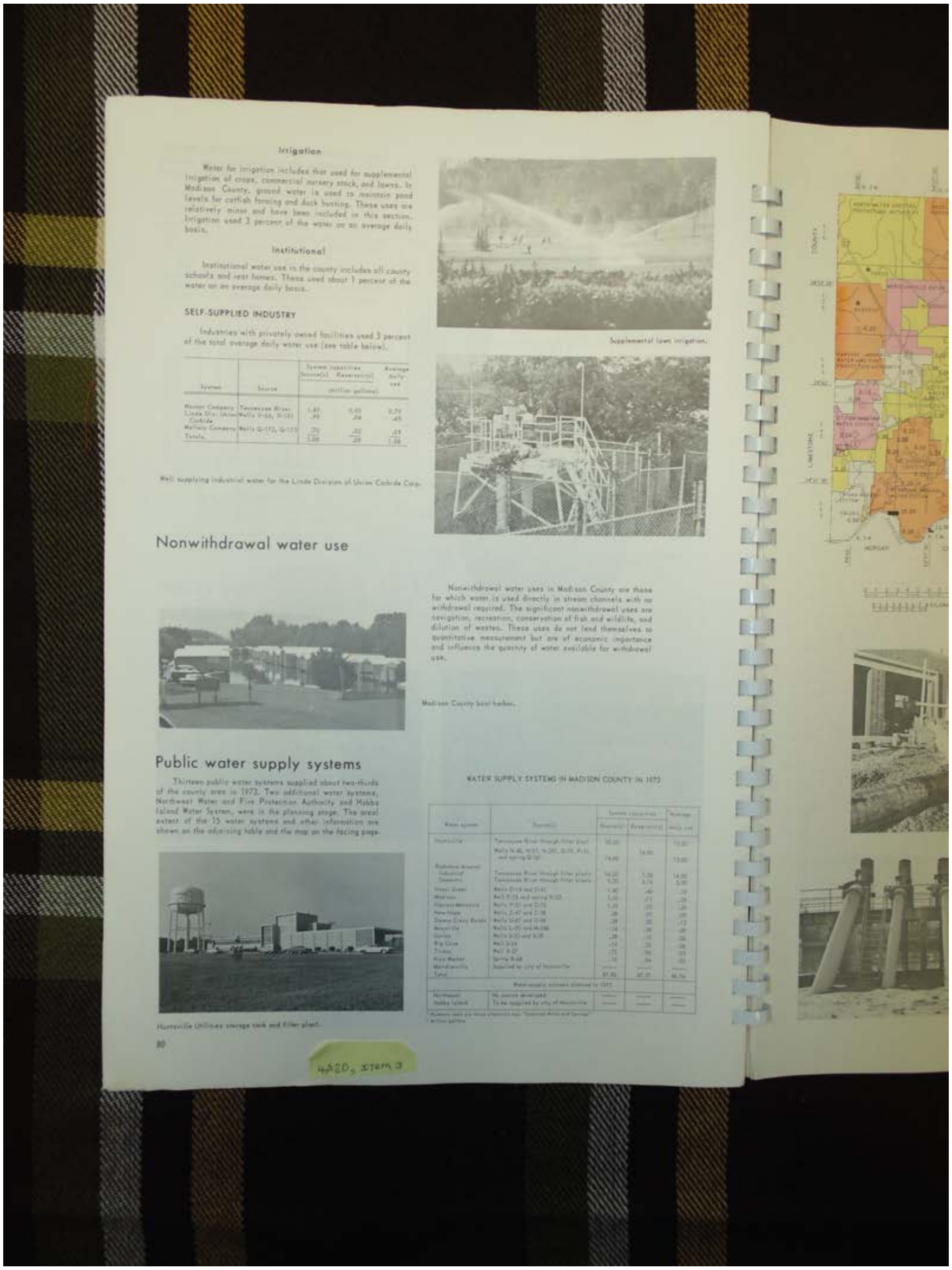
Names:
Domestic & Stock Water Supply
Rural water Supply
Water Sources

Places:
Madison Co., AL

Types:
atlas
map
photographs
atlas
atlas

Dates:
1975

Frances Cabaniss Roberts Collection: Series 4, Subseries A, Box 20, Item 3
Environmental Geology and Hydrology, 1975
Image 83 r04a20-00-003-5146 Contents Index About



Names:
Public Water Supply Systems

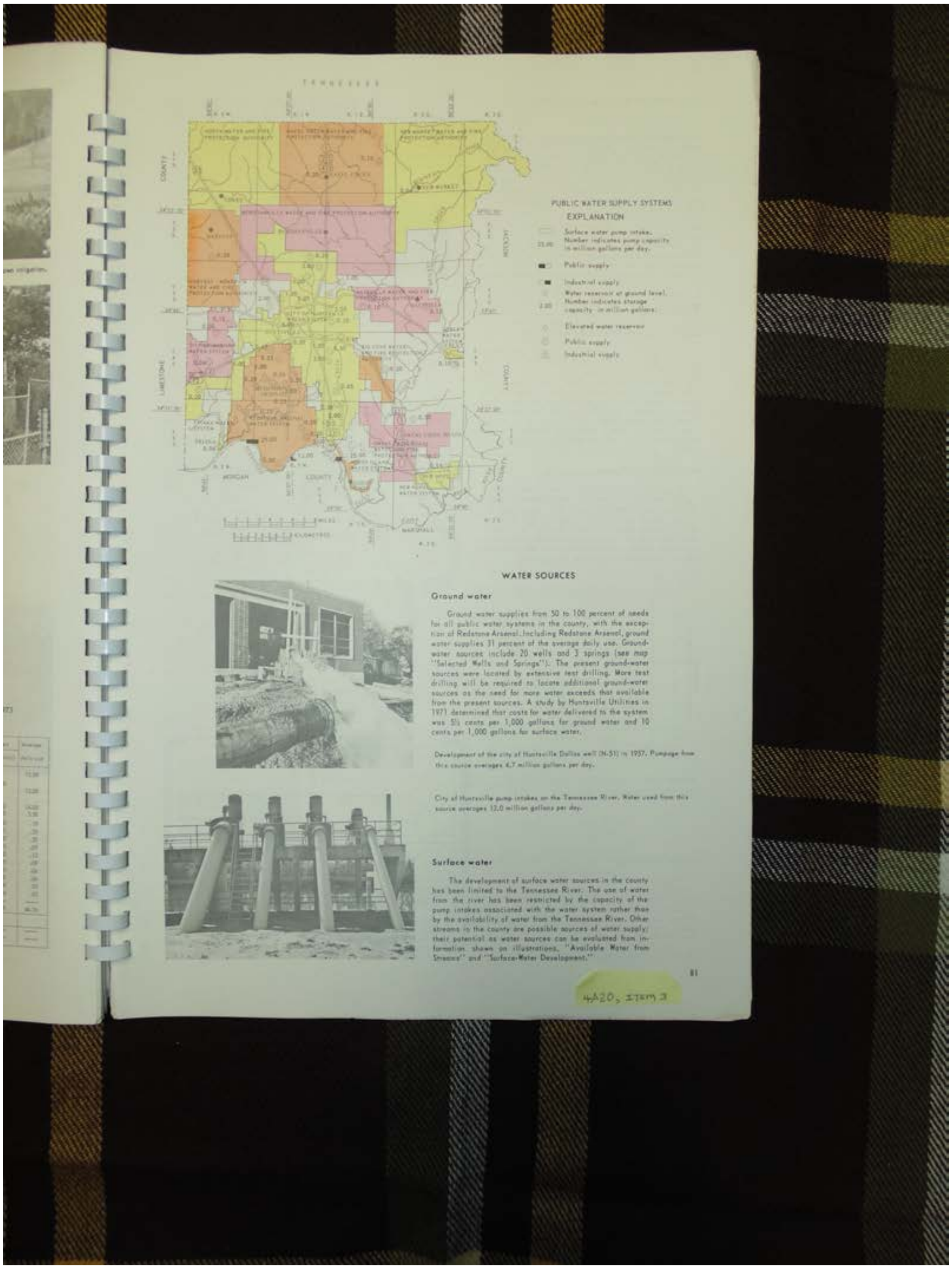
Places:
Madison Co., AL

Types:
atlas photographs chart

Dates:
1975

Frances Cabaniss Roberts Collection: Series 4, Subseries A, Box 20, Item 3
Environmental Geology and Hydrology, 1975

Image 84 r04a20-00-003-5147 Contents Index About



WATER SOURCES

Ground water

Ground water supplies from 50 to 100 percent of needs for all public water systems in the county, with the exception of Redstone Arsenal. Including Redstone Arsenal, ground water supplies 31 percent of the average daily use. Ground-water sources include 20 wells and 3 springs (see map "Selected Wells and Springs"). The present ground-water sources were located by extensive test drilling. More test drilling will be required to locate additional ground-water sources as the need for more water exceeds that available from the present sources. A study by Huntsville Utilities in 1971 determined that costs for water delivered to the system was 5½ cents per 1,000 gallons for ground water and 10 cents per 1,000 gallons for surface water.

Development of the city of Huntsville Dallas well (N-51) in 1957. Pumpage from this source averages 4.7 million gallons per day.

City of Huntsville pump intakes on the Tennessee River. Water used from this source averages 12.0 million gallons per day.

Surface water

The development of surface water sources in the county has been limited to the Tennessee River. The use of water from the river has been restricted by the capacity of the pump intakes associated with the water system rather than by the availability of water from the Tennessee River. Other streams in the county are possible sources of water supply; their potential as water sources can be evaluated from information shown on illustrations, "Available Water from Streams" and "Surface-Water Development."

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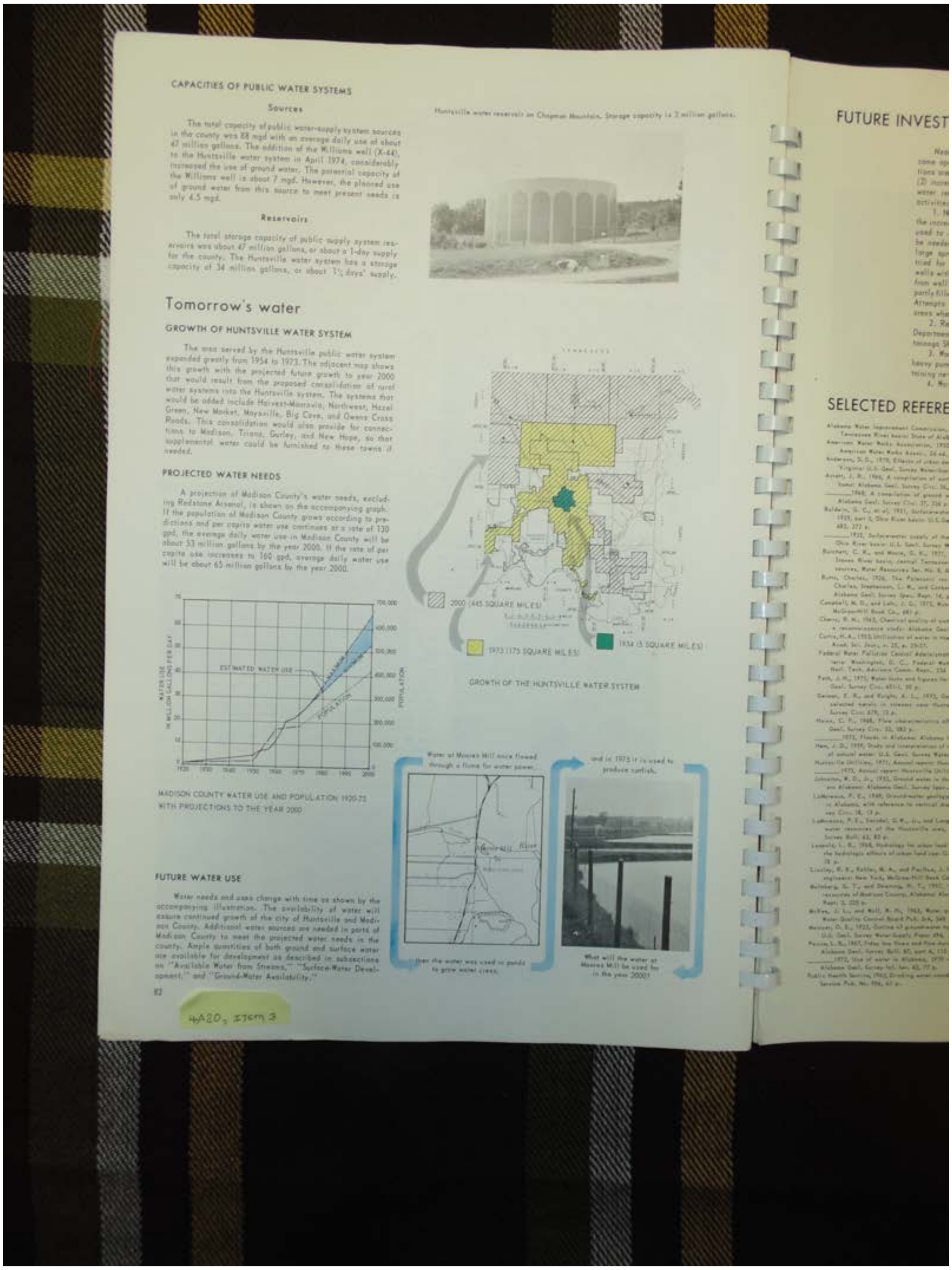
4A20, Item 3

Names:
Public Water Systems
Water Sources

Places:
Madison Co., AL

Types:
atlas
atlas
map

Dates:
1975



Names:
Projected Water Needs

Places:
Madison Co., AL

Types:
atlas map

Dates:
1975

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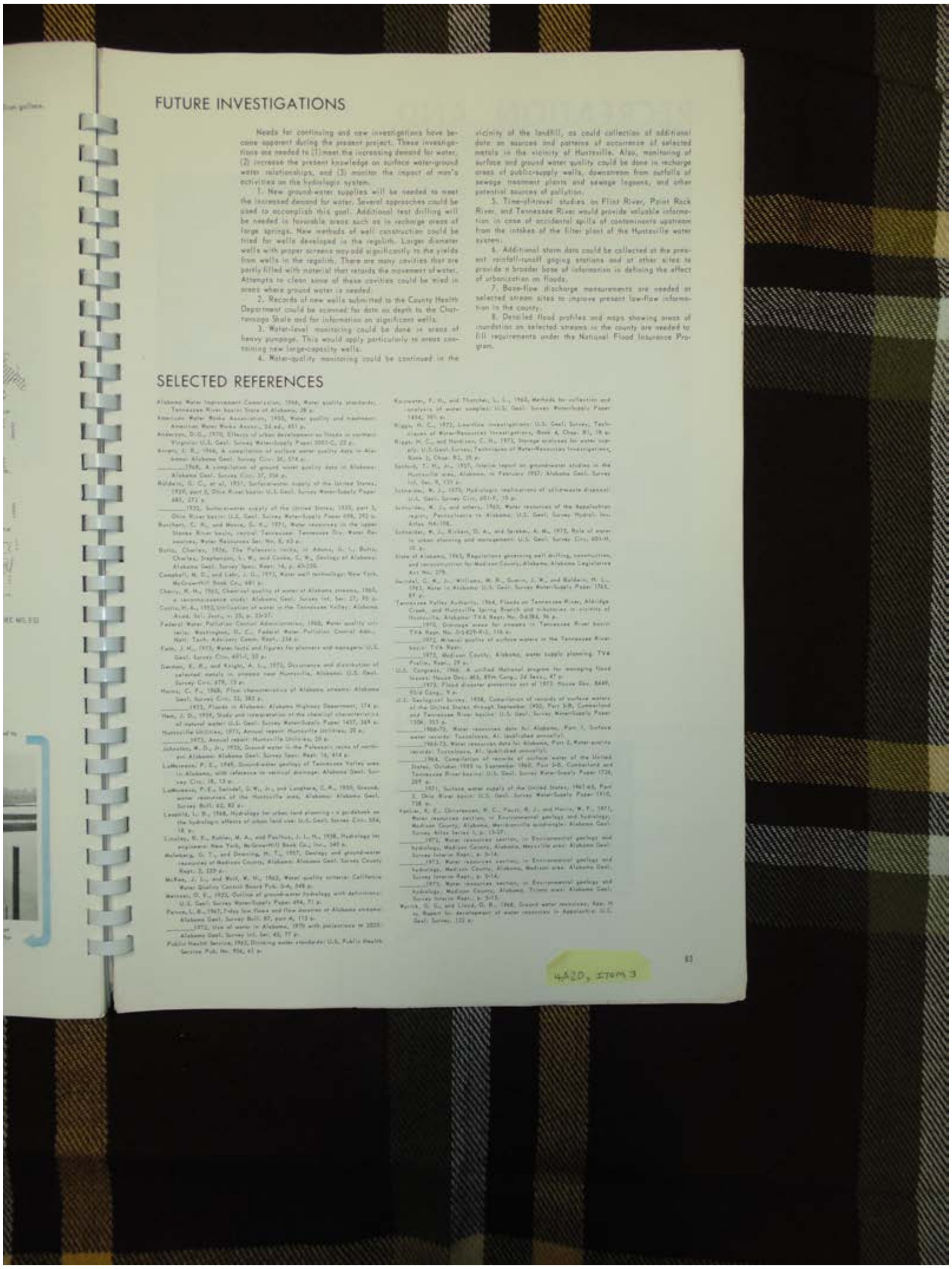
Environmental Geology and Hydrology, 1975
Image 86 r04a20-00-003-5149 Contents Index About



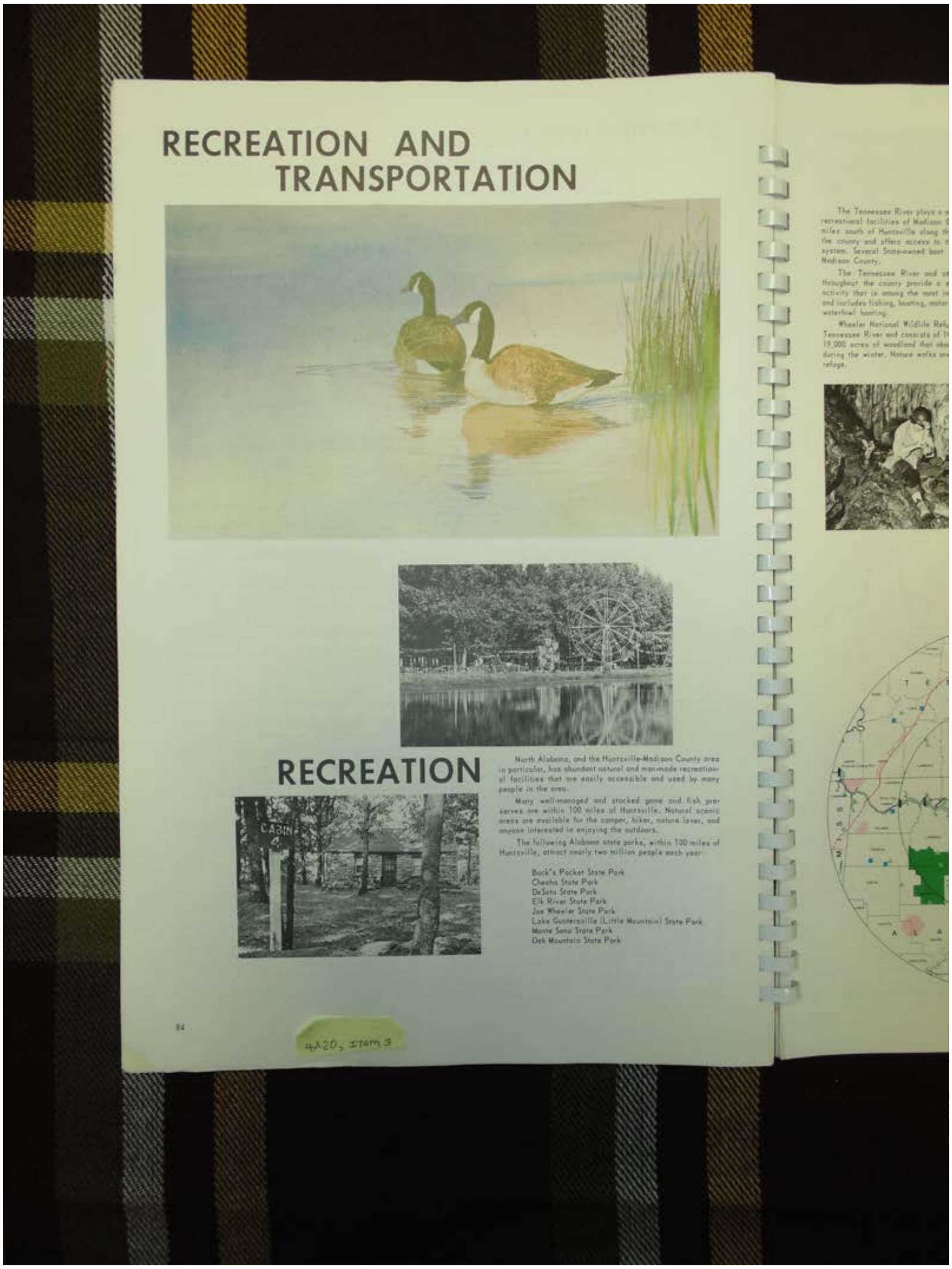
Names:
Future Investigations of the Hydrologic System

Places:
Madison Co., AL

Types:
atlas

Dates:
1975

Frances Cabaniss Roberts Collection: Series 4, Subseries A, Box 20, Item 3
Environmental Geology and Hydrology, 1975
Image 87 r04a20-00-003-5150 Contents Index About


RECREATION AND TRANSPORTATION

RECREATION

North Alabama, and the Huntsville-Madison County area in particular, has abundant natural and man-made recreational facilities that are easily accessible and used by many people in the area.

Many well-managed and stocked game and fish preserves are within 100 miles of Huntsville. Natural scenic areas are available for the camper, hiker, nature lover, and anyone interested in enjoying the outdoors.

The following Alabama state parks, within 100 miles of Huntsville, attract nearly two million people each year:

Buck's Pocket State Park
Cheaha State Park
DeSoto State Park
Elk River State Park
Joe Wheeler State Park
Lake Guntersville (Little Mountain) State Park
Monte Sano State Park
Oak Mountain State Park

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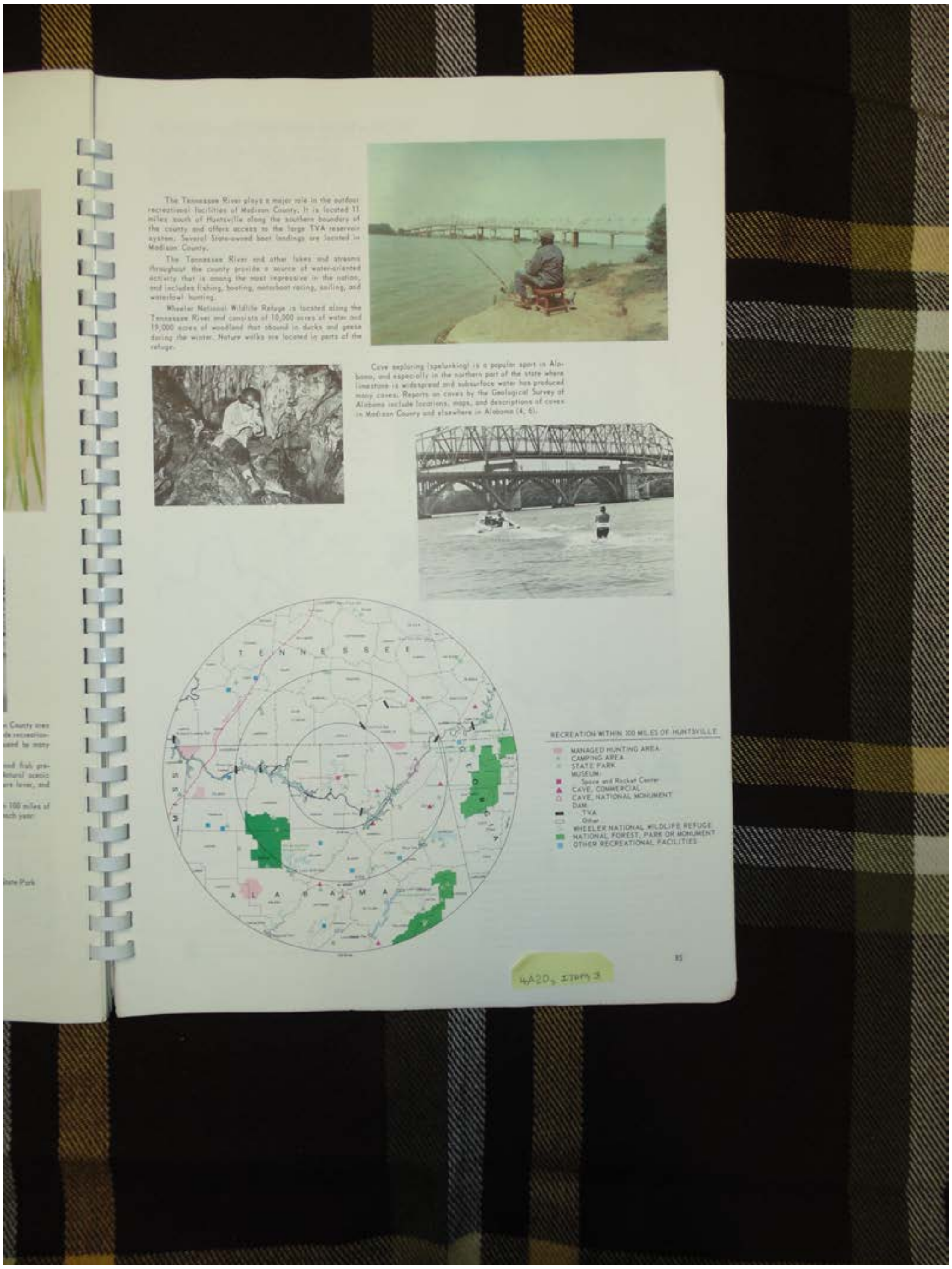
Names:
Recreation & Transportation

Places:
Madison Co., AL

Types:
atlas

Dates:
1975

Frances Cabaniss Roberts Collection: **Series 4, Subseries A, Box 20, Item 3**
Environmental Geology and Hydrology, 1975
Image 88 r04a20-00-003-5151 [Contents](#) [Index](#) [About](#)



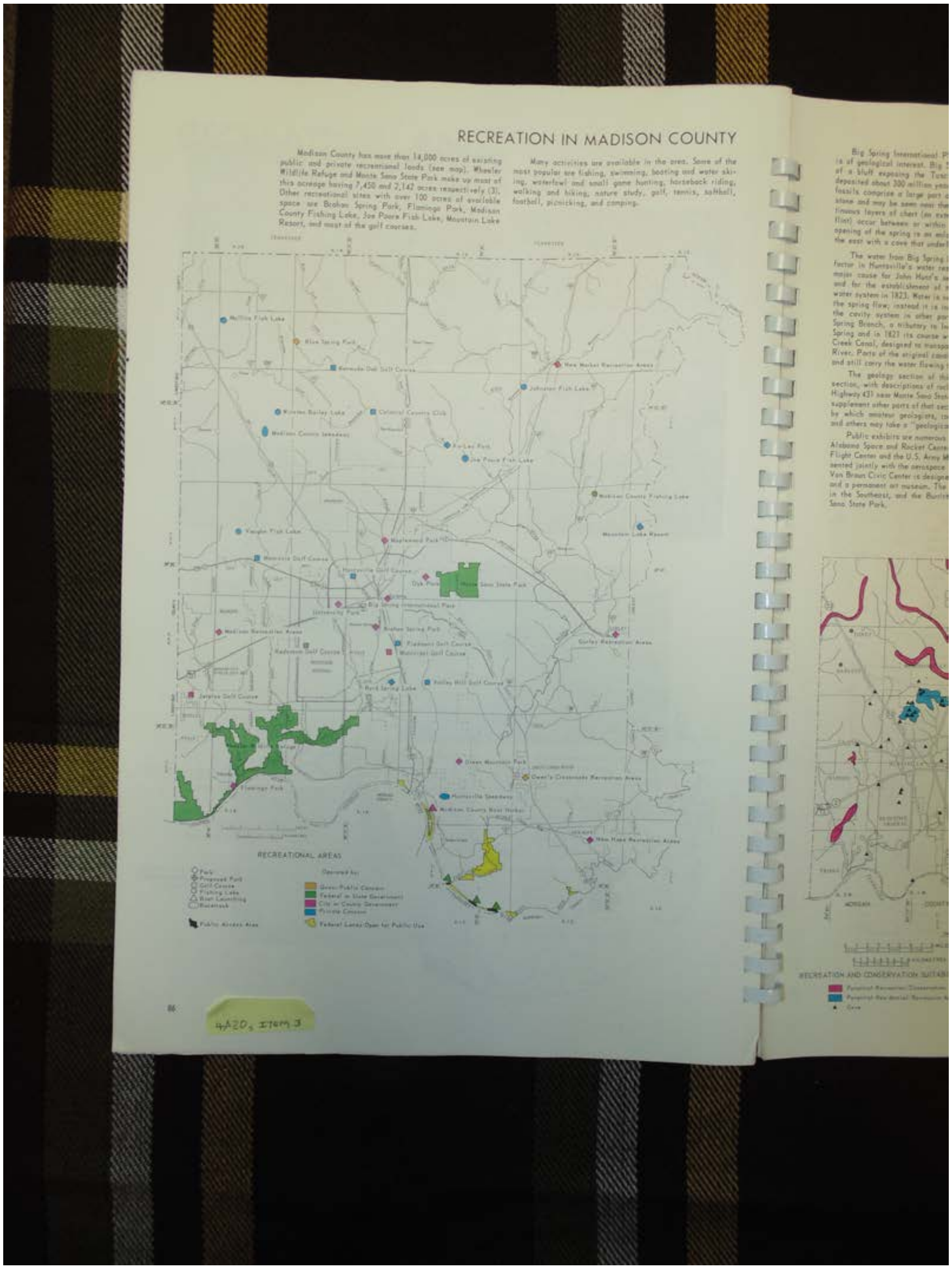
Names:
Recreation

Places:
Madison Co., AL

Types:
atlas map photographs

Dates:
1975

Frances Cabaniss Roberts Collection: **Series 4, Subseries A, Box 20, Item 3**
Environmental Geology and Hydrology, 1975
Image 89 r04a20-00-003-5152 Contents Index About

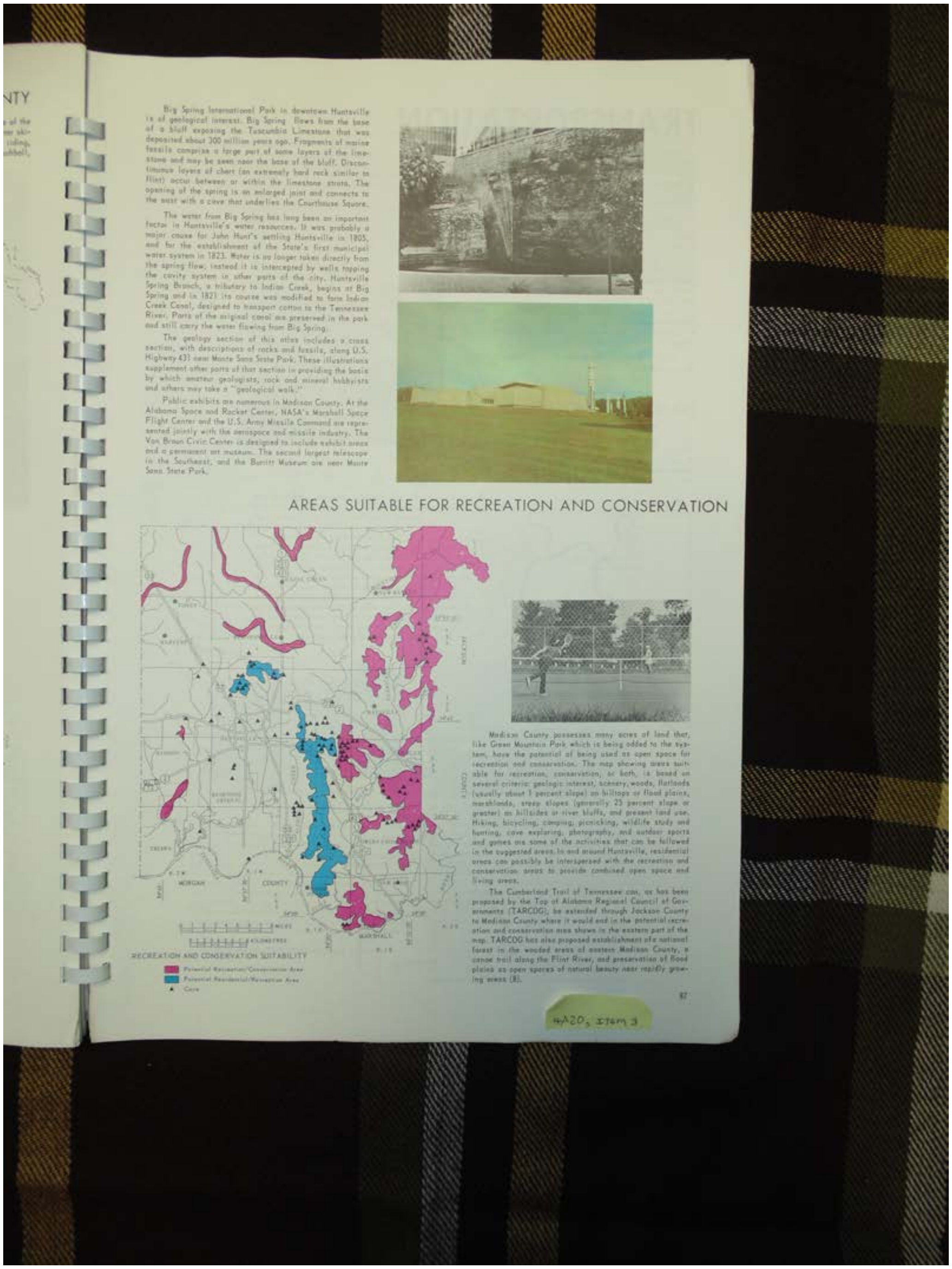


Names:
Recreational Areas

Places:
Madison Co., AL

Types:
atlas map

Dates:
1975



Big Spring International Park in downtown Huntsville is of geological interest. Big Spring flows from the base of a bluff exposing the Tuscumbia Limestone that was deposited about 300 million years ago. Fragments of marine fossils comprise a large part of some layers of the limestone and may be seen near the base of the bluff. Discontinuous layers of chert (an extremely hard rock similar to flint) occur between or within the limestone strata. The opening of the spring is an enlarged joint and connects to the east with a cave that underlies the Courthouse Square.

The water from Big Spring has long been an important factor in Huntsville's water resources. It was probably a major cause for John Hunt's settling Huntsville in 1805, and for the establishment of the State's first municipal water system in 1823. Water is no longer taken directly from the spring flow; instead it is intercepted by wells tapping the cavity system in other parts of the city. Huntsville Spring Branch, a tributary to Indian Creek, begins at Big Spring and in 1821 its course was modified to form Indian Creek Canal, designed to transport cotton to the Tennessee River. Parts of the original canal are preserved in the park and still carry the water flowing from Big Spring.

The geology section of this atlas includes a cross section, with descriptions of rocks and fossils, along U.S. Highway 431 near Monte Sano State Park. These illustrations supplement other parts of that section in providing the basis by which amateur geologists, rock and mineral hobbyists and others may take a "geological walk."

Public exhibits are numerous in Madison County. At the Alabama Space and Rocket Center, NASA's Marshall Space Flight Center and the U.S. Army Missile Command are represented jointly with the aerospace and missile industry. The Von Braun Civic Center is designed to include exhibit areas and a permanent art museum. The second largest telescope in the Southeast, and the Burritt Museum are near Monte Sano State Park.

AREAS SUITABLE FOR RECREATION AND CONSERVATION

RECREATION AND CONSERVATION SUITABILITY

Madison County possesses many acres of land that, like Green Mountain Park which is being added to the system, have the potential of being used as open space for recreation and conservation. The map showing areas suitable for recreation, conservation, or both, is based on several criteria: geologic interest, scenery, woods, flatlands (usually about 1 percent slope) on hilltops or flood plains, marshlands, steep slopes (generally 25 percent slope or greater) on hillsides or river bluffs, and present land use. Hiking, bicycling, camping, picnicking, wildlife study and hunting, cave exploring, photography, and outdoor sports and games are some of the activities that can be followed in the suggested areas. In and around Huntsville, residential areas can possibly be interspersed with the recreation and conservation areas to provide combined open space and living areas.

The Cumberland Trail of Tennessee can, as has been proposed by the Top of Alabama Regional Council of Governments (TARCOG), be extended through Jackson County to Madison County where it would end in the potential recreation and conservation area shown in the eastern part of the map. TARCOG has also proposed establishment of a national forest in the wooded areas of eastern Madison County, a canoe trail along the Flint River, and preservation of flood plains as open spaces of natural beauty near rapidly growing areas (8).

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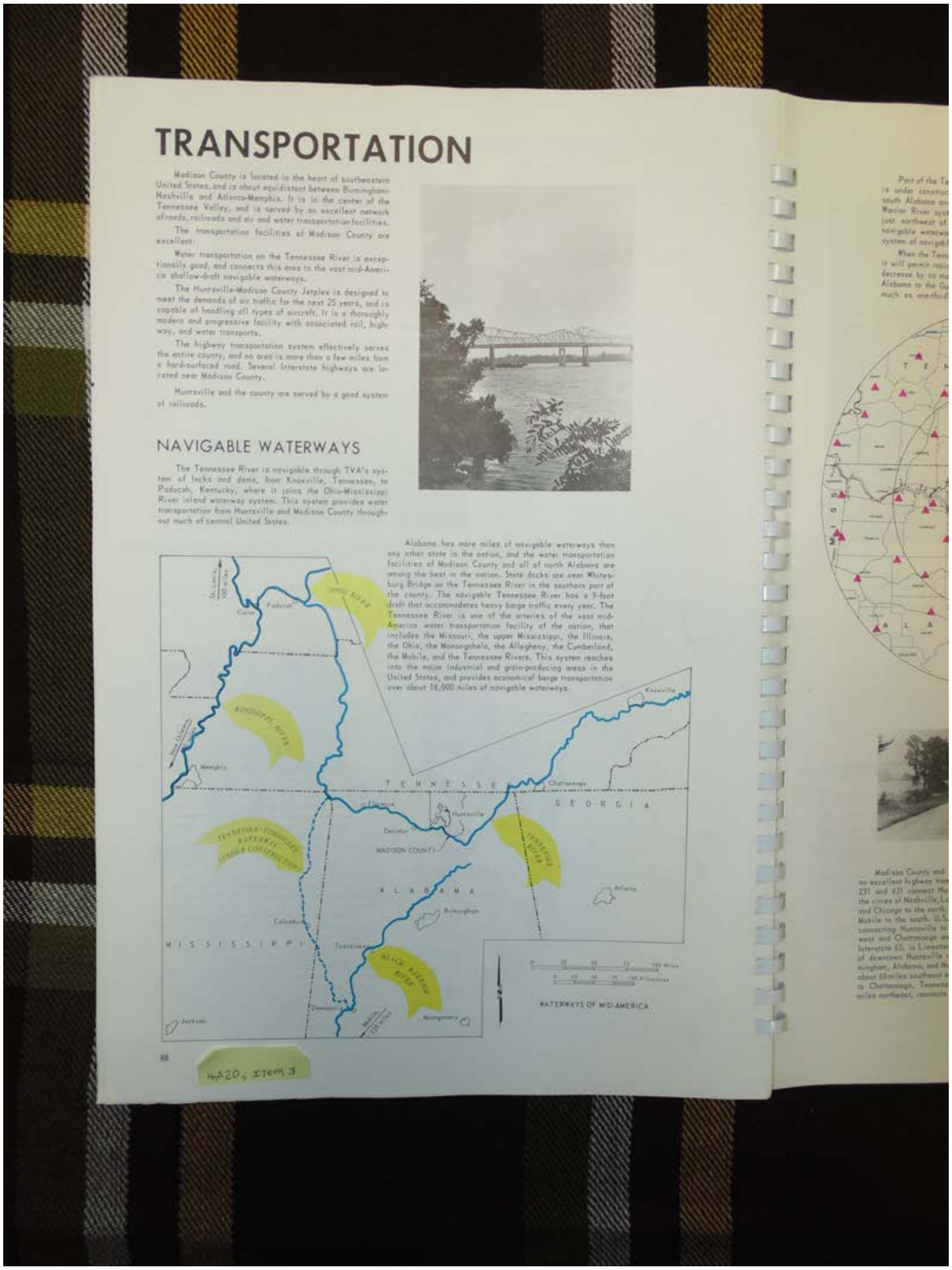
4A20, Item 3

Names:
Suitable Areas for Recreation & Conservation

Places:
Madison Co., AL

Types:
atlas map photographs

Dates:
1975



TRANSPORTATION

Madison County is located in the heart of southeastern United States, and is about equidistant between Birmingham-Nashville and Atlanta-Memphis. It is in the center of the Tennessee Valley, and is served by an excellent network of roads, railroads and air and water transportation facilities.

The transportation facilities of Madison County are excellent:

Water transportation on the Tennessee River is exceptionally good, and connects this area to the vast mid-America shallow-draft navigable waterways.

The Huntsville-Madison County Jetplex is designed to meet the demands of air traffic for the next 25 years, and is capable of handling all types of aircraft. It is a thoroughly modern and progressive facility with associated rail, highway, and water transports.

The highway transportation system effectively serves the entire county, and no area is more than a few miles from a hard-surfaced road. Several Interstate highways are located near Madison County.

Huntsville and the county are served by a good system of railroads.

NAVIGABLE WATERWAYS

The Tennessee River is navigable through TVA's system of locks and dams, from Knoxville, Tennessee, to Paducah, Kentucky, where it joins the Ohio-Mississippi River inland waterway system. This system provides water transportation from Huntsville and Madison County throughout much of central United States.

Alabama has more miles of navigable waterways than any other state in the nation, and the water transportation facilities of Madison County and all of north Alabama are among the best in the nation. State docks are near Whitesburg Bridge on the Tennessee River in the southern part of the county. The navigable Tennessee River has a 9-foot draft that accommodates heavy barge traffic every year. The Tennessee River is one of the arteries of the vast mid-America water transportation facility of the nation, that includes the Missouri, the upper Mississippi, the Illinois, the Ohio, the Monongahela, the Allegheny, the Cumberland, the Mobile, and the Tennessee Rivers. This system reaches into the major industrial and grain-producing areas in the United States, and provides economical barge transportation over about 16,000 miles of navigable waterways.

Names:
Transportation - Navagable
Waterways

Places:
Madison Co., AL

Types:
atlas
map

Dates:
1975

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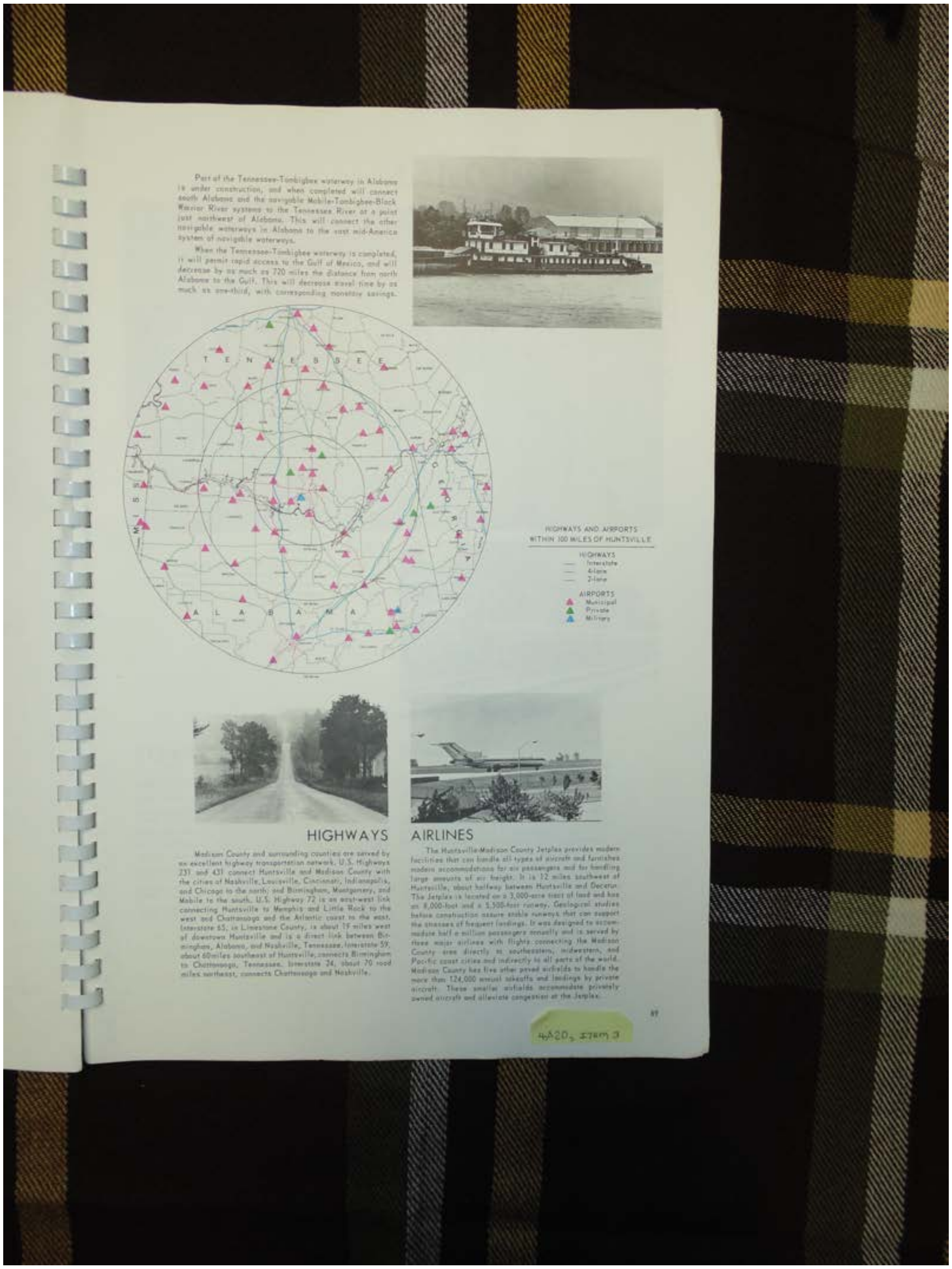
Environmental Geology and Hydrology, 1975
Image 92 r04a20-00-003-5155 Contents Index About



Part of the Tennessee-Tombigbee waterway in Alabama is under construction, and when completed will connect south Alabama and the navigable Mobile-Tombigbee-Black Warrior River systems to the Tennessee River at a point just northwest of Alabama. This will connect the other navigable waterways in Alabama to the vast mid-America system of navigable waterways.

When the Tennessee-Tombigbee waterway is completed, it will permit rapid access to the Gulf of Mexico, and will decrease by as much as 720 miles the distance from north Alabama to the Gulf. This will decrease travel time by as much as one-third, with corresponding monetary savings.

HIGHWAYS

Madison County and surrounding counties are served by an excellent highway transportation network. U.S. Highways 231 and 431 connect Huntsville and Madison County with the cities of Nashville, Louisville, Cincinnati, Indianapolis, and Chicago to the north; and Birmingham, Montgomery, and Mobile to the south. U.S. Highway 72 is an east-west link connecting Huntsville to Memphis and Little Rock to the west and Chattanooga and the Atlantic coast to the east. Interstate 65, in Limestone County, is about 19 miles west of downtown Huntsville and is a direct link between Birmingham, Alabama, and Nashville, Tennessee. Interstate 59, about 60 miles southeast of Huntsville, connects Birmingham to Chattanooga, Tennessee. Interstate 24, about 70 road miles northeast, connects Chattanooga and Nashville.

AIRLINES

The Huntsville-Madison County Jetplex provides modern facilities that can handle all types of aircraft and furnishes modern accommodations for air passengers and for handling large amounts of air freight. It is 12 miles southwest of Huntsville, about halfway between Huntsville and Decatur. The Jetplex is located on a 3,000-acre tract of land and has an 8,000-foot and a 5,500-foot runway. Geological studies before construction assure stable runways that can support the stresses of frequent landings. It was designed to accommodate half a million passengers annually and is served by three major airlines with flights connecting the Madison County area directly to southeastern, midwestern, and Pacific coast cities and indirectly to all parts of the world. Madison County has five other paved airfields to handle the more than 124,000 annual takeoffs and landings by private aircraft. These smaller airfields accommodate privately owned aircraft and alleviate congestion at the Jetplex.

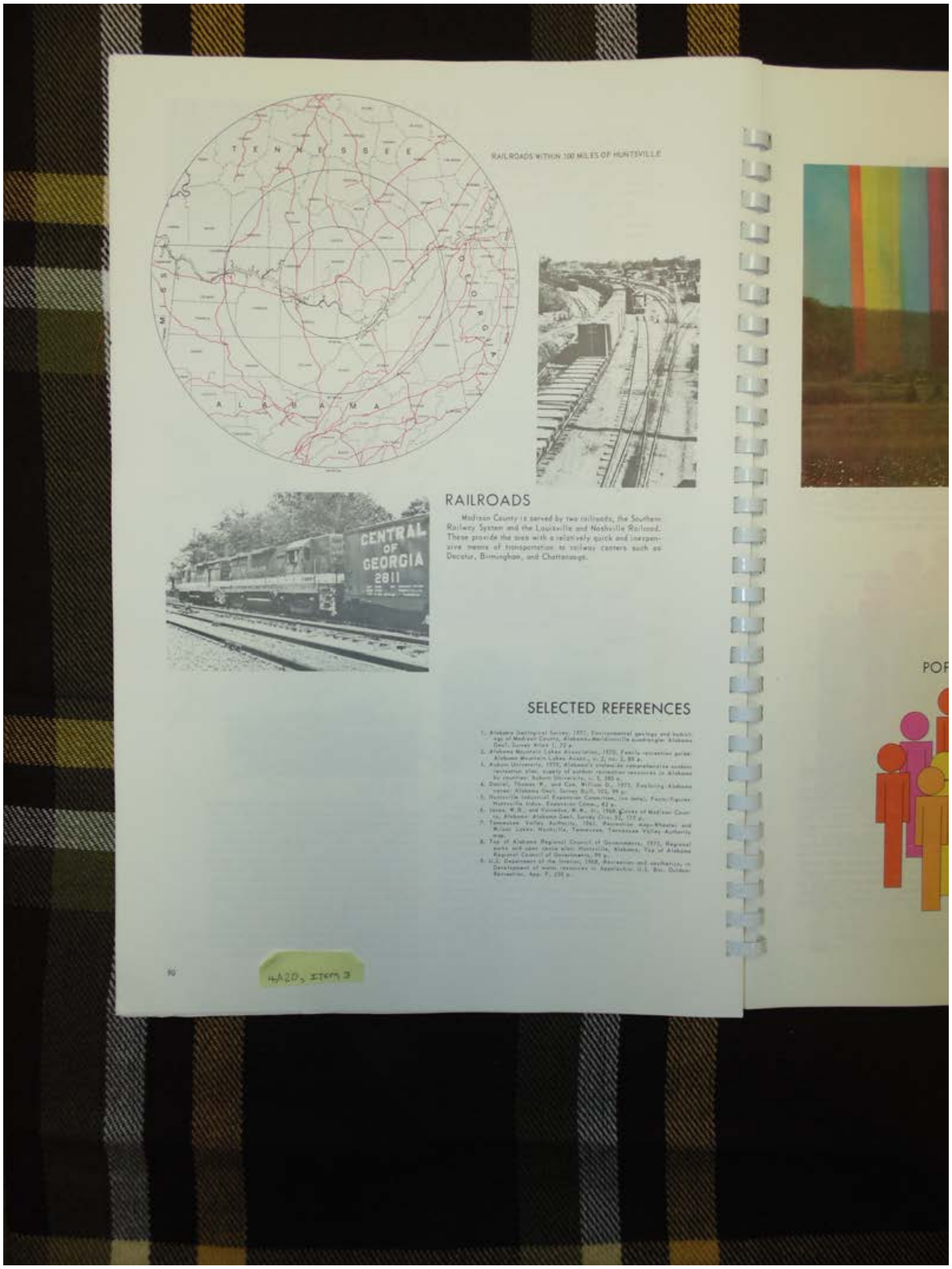
4A20, Item 3

Names:
Transportation - Airlines
Transportation - Highways

Places:
Madison Co., AL

Types:
atlas

Dates:
1975

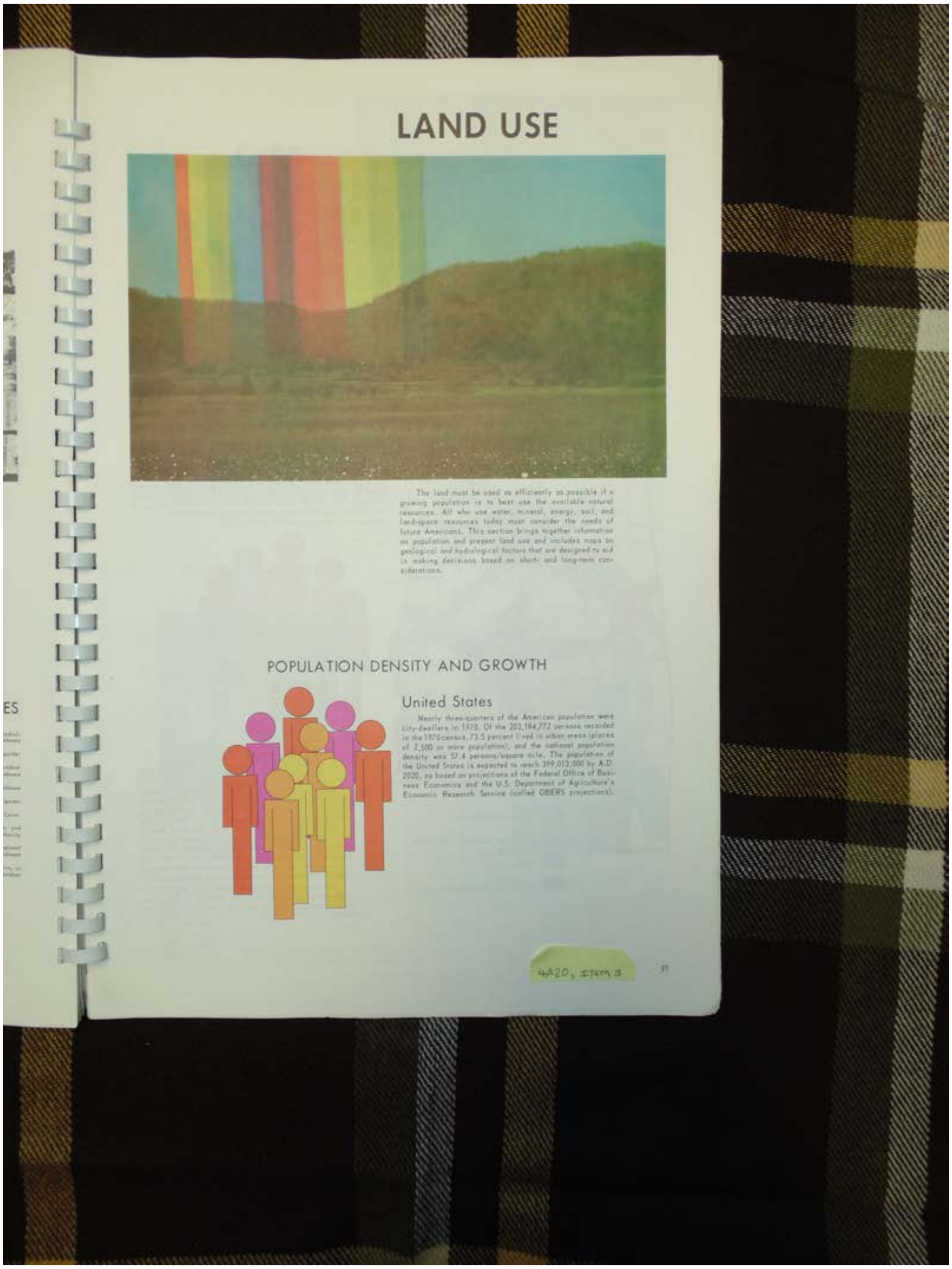


Names:
Transportation -
Railroads

Places:
Madison Co., AL

Types:
atlas map

Dates:
1975


LAND USE

The land must be used as efficiently as possible if a growing population is to best use the available natural resources. All who use water, mineral, energy, soil, and land-space resources today must consider the needs of future Americans. This section brings together information on population and present land use and includes maps on geological and hydrological factors that are designed to aid in making decisions based on short- and long-term considerations.

POPULATION DENSITY AND GROWTH

United States

Nearly three-quarters of the American population were city-dwellers in 1970. Of the 203,184,772 persons recorded in the 1970 census, 73.5 percent lived in urban areas (places of 2,500 or more population), and the national population density was 57.4 persons/square mile. The population of the United States is expected to reach 399,013,000 by A.D. 2020, as based on projections of the Federal Office of Business Economics and the U.S. Department of Agriculture's Economic Research Service (called OBERS projections).

Names:
Land Use
Population Density & Growth

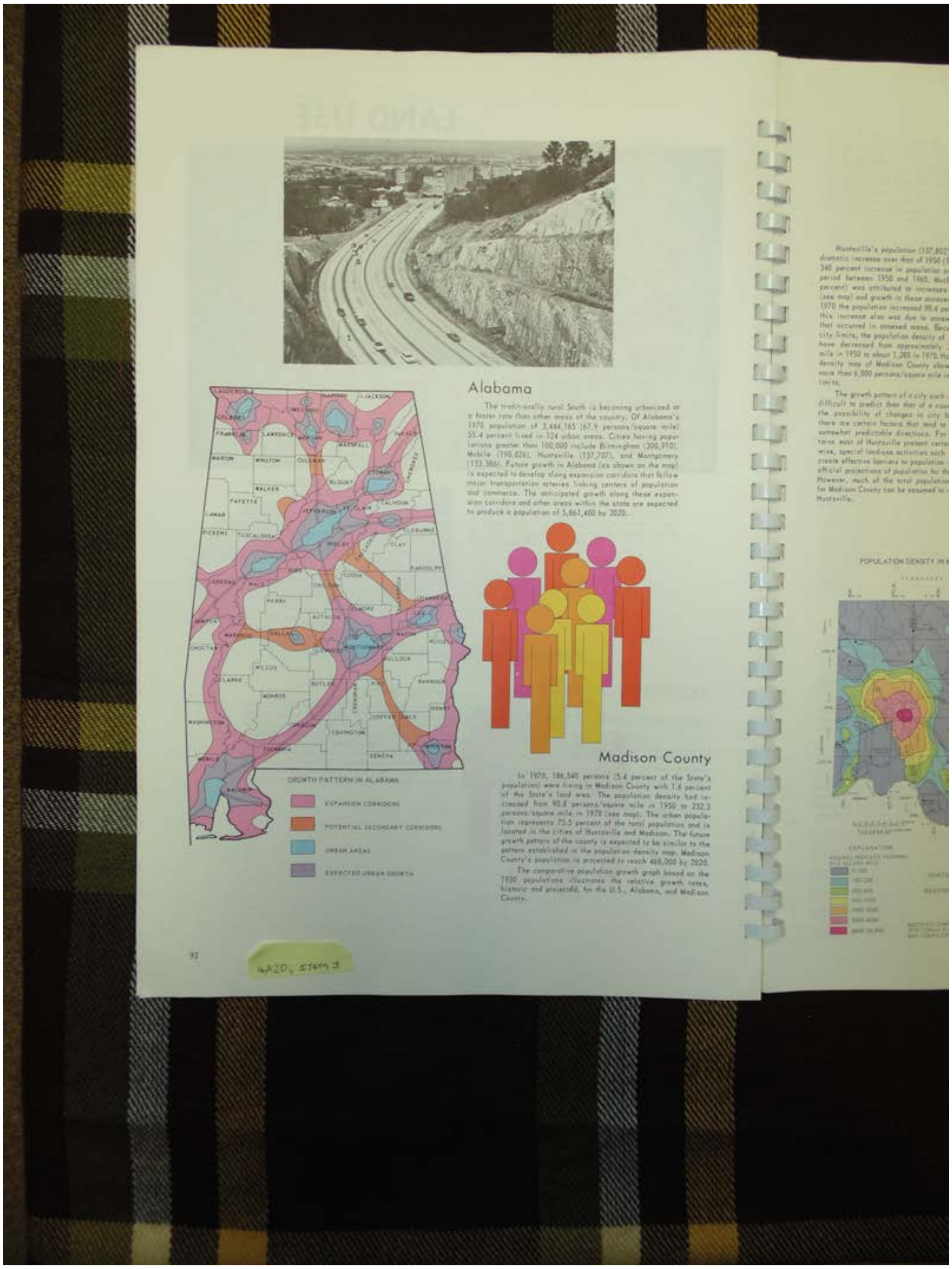
Places:
United States

Types:
atlas

Dates:
1975

Frances Cabaniss Roberts Collection: Series 4, Subseries A, Box 20, Item 3
Environmental Geology and Hydrology, 1975

Image 95 r04a20-00-003-5158 Contents Index About



Names:

Population Pattern

Places:

Alabama

Madison Co., AL

Types:

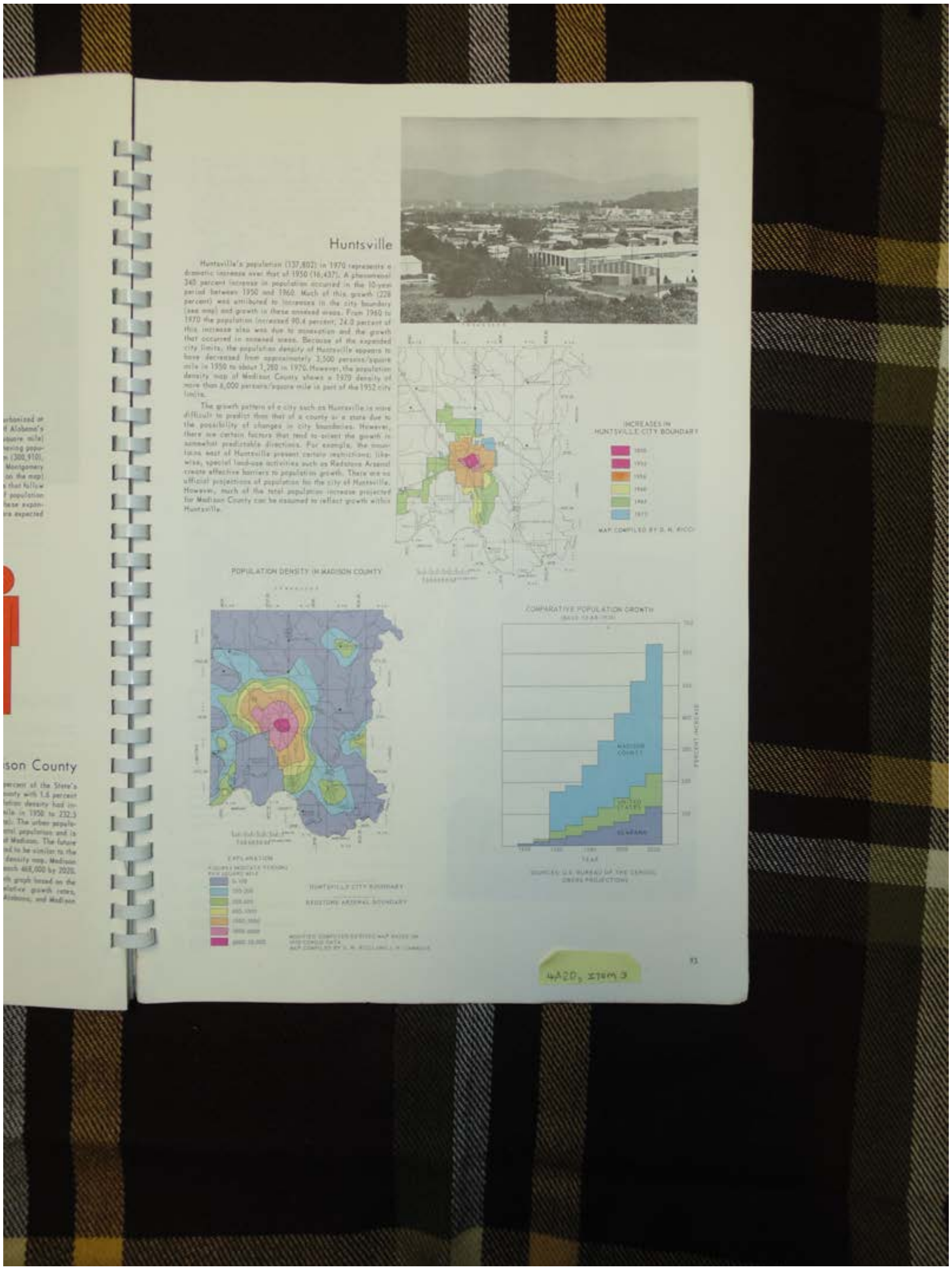
atlas

map

Dates:

1975

Frances Cabaniss Roberts Collection: Series 4, Subseries A, Box 20, Item 3
Environmental Geology and Hydrology, 1975
Image 96 r04a20-00-003-5159 Contents Index About



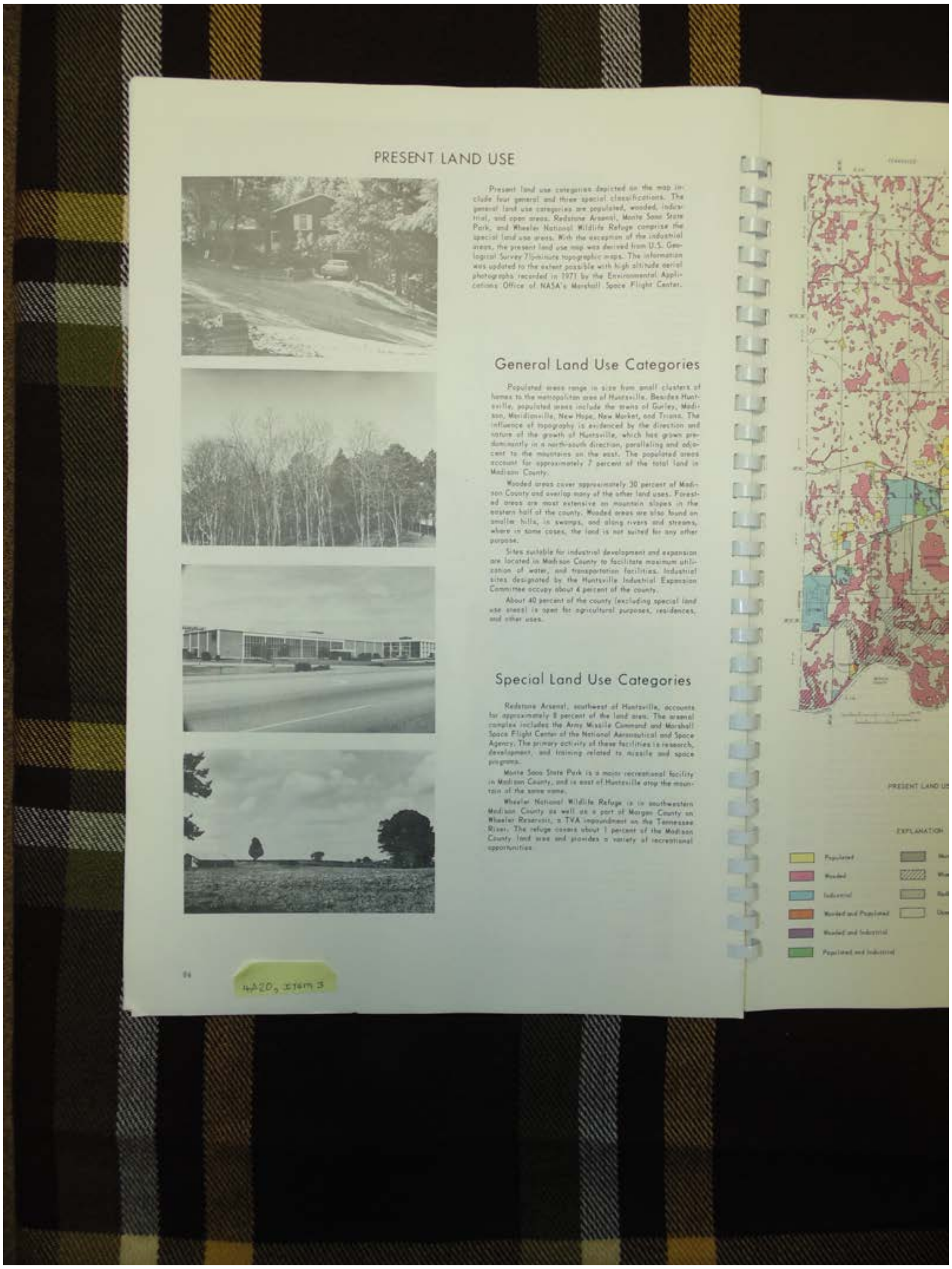
Names:
Population Density & Growth

Places:
Huntsville & Madison Co., AL

Types:
atlas maps

Dates:
1975

Frances Cabaniss Roberts Collection: **Series 4, Subseries A, Box 20, Item 3**
Environmental Geology and Hydrology, 1975
Image 97 r04a20-00-003-5160 Contents Index About



PRESENT LAND USE

Present land use categories depicted on the map include four general and three special classifications. The general land use categories are populated, wooded, industrial, and open areas. Redstone Arsenal, Monte Sano State Park, and Wheeler National Wildlife Refuge comprise the special land use areas. With the exception of the industrial areas, the present land use map was derived from U.S. Geological Survey 7½-minute topographic maps. The information was updated to the extent possible with high altitude aerial photographs recorded in 1971 by the Environmental Applications Office of NASA's Marshall Space Flight Center.

General Land Use Categories

Populated areas range in size from small clusters of homes to the metropolitan area of Huntsville. Besides Huntsville, populated areas include the towns of Gurley, Madison, Meridianville, New Hope, New Market, and Triana. The influence of topography is evidenced by the direction and nature of the growth of Huntsville, which has grown predominantly in a north-south direction, paralleling and adjacent to the mountains on the east. The populated areas account for approximately 7 percent of the total land in Madison County.

Wooded areas cover approximately 30 percent of Madison County and overlap many of the other land uses. Forested areas are most extensive on mountain slopes in the eastern half of the county. Wooded areas are also found on smaller hills, in swamps, and along rivers and streams, where in some cases, the land is not suited for any other purpose.

Sites suitable for industrial development and expansion are located in Madison County to facilitate maximum utilization of water, and transportation facilities. Industrial sites designated by the Huntsville Industrial Expansion Committee occupy about 4 percent of the county.

About 40 percent of the county (excluding special land use areas) is open for agricultural purposes, residences, and other uses.

Special Land Use Categories

Redstone Arsenal, southwest of Huntsville, accounts for approximately 8 percent of the land area. The arsenal complex includes the Army Missile Command and Marshall Space Flight Center of the National Aeronautical and Space Agency. The primary activity of these facilities is research, development, and training related to missile and space programs.

Monte Sano State Park is a major recreational facility in Madison County, and is east of Huntsville atop the mountain of the same name.

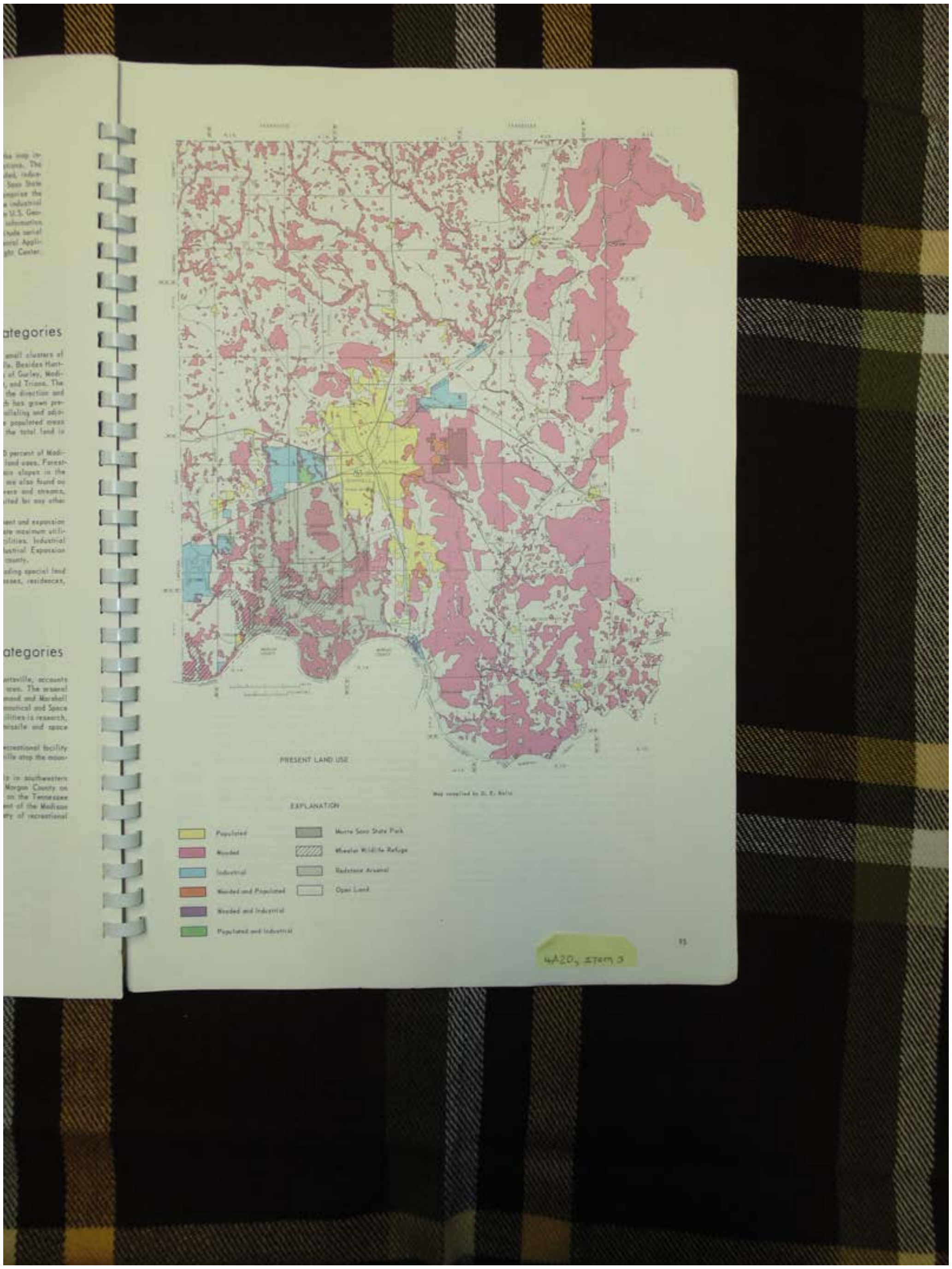
Wheeler National Wildlife Refuge is in southwestern Madison County as well as a part of Morgan County on Wheeler Reservoir, a TVA impoundment on the Tennessee River. The refuge covers about 1 percent of the Madison County land area and provides a variety of recreational opportunities.

Names:
Land Use Categories
Special Land Use Categories

Places:
Madison Co., AL

Types:
atlas
photographs

Dates:
1975



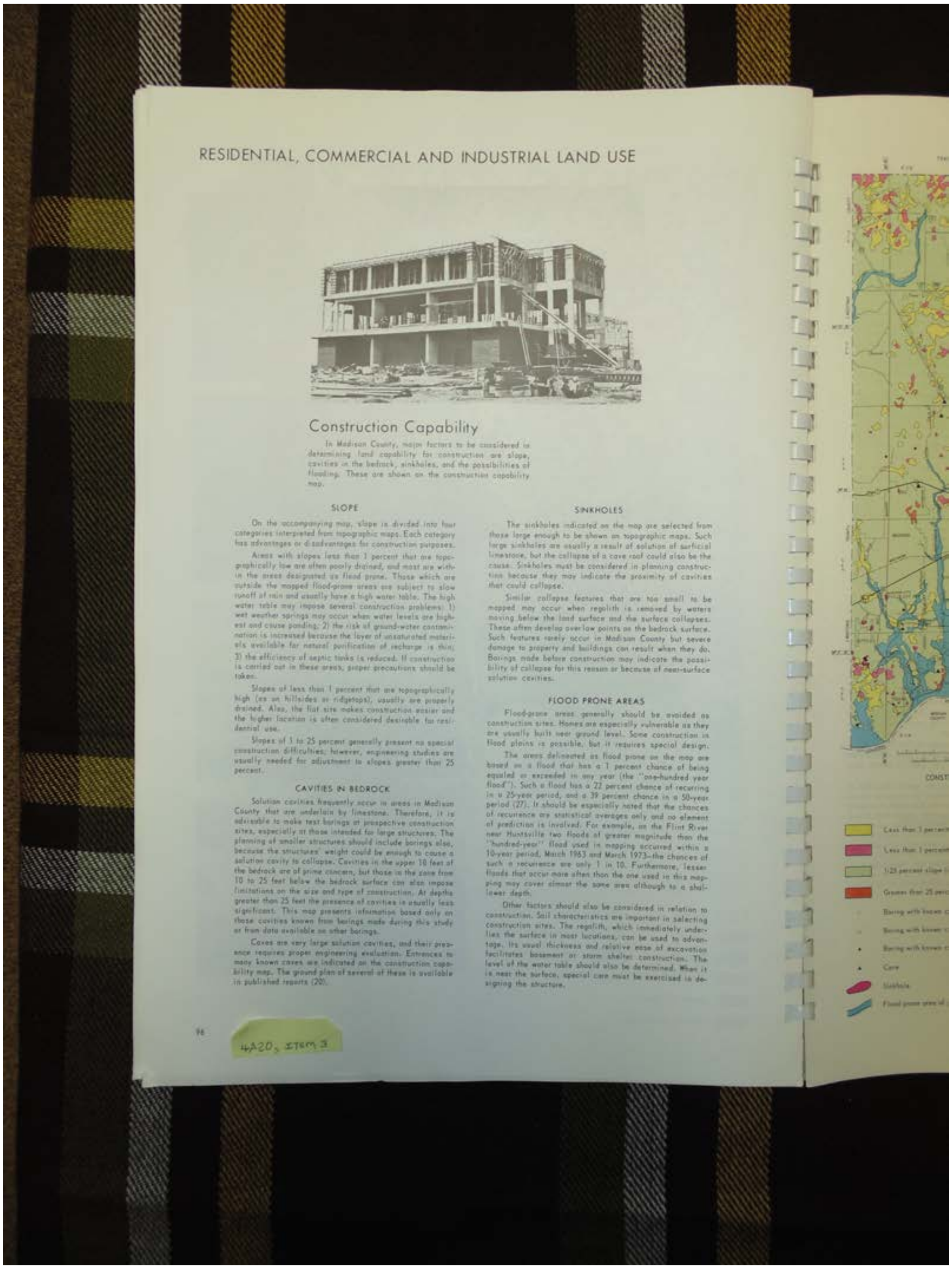
Names:
Present Land Use

Places:
Madison Co., AL

Types:
atlas map

Dates:
1975

Frances Cabaniss Roberts Collection: **Series 4, Subseries A, Box 20, Item 3**
Environmental Geology and Hydrology, 1975
Image 99 r04a20-00-003-5162 Contents Index About



RESIDENTIAL, COMMERCIAL AND INDUSTRIAL LAND USE

Construction Capability

In Madison County, major factors to be considered in determining land capability for construction are slope, cavities in the bedrock, sinkholes, and the possibilities of flooding. These are shown on the construction capability map.

SLOPE

On the accompanying map, slope is divided into four categories interpreted from topographic maps. Each category has advantages or disadvantages for construction purposes.

Areas with slopes less than 1 percent that are topographically low are often poorly drained, and most are within the areas designated as flood prone. Those which are outside the mapped flood-prone areas are subject to slow runoff of rain and usually have a high water table. The high water table may impose several construction problems: 1) wet weather springs may occur when water levels are highest and cause ponding; 2) the risk of ground-water contamination is increased because the layer of unsaturated materials available for natural purification of recharge is thin; 3) the efficiency of septic tanks is reduced. If construction is carried out in these areas, proper precautions should be taken.

Slopes of less than 1 percent that are topographically high (as on hillsides or ridgetops), usually are properly drained. Also, the flat site makes construction easier and the higher location is often considered desirable for residential use.

Slopes of 1 to 25 percent generally present no special construction difficulties; however, engineering studies are usually needed for adjustment to slopes greater than 25 percent.

CAVITIES IN BEDROCK

Solution cavities frequently occur in areas in Madison County that are underlain by limestone. Therefore, it is advisable to make test borings at prospective construction sites, especially at those intended for large structures. The planning of smaller structures should include borings also, because the structures' weight could be enough to cause a solution cavity to collapse. Cavities in the upper 10 feet of the bedrock are of prime concern, but those in the zone from 10 to 25 feet below the bedrock surface can also impose limitations on the size and type of construction. At depths greater than 25 feet the presence of cavities is usually less significant. This map presents information based only on those cavities known from borings made during this study or from data available on other borings.

Caves are very large solution cavities, and their presence requires proper engineering evaluation. Entrances to many known caves are indicated on the construction capability map. The ground plan of several of these is available in published reports (20).

SINKHOLES

The sinkholes indicated on the map are selected from those large enough to be shown on topographic maps. Such large sinkholes are usually a result of solution of surficial limestone, but the collapse of a cave roof could also be the cause. Sinkholes must be considered in planning construction because they may indicate the proximity of cavities that could collapse.

Similar collapse features that are too small to be mapped may occur when regolith is removed by waters moving below the land surface and the surface collapses. These often develop over low points on the bedrock surface. Such features rarely occur in Madison County but severe damage to property and buildings can result when they do. Borings made before construction may indicate the possibility of collapse for this reason or because of near-surface solution cavities.

FLOOD PRONE AREAS

Flood-prone areas generally should be avoided as construction sites. Homes are especially vulnerable as they are usually built near ground level. Some construction in flood plains is possible, but it requires special design.

The areas delineated as flood prone on the map are based on a flood that has a 1 percent chance of being equaled or exceeded in any year (the "one-hundred year flood"). Such a flood has a 22 percent chance of recurring in a 25-year period, and a 39 percent chance in a 50-year period (27). It should be especially noted that the chances of recurrence are statistical averages only and no element of prediction is involved. For example, on the Flint River near Huntsville two floods of greater magnitude than the "hundred-year" flood used in mapping occurred within a 10-year period, March 1963 and March 1973—the chances of such a recurrence are only 1 in 10. Furthermore, lesser floods that occur more often than the one used in this mapping may cover almost the same area although to a shallower depth.

Other factors should also be considered in relation to construction. Soil characteristics are important in selecting construction sites. The regolith, which immediately underlies the surface in most locations, can be used to advantage. Its usual thickness and relative ease of excavation facilitates basement or storm shelter construction. The level of the water table should also be determined. When it is near the surface, special care must be exercised in designing the structure.

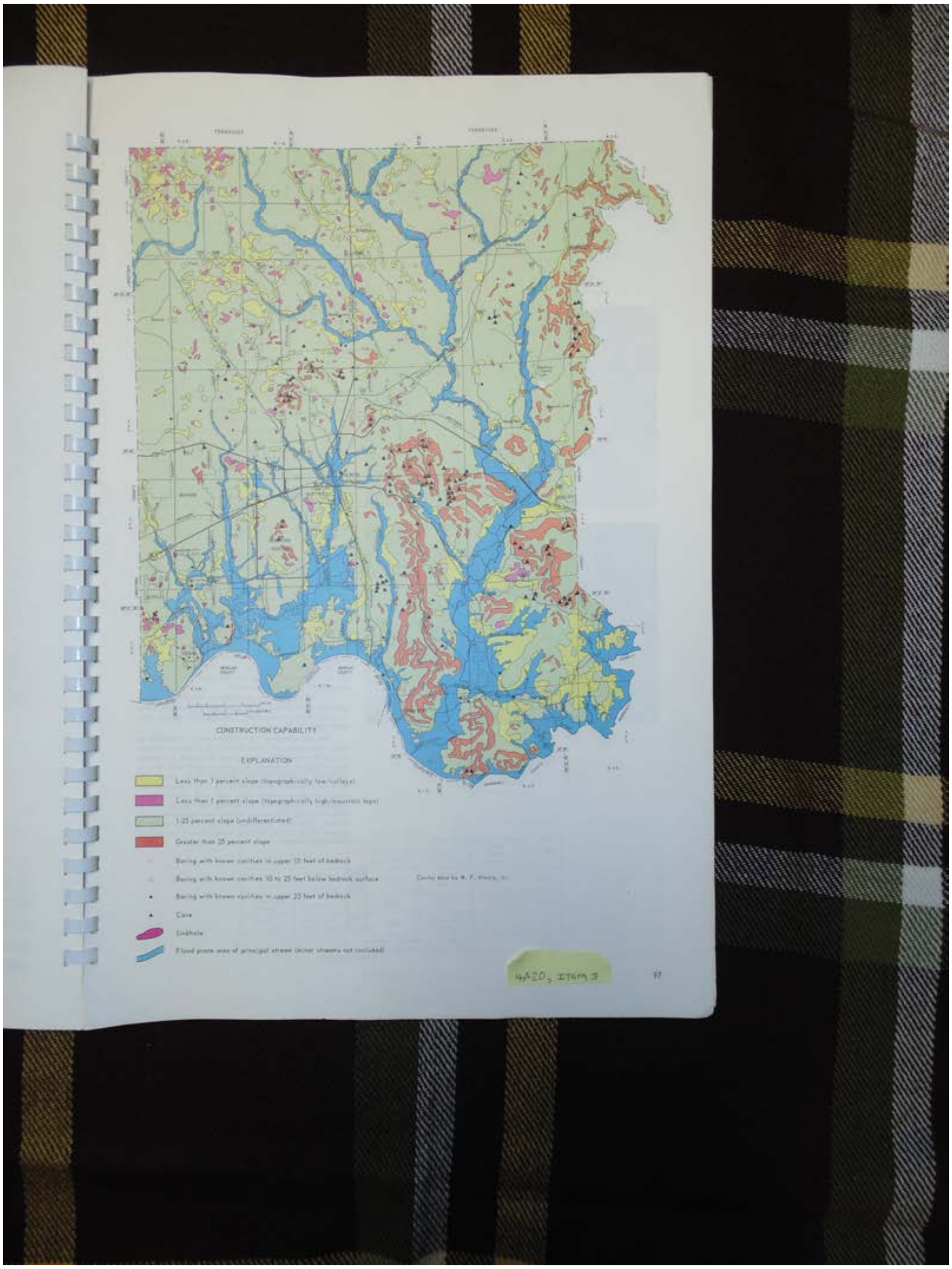
4A20, Item 3

Names:
Construction Capability

Places:
Madison Co., AL

Types:
atlas

Dates:
1975



Names:
Construction Capability

Places:
Madison Co., AL

Types:
atlas map

Dates:
1975

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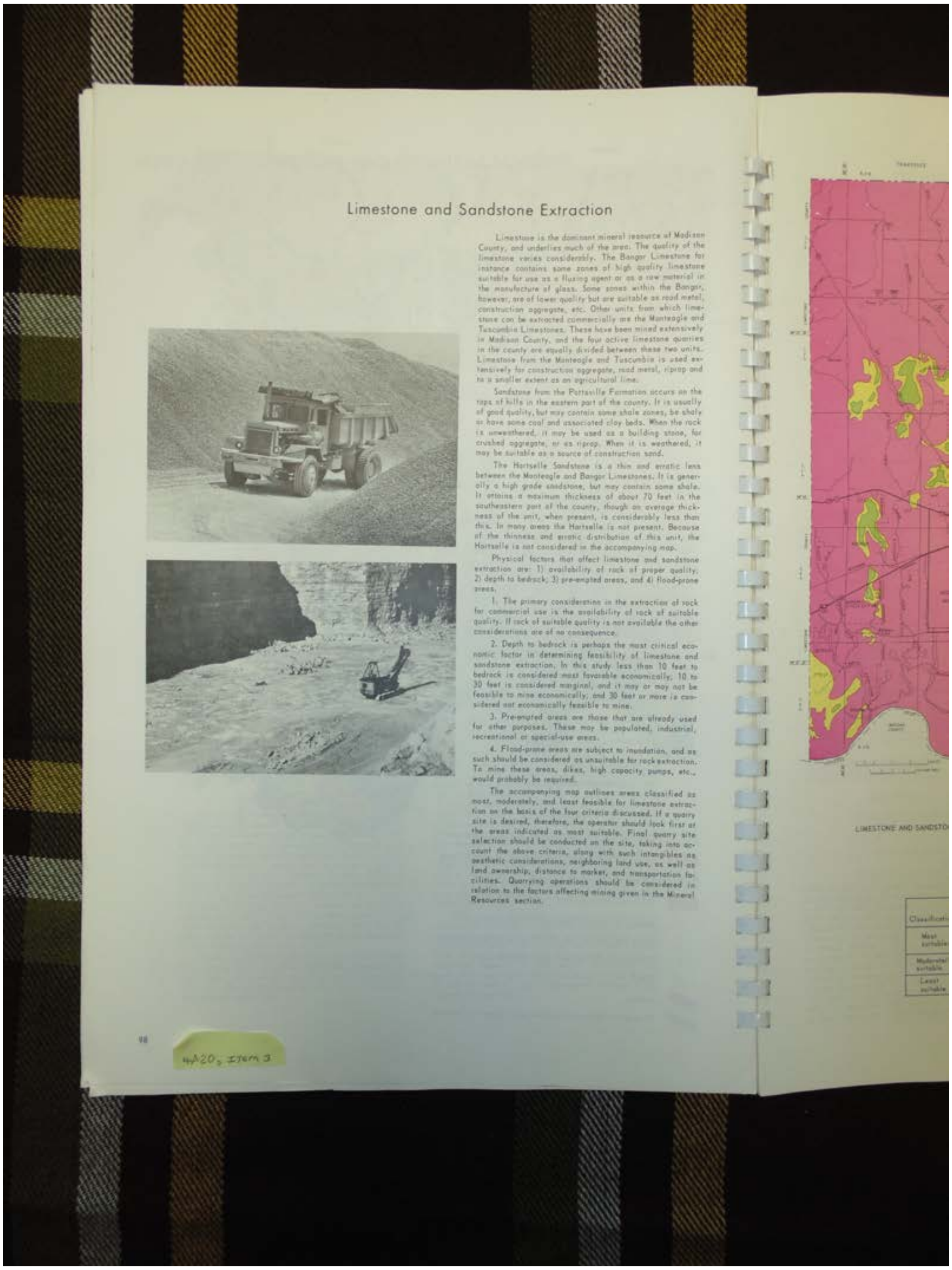
Environmental Geology and Hydrology, 1975
Image 101 r04a20-00-003-5164 Contents Index About



Limestone and Sandstone Extraction

Limestone is the dominant mineral resource of Madison County, and underlies much of the area. The quality of the limestone varies considerably. The Bangor Limestone for instance contains some zones of high quality limestone suitable for use as a fluxing agent or as a raw material in the manufacture of glass. Some zones within the Bangor, however, are of lower quality but are suitable as road metal, construction aggregate, etc. Other units from which limestone can be extracted commercially are the Monteagle and Tuscumbia Limestones. These have been mined extensively in Madison County, and the four active limestone quarries in the county are equally divided between these two units. Limestone from the Monteagle and Tuscumbia is used extensively for construction aggregate, road metal, riprap and to a smaller extent as an agricultural lime.

Sandstone from the Pottsville Formation occurs on the tops of hills in the eastern part of the county. It is usually of good quality, but may contain some shale zones, be shaly or have some coal and associated clay beds. When the rock is unweathered, it may be used as a building stone, for crushed aggregate, or as riprap. When it is weathered, it may be suitable as a source of construction sand.

The Hartselle Sandstone is a thin and erratic lens between the Monteagle and Bangor Limestones. It is generally a high grade sandstone, but may contain some shale. It attains a maximum thickness of about 70 feet in the southeastern part of the county, though an average thickness of the unit, when present, is considerably less than this. In many areas the Hartselle is not present. Because of the thinness and erratic distribution of this unit, the Hartselle is not considered in the accompanying map.

Physical factors that affect limestone and sandstone extraction are: 1) availability of rock of proper quality, 2) depth to bedrock; 3) pre-empted areas, and 4) flood-prone areas.

1. The primary consideration in the extraction of rock for commercial use is the availability of rock of suitable quality. If rock of suitable quality is not available the other considerations are of no consequence.

2. Depth to bedrock is perhaps the most critical economic factor in determining feasibility of limestone and sandstone extraction. In this study less than 10 feet to bedrock is considered most favorable economically; 10 to 30 feet is considered marginal, and it may or may not be feasible to mine economically; and 30 feet or more is considered not economically feasible to mine.

3. Pre-empted areas are those that are already used for other purposes. These may be populated, industrial, recreational or special-use areas.

4. Flood-prone areas are subject to inundation, and as such should be considered as unsuitable for rock extraction. To mine these areas, dikes, high capacity pumps, etc., would probably be required.

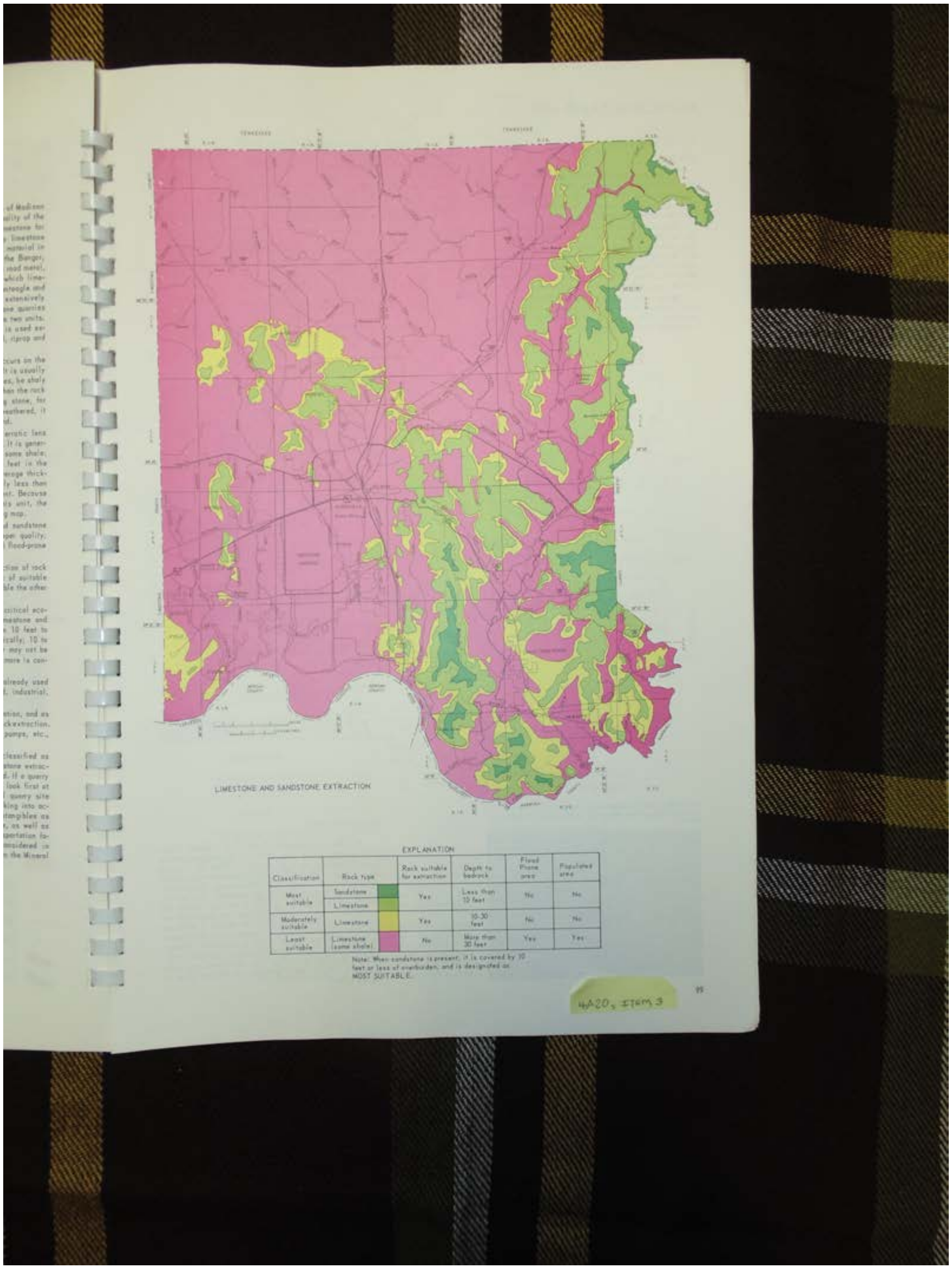
The accompanying map outlines areas classified as most, moderately, and least feasible for limestone extraction on the basis of the four criteria discussed. If a quarry site is desired, therefore, the operator should look first at the areas indicated as most suitable. Final quarry site selection should be conducted on the site, taking into account the above criteria, along with such intangibles as aesthetic considerations, neighboring land use, as well as land ownership, distance to market, and transportation facilities. Quarrying operations should be considered in relation to the factors affecting mining given in the Mineral Resources section.

Names:
Limestone & Sandstone Extraction

Places:
Madison Co., AL

Types:
atlas

Dates:
1975



Names:

Limestone & Sandstone

Extraction

Places:

Madison Co., AL

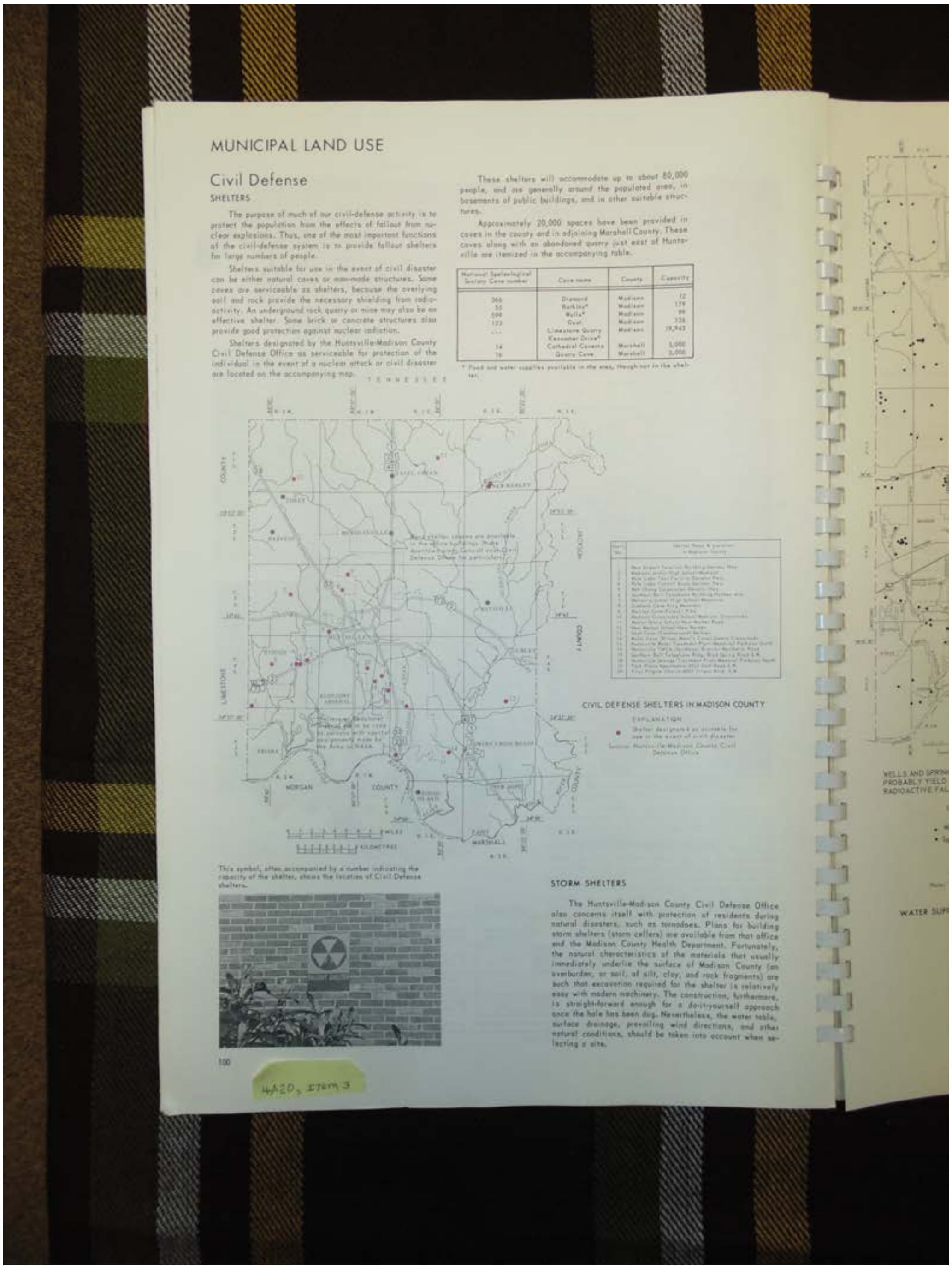
Types:

atlas

map

Dates:

1975



MUNICIPAL LAND USE

Civil Defense

SHELTERS

The purpose of much of our civil-defense activity is to protect the population from the effects of fallout from nuclear explosions. Thus, one of the most important functions of the civil-defense system is to provide fallout shelters for large numbers of people.

Shelters suitable for use in the event of civil disaster can be either natural caves or man-made structures. Some caves are serviceable as shelters, because the overlying soil and rock provide the necessary shielding from radioactivity. An underground rock quarry or mine may also be an effective shelter. Some brick or concrete structures also provide good protection against nuclear radiation.

Shelters designated by the Huntsville-Madison County Civil Defense Office as serviceable for protection of the individual in the event of a nuclear attack or civil disaster are located on the accompanying map.

These shelters will accommodate up to about 80,000 people, and are generally around the populated area, in basements of public buildings, and in other suitable structures.

Approximately 20,000 spaces have been provided in caves in the county and in adjoining Marshall County. These caves along with an abandoned quarry just east of Huntsville are itemized in the accompanying table.

National Speleological Society Cave number	Cave name	County	Capacity
366	Diamond	Madison	12
55	Barkley*	Madison	179
599	Wells*	Madison	99
123	Goat	Madison	338
....	Limestone Quarry Keenomer Drive*	Madison	19,943
14	Cathedral Caverns	Marshall	5,000
16	Quarry Cave	Marshall	3,000

* Food and water supplies available in the area, though not in the shelter.

This symbol, often accompanied by a number indicating the capacity of the shelter, shows the location of Civil Defense shelters.

STORM SHELTERS

The Huntsville-Madison County Civil Defense Office also concerns itself with protection of residents during natural disasters, such as tornadoes. Plans for building storm shelters (storm cellars) are available from that office and the Madison County Health Department. Fortunately, the natural characteristics of the materials that usually immediately underlie the surface of Madison County (an overburden, or soil, of silt, clay, and rock fragments) are such that excavation required for the shelter is relatively easy with modern machinery. The construction, furthermore, is straight-forward enough for a do-it-yourself approach once the hole has been dug. Nevertheless, the water table, surface drainage, prevailing wind directions, and other natural conditions, should be taken into account when selecting a site.

100

4A20, Item 3

Names:
Civil Defense
Shelters
Municipal Land Use
Storm Shelters

Places:
Madison Co., AL

Types:
atlas
atlas
map

Dates:
1975

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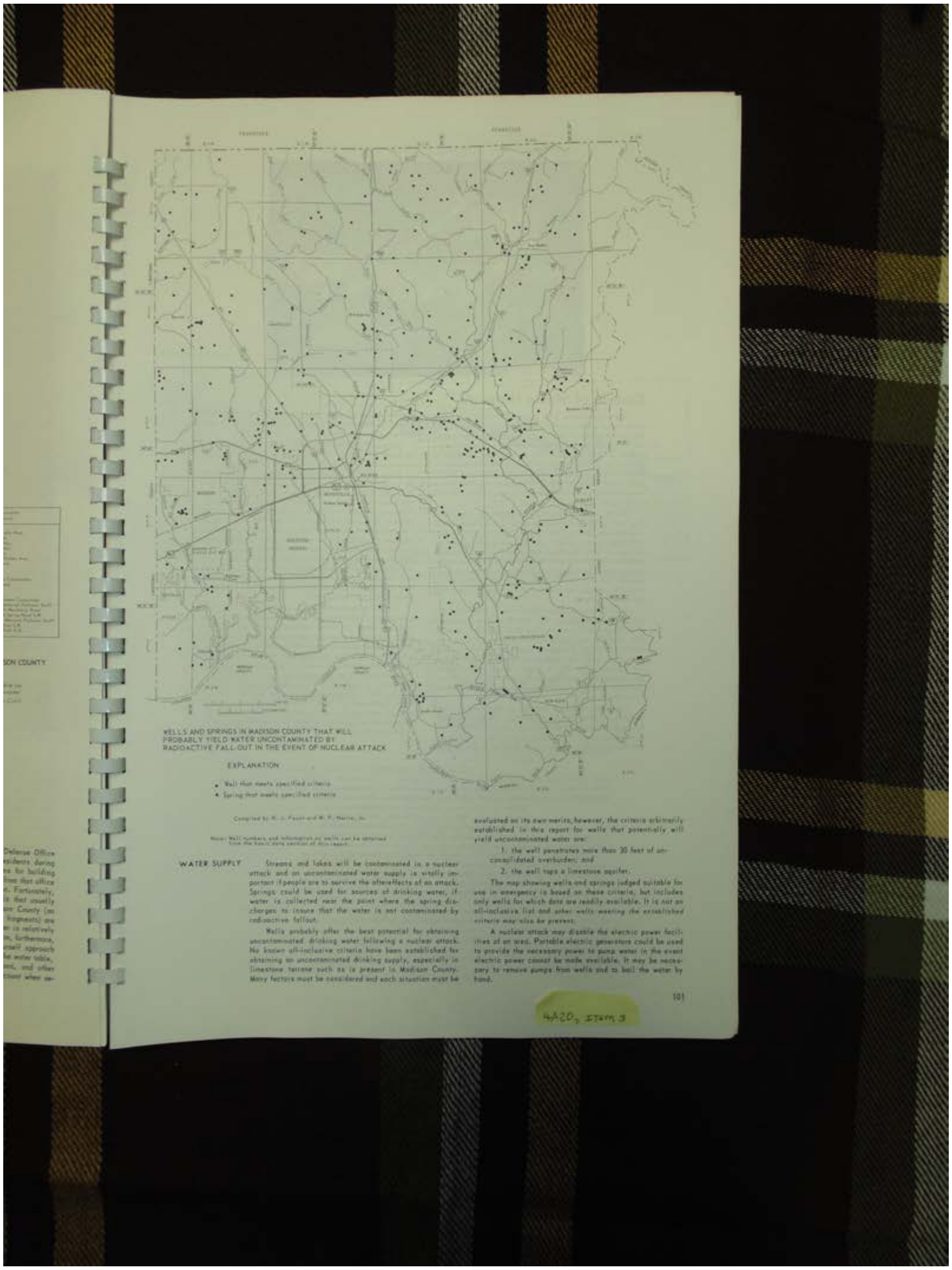
Environmental Geology and Hydrology, 1975
Image 104 r04a20-00-003-5167 Contents Index About


WELLS AND SPRINGS IN MADISON COUNTY THAT WILL PROBABLY YIELD WATER UNCONTAMINATED BY RADIOACTIVE FALL-OUT IN THE EVENT OF NUCLEAR ATTACK

EXPLANATION

- Well that meets specified criteria
- Spring that meets specified criteria

WATER SUPPLY

Streams and lakes will be contaminated in a nuclear attack and an uncontaminated water supply is vitally important if people are to survive the aftereffects of an attack. Springs could be used for sources of drinking water, if water is collected near the point where the spring discharges to insure that the water is not contaminated by radioactive fallout.

Wells probably offer the best potential for obtaining uncontaminated drinking water following a nuclear attack. No known all-inclusive criteria have been established for obtaining an uncontaminated drinking supply, especially in limestone terrane such as is present in Madison County. Many factors must be considered and each situation must be evaluated on its own merits, however, the criteria arbitrarily established in this report for wells that potentially will yield uncontaminated water are:

1. the well penetrates more than 30 feet of unconsolidated overburden; and
2. the well taps a limestone aquifer.

The map showing wells and springs judged suitable for use in emergency is based on these criteria, but includes only wells for which data are readily available. It is not an all-inclusive list and other wells meeting the established criteria may also be present.

A nuclear attack may disable the electric power facilities of an area. Portable electric generators could be used to provide the necessary power to pump water in the event electric power cannot be made available. It may be necessary to remove pumps from wells and to bail the water by hand.

101

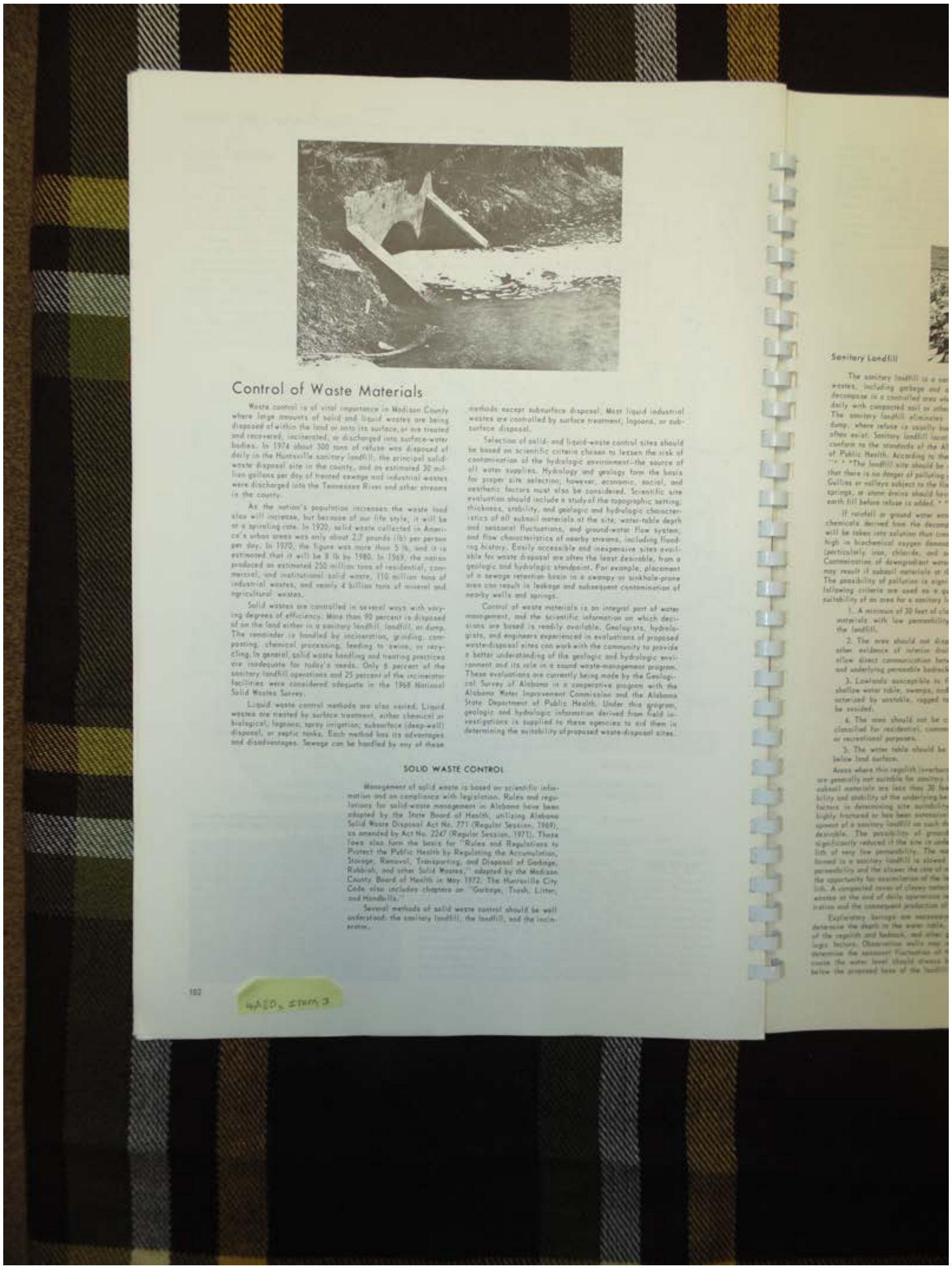
4A20, Item 3

Names:
Emergency Water Supply

Places:
Madison Co., AL

Types:
atlas map

Dates:
1975



Control of Waste Materials

Waste control is of vital importance in Madison County where large amounts of solid and liquid wastes are being disposed of within the land or onto its surface, or are treated and recovered, incinerated, or discharged into surface-water bodies. In 1974 about 300 tons of refuse was disposed of daily in the Huntsville sanitary landfill, the principal solid-waste disposal site in the county, and an estimated 30 million gallons per day of treated sewage and industrial wastes were discharged into the Tennessee River and other streams in the county.

As the nation's population increases the waste load also will increase, but because of our life style, it will be at a spiraling rate. In 1920, solid waste collected in America's urban areas was only about 2.7 pounds (lb) per person per day. In 1970, the figure was more than 5 lb, and it is estimated that it will be 8 lb by 1980. In 1969, the nation produced an estimated 250 million tons of residential, commercial, and institutional solid waste, 110 million tons of industrial wastes, and nearly 4 billion tons of mineral and agricultural wastes.

Solid wastes are controlled in several ways with varying degrees of efficiency. More than 90 percent is disposed of on the land either in a sanitary landfill, landfill, or dump. The remainder is handled by incineration, grinding, composting, chemical processing, feeding to swine, or recycling. In general, solid waste handling and treating practices are inadequate for today's needs. Only 6 percent of the sanitary landfill operations and 25 percent of the incinerator facilities were considered adequate in the 1968 National Solid Wastes Survey.

Liquid waste control methods are also varied. Liquid wastes are treated by surface treatment, either chemical or biological; lagoons; spray irrigation; subsurface (deep-well) disposal, or septic tanks. Each method has its advantages and disadvantages. Sewage can be handled by any of these methods except subsurface disposal. Most liquid industrial wastes are controlled by surface treatment, lagoons, or subsurface disposal.

Selection of solid- and liquid-waste control sites should be based on scientific criteria chosen to lessen the risk of contamination of the hydrologic environment—the source of all water supplies. Hydrology and geology form the basis for proper site selection; however, economic, social, and aesthetic factors must also be considered. Scientific site evaluation should include a study of the topographic setting; thickness, stability, and geologic and hydrologic characteristics of all subsoil materials at the site; water-table depth and seasonal fluctuations, and ground-water flow system, and flow characteristics of nearby streams, including flooding history. Easily accessible and inexpensive sites available for waste disposal are often the least desirable, from a geologic and hydrologic standpoint. For example, placement of a sewage retention basin in a swampy or sinkhole-prone area can result in leakage and subsequent contamination of nearby wells and springs.

Control of waste materials is an integral part of water management, and the scientific information on which decisions are based is readily available. Geologists, hydrologists, and engineers experienced in evaluations of proposed waste-disposal sites can work with the community to provide a better understanding of the geologic and hydrologic environment and its role in a sound waste-management program. These evaluations are currently being made by the Geological Survey of Alabama in a cooperative program with the Alabama Water Improvement Commission and the Alabama State Department of Public Health. Under this program, geologic and hydrologic information derived from field investigations is supplied to these agencies to aid them in determining the suitability of proposed waste-disposal sites.

SOLID WASTE CONTROL

Management of solid waste is based on scientific information and on compliance with legislation. Rules and regulations for solid-waste management in Alabama have been adopted by the State Board of Health, utilizing Alabama Solid Waste Disposal Act No. 771 (Regular Session, 1969), as amended by Act No. 2247 (Regular Session, 1971). These laws also form the basis for "Rules and Regulations to Protect the Public Health by Regulating the Accumulation, Storage, Removal, Transporting, and Disposal of Garbage, Rubbish, and other Solid Wastes," adopted by the Madison County Board of Health in May 1972. The Huntsville City Code also includes chapters on "Garbage, Trash, Litter, and Handbills."

Several methods of solid waste control should be well understood: the sanitary landfill, the landfill, and the incinerator.

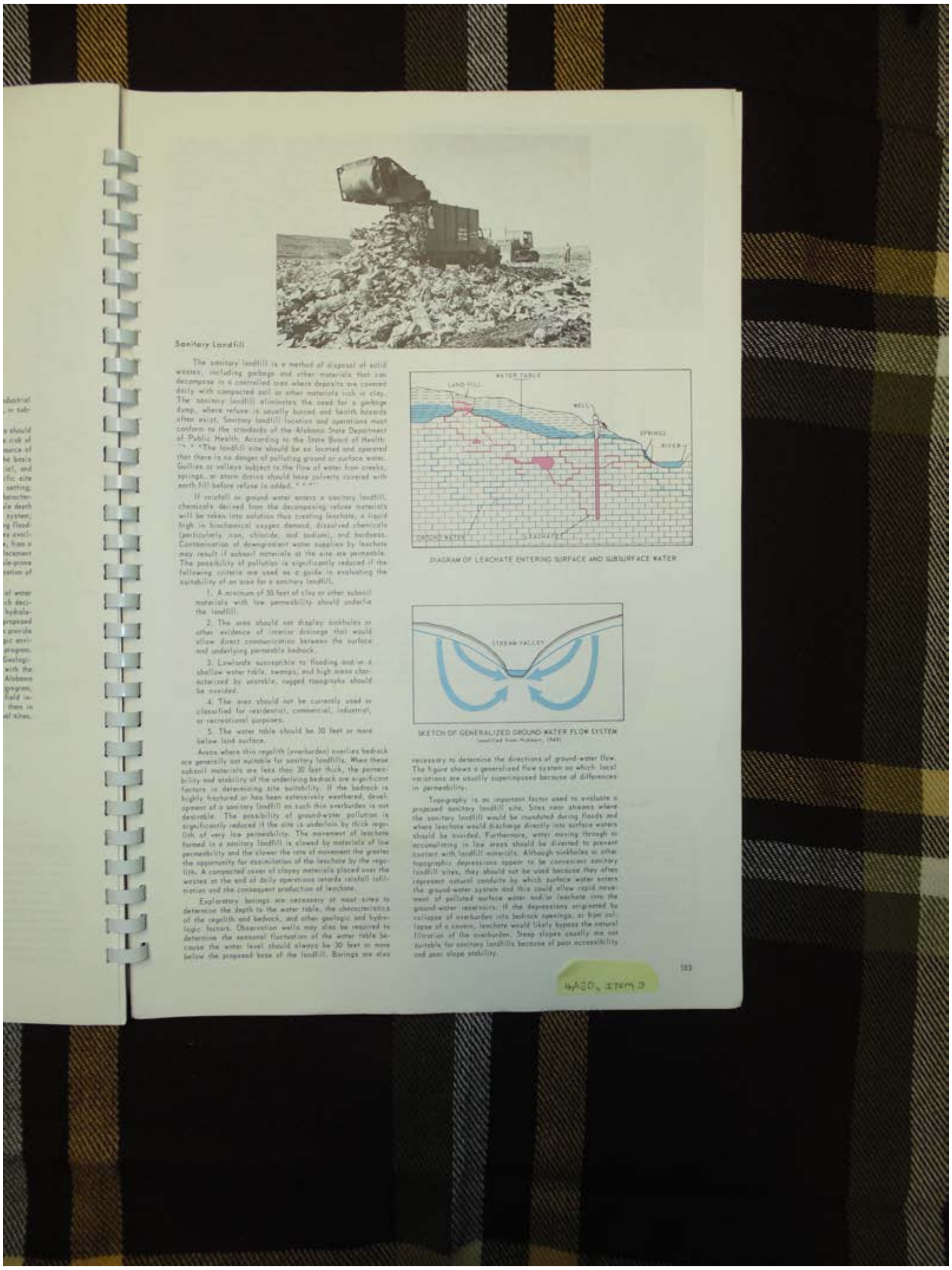
102

Names:
Solid Waste Control
Waste Material Control

Places:
Madison Co., AL

Types:
atlas

Dates:
1975



Sanitary Landfill

The sanitary landfill is a method of disposal of solid wastes, including garbage and other materials that can decompose in a controlled area where deposits are covered daily with compacted soil or other materials rich in clay. The sanitary landfill eliminates the need for a garbage dump, where refuse is usually burned and health hazards often exist. Sanitary landfill location and operations must conform to the standards of the Alabama State Department of Public Health. According to the State Board of Health: "* * *The landfill site should be so located and operated that there is no danger of polluting ground or surface water. Gullies or valleys subject to the flow of water from creeks, springs, or storm drains should have culverts covered with earth fill before refuse is added. * * *"

If rainfall or ground water enters a sanitary landfill, chemicals derived from the decomposing refuse materials will be taken into solution thus creating leachate, a liquid high in biochemical oxygen demand, dissolved chemicals (particularly iron, chloride, and sodium), and hardness. Contamination of downgradient water supplies by leachate may result if subsoil materials at the site are permeable. The possibility of pollution is significantly reduced if the following criteria are used as a guide in evaluating the suitability of an area for a sanitary landfill.

1. A minimum of 30 feet of clay or other subsoil materials with low permeability should underlie the landfill.

2. The area should not display sinkholes or other evidence of interior drainage that would allow direct communication between the surface and underlying permeable bedrock.

3. Lowlands susceptible to flooding and/or a shallow water table, swamps, and high areas characterized by unstable, rugged topography should be avoided.

4. The area should not be currently used or classified for residential, commercial, industrial, or recreational purposes.

5. The water table should be 30 feet or more below land surface.

Areas where thin regolith (overburden) overlies bedrock are generally not suitable for sanitary landfills. Where these subsoil materials are less than 30 feet thick, the permeability and stability of the underlying bedrock are significant factors in determining site suitability. If the bedrock is highly fractured or has been extensively weathered, development of a sanitary landfill on such thin overburden is not desirable. The possibility of ground-water pollution is significantly reduced if the site is underlain by thick regolith of very low permeability. The movement of leachate formed in a sanitary landfill is slowed by materials of low permeability and the slower the rate of movement the greater the opportunity for assimilation of the leachate by the regolith. A compacted cover of clayey materials placed over the wastes at the end of daily operations retards rainfall infiltration and the consequent production of leachate.

Exploratory borings are necessary at most sites to determine the depth to the water table, the characteristics of the regolith and bedrock, and other geologic and hydrologic factors. Observation wells may also be required to determine the seasonal fluctuation of the water table because the water level should always be 30 feet or more below the proposed base of the landfill. Borings are also necessary to determine the directions of ground-water flow. The figure shows a generalized flow system on which local variations are usually superimposed because of differences in permeability.

DIAGRAM OF LEACHATE ENTERING SURFACE AND SUBSURFACE WATER

SKETCH OF GENERALIZED GROUND-WATER FLOW SYSTEM
(modified from Hubbert, 1940)

Topography is an important factor used to evaluate a proposed sanitary landfill site. Sites near streams where the sanitary landfill would be inundated during floods and where leachate would discharge directly into surface waters should be avoided. Furthermore, water moving through or accumulating in low areas should be diverted to prevent contact with landfill materials. Although sinkholes or other topographic depressions appear to be convenient sanitary landfill sites, they should not be used because they often represent natural conduits by which surface water enters the ground-water system and this could allow rapid movement of polluted surface water and/or leachate into the ground-water reservoirs. If the depressions originated by collapse of overburden into bedrock openings, or from collapse of a cavern, leachate would likely bypass the natural filtration of the overburden. Steep slopes usually are not suitable for sanitary landfills because of poor accessibility and poor slope stability.

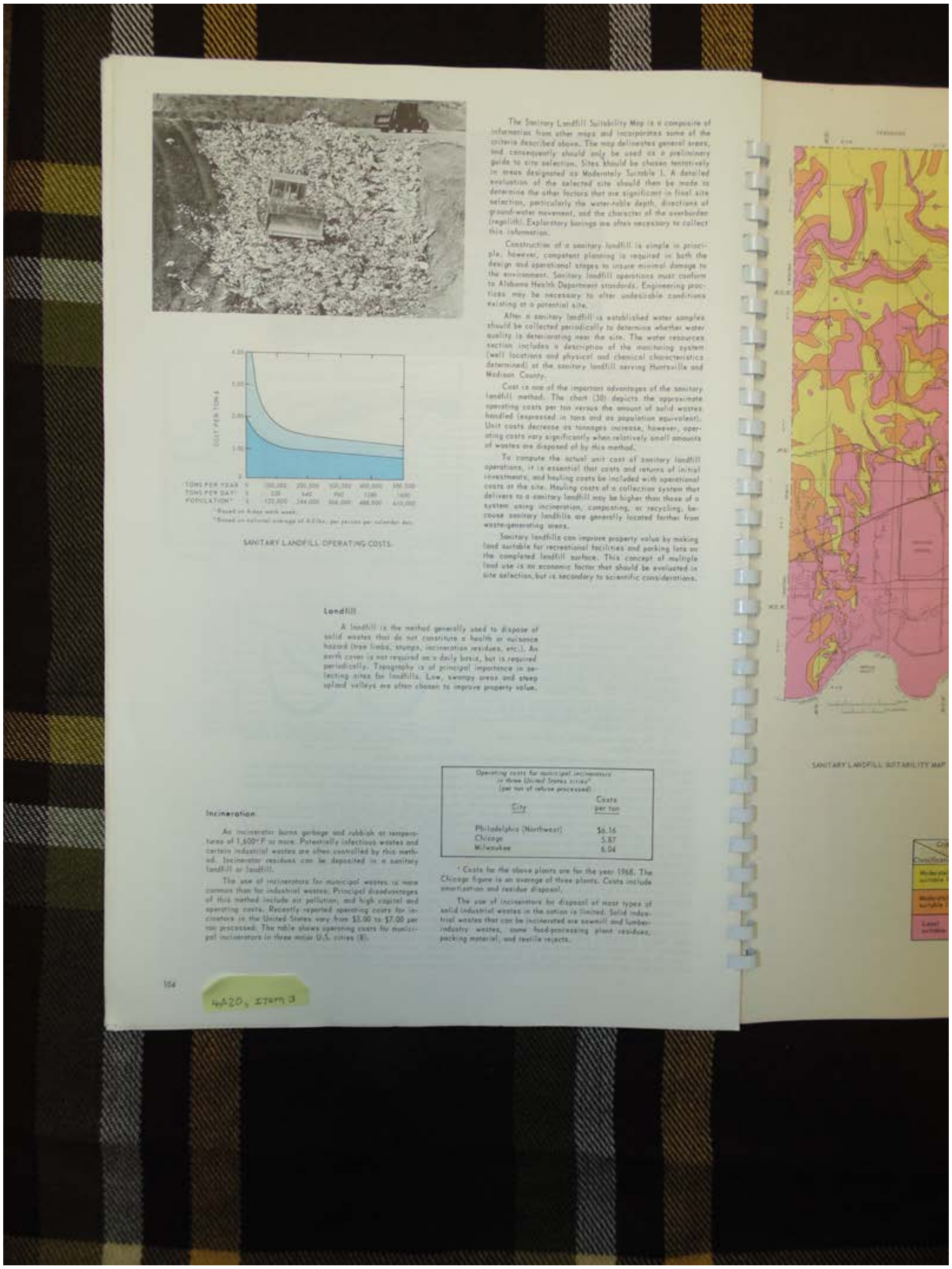
4A20, ITEM 3

Names:
Sanitary Landfill

Places:
Madison Co., AL

Types:
atlas diagrams

Dates:
1975



The Sanitary Landfill Suitability Map is a composite of information from other maps and incorporates some of the criteria described above. The map delineates general areas, and consequently should only be used as a preliminary guide to site selection. Sites should be chosen tentatively in areas designated as Moderately Suitable 1. A detailed evaluation of the selected site should then be made to determine the other factors that are significant in final site selection, particularly the water-table depth, directions of ground-water movement, and the character of the overburden (regolith). Exploratory borings are often necessary to collect this information.

Construction of a sanitary landfill is simple in principle, however, competent planning is required in both the design and operational stages to insure minimal damage to the environment. Sanitary landfill operations must conform to Alabama Health Department standards. Engineering practices may be necessary to alter undesirable conditions existing at a potential site.

After a sanitary landfill is established water samples should be collected periodically to determine whether water quality is deteriorating near the site. The water resources section includes a description of the monitoring system (well locations and physical and chemical characteristics determined) at the sanitary landfill serving Huntsville and Madison County.

Cost is one of the important advantages of the sanitary landfill method. The chart (30) depicts the approximate operating costs per ton versus the amount of solid wastes handled (expressed in tons and as population equivalent). Unit costs decrease as tonnages increase, however, operating costs vary significantly when relatively small amounts of wastes are disposed of by this method.

To compute the actual unit cost of sanitary landfill operations, it is essential that costs and returns of initial investments, and hauling costs be included with operational costs at the site. Hauling costs of a collection system that delivers to a sanitary landfill may be higher than those of a system using incineration, composting, or recycling, because sanitary landfills are generally located farther from waste-generating areas.

Sanitary landfills can improve property value by making land suitable for recreational facilities and parking lots on the completed landfill surface. This concept of multiple land use is an economic factor that should be evaluated in site selection, but is secondary to scientific considerations.

SANITARY LANDFILL OPERATING COSTS

Landfill

A landfill is the method generally used to dispose of solid wastes that do not constitute a health or nuisance hazard (tree limbs, stumps, incineration residues, etc.). An earth cover is not required on a daily basis, but is required periodically. Topography is of principal importance in selecting sites for landfills. Low, swampy areas and steep upland valleys are often chosen to improve property value.

Incineration

An incinerator burns garbage and rubbish at temperatures of 1,600° F or more. Potentially infectious wastes and certain industrial wastes are often controlled by this method. Incinerator residues can be deposited in a sanitary landfill or landfill.

The use of incinerators for municipal wastes is more common than for industrial wastes. Principal disadvantages of this method include air pollution, and high capital and operating costs. Recently reported operating costs for incinerators in the United States vary from $3.00 to $7.00 per ton processed. The table shows operating costs for municipal incinerators in three major U.S. cities (8).

Operating costs for municipal incinerators in three United States cities*
(per ton of refuse processed)

City	Costs per ton
Philadelphia (Northwest)	$6.16
Chicago	5.87
Milwaukee	6.04

* Costs for the above plants are for the year 1968. The Chicago figure is an average of three plants. Costs include amortization and residue disposal.

The use of incinerators for disposal of most types of solid industrial wastes in the nation is limited. Solid industrial wastes that can be incinerated are sawmill and lumber-industry wastes, some food-processing plant residues, packing material, and textile rejects.

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SANITARY LANDFILL SUITABILITY MAP

Names:
Incineration
Sanitary Landfill

Places:
Madison Co., AL

Types:
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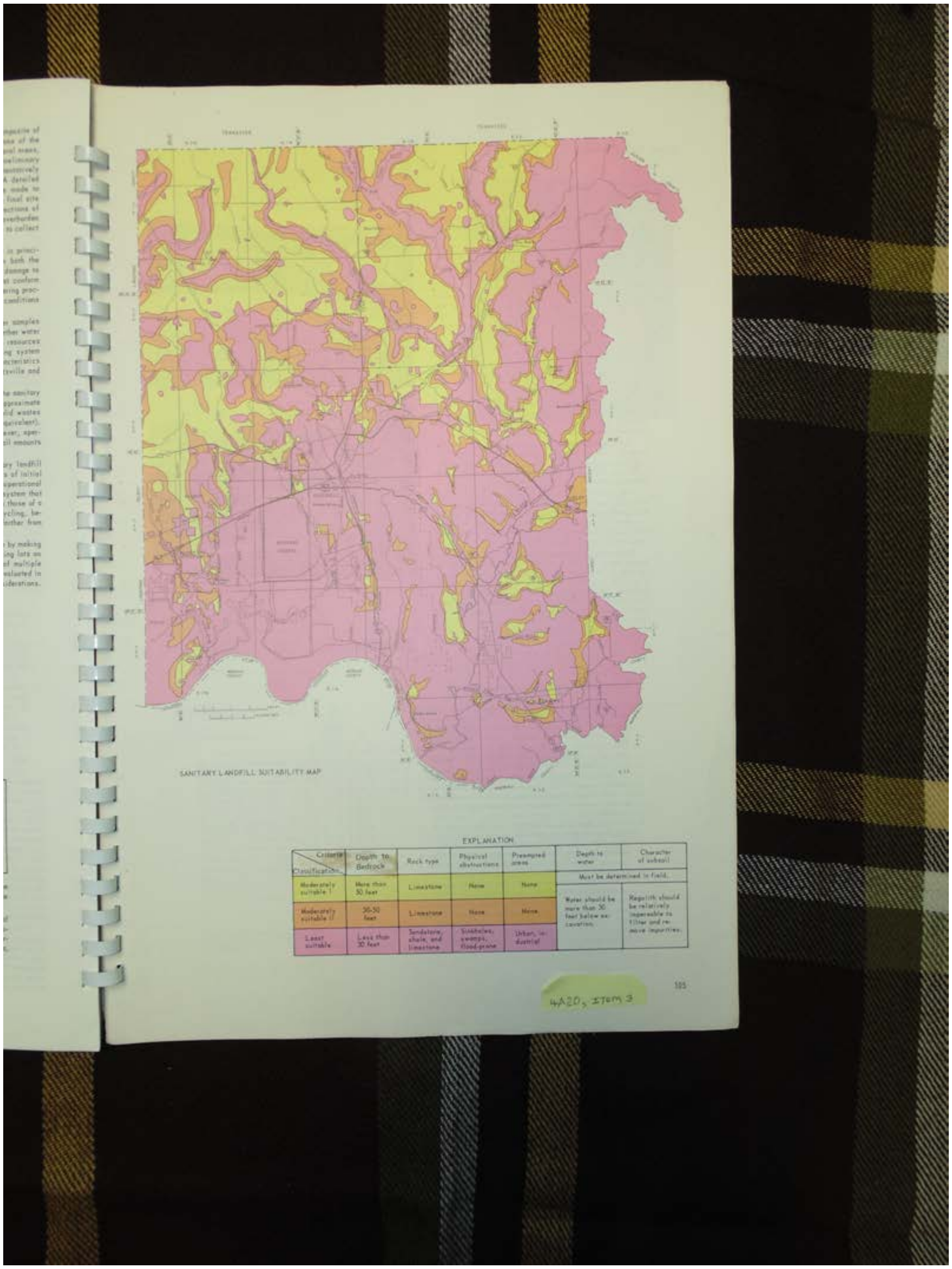
atlas
diagram

Dates:
1975

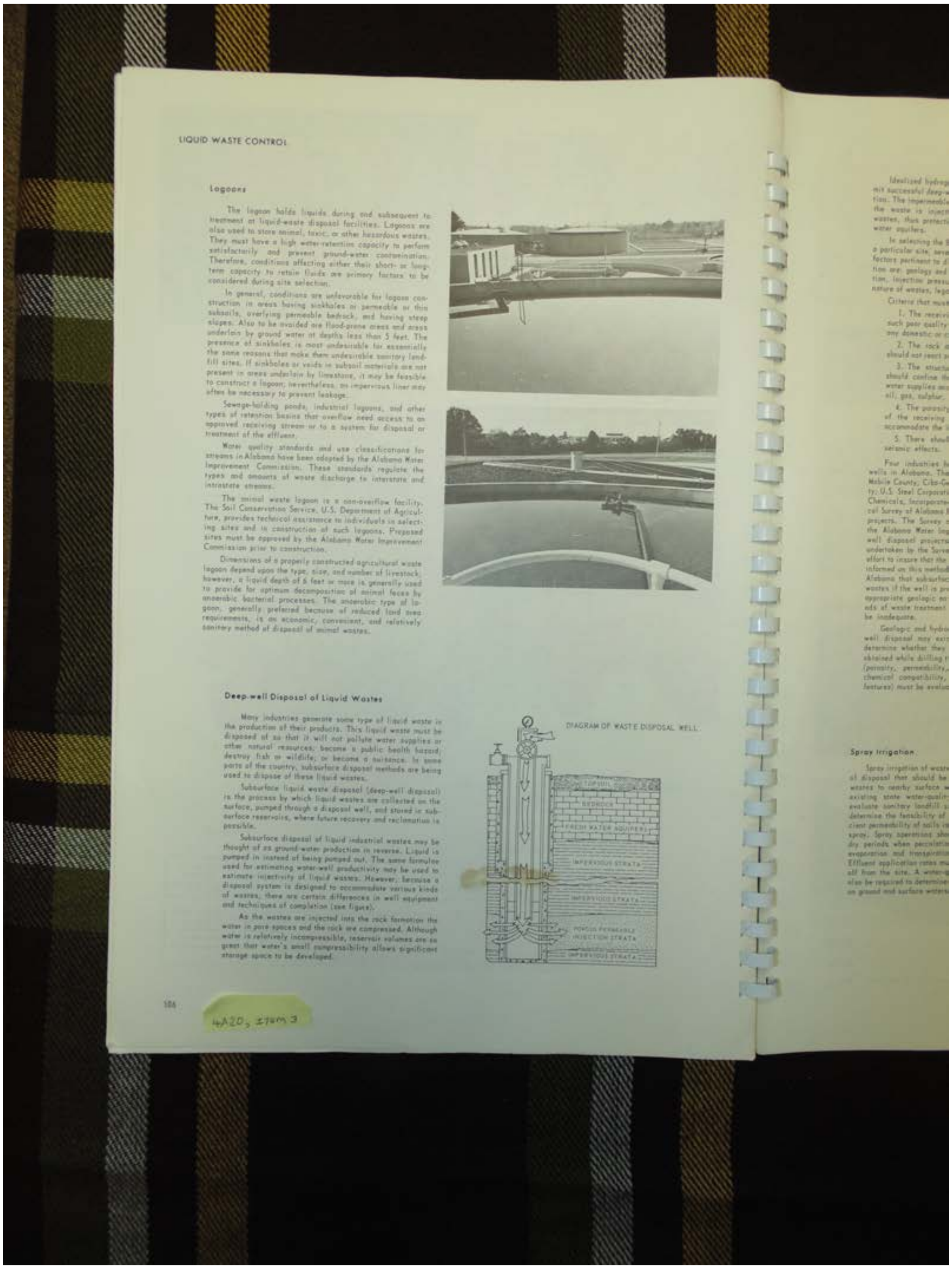


Names:
Sanitary Landfill Suitability Map

Places:
Madison Co., AL

Types:
map

Dates:
1975



LIQUID WASTE CONTROL

Lagoons

The lagoon holds liquids during and subsequent to treatment at liquid-waste disposal facilities. Lagoons are also used to store animal, toxic, or other hazardous wastes. They must have a high water-retention capacity to perform satisfactorily and prevent ground-water contamination. Therefore, conditions affecting either their short- or long-term capacity to retain fluids are primary factors to be considered during site selection.

In general, conditions are unfavorable for lagoon construction in areas having sinkholes or permeable or thin subsoils, overlying permeable bedrock, and having steep slopes. Also to be avoided are flood-prone areas and areas underlain by ground water at depths less than 5 feet. The presence of sinkholes is most undesirable for essentially the same reasons that make them undesirable sanitary landfill sites. If sinkholes or voids in subsoil materials are not present in areas underlain by limestone, it may be feasible to construct a lagoon; nevertheless, an impervious liner may often be necessary to prevent leakage.

Sewage-holding ponds, industrial lagoons, and other types of retention basins that overflow need access to an approved receiving stream or to a system for disposal or treatment of the effluent.

Water quality standards and use classifications for streams in Alabama have been adopted by the Alabama Water Improvement Commission. These standards regulate the types and amounts of waste discharge to interstate and intrastate streams.

The animal waste lagoon is a non-overflow facility. The Soil Conservation Service, U.S. Department of Agriculture, provides technical assistance to individuals in selecting sites and in construction of such lagoons. Proposed sites must be approved by the Alabama Water Improvement Commission prior to construction.

Dimensions of a properly constructed agricultural waste lagoon depend upon the type, size, and number of livestock; however, a liquid depth of 6 feet or more is generally used to provide for optimum decomposition of animal feces by anaerobic bacterial processes. The anaerobic type of lagoon, generally preferred because of reduced land area requirements, is an economic, convenient, and relatively sanitary method of disposal of animal wastes.

Deep-well Disposal of Liquid Wastes

Many industries generate some type of liquid waste in the production of their products. This liquid waste must be disposed of so that it will not pollute water supplies or other natural resources; become a public health hazard; destroy fish or wildlife; or become a nuisance. In some parts of the country, subsurface disposal methods are being used to dispose of these liquid wastes.

Subsurface liquid waste disposal (deep-well disposal) is the process by which liquid wastes are collected on the surface, pumped through a disposal well, and stored in subsurface reservoirs, where future recovery and reclamation is possible.

Subsurface disposal of liquid industrial wastes may be thought of as ground-water production in reverse. Liquid is pumped in instead of being pumped out. The same formulae used for estimating water-well productivity may be used to estimate injectivity of liquid wastes. However, because a disposal system is designed to accommodate various kinds of wastes, there are certain differences in well equipment and techniques of completion (see figure).

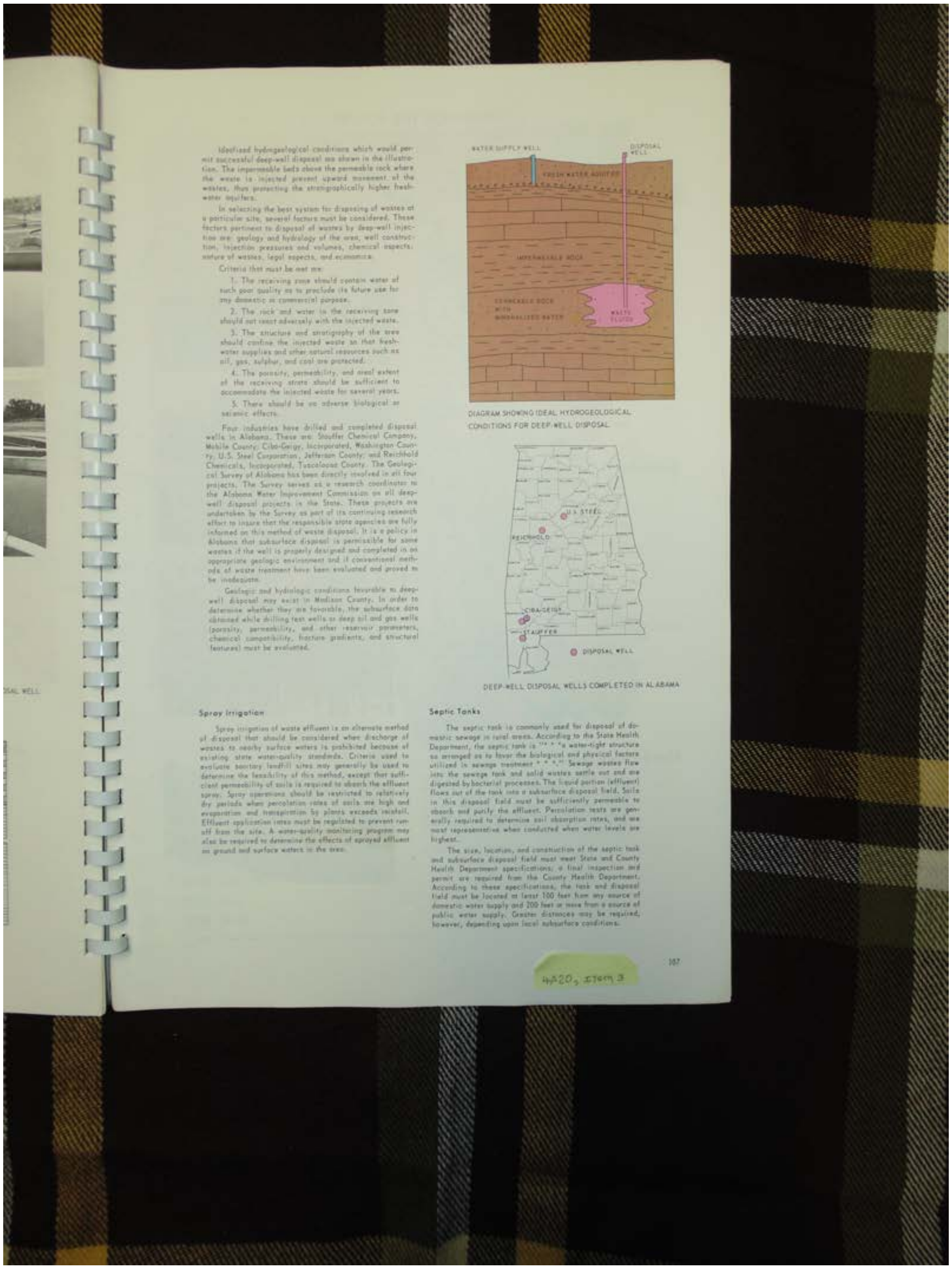
As the wastes are injected into the rock formation the water in pore spaces and the rock are compressed. Although water is relatively incompressible, reservoir volumes are so great that water's small compressibility allows significant storage space to be developed.

Names:
Liquid Waste Control

Places:
Madison Co., AL

Types:
atlas photographs chart

Dates:
1975



Idealized hydrogeological conditions which would permit successful deep-well disposal are shown in the illustration. The impermeable beds above the permeable rock where the waste is injected prevent upward movement of the wastes, thus protecting the stratigraphically higher fresh-water aquifers.

In selecting the best system for disposing of wastes at a particular site, several factors must be considered. These factors pertinent to disposal of wastes by deep-well injection are: geology and hydrology of the area, well construction, injection pressures and volumes, chemical aspects, nature of wastes, legal aspects, and economics.

Criteria that must be met are:

1. The receiving zone should contain water of such poor quality as to preclude its future use for any domestic or commercial purpose.
2. The rock and water in the receiving zone should not react adversely with the injected waste.
3. The structure and stratigraphy of the area should confine the injected waste so that fresh-water supplies and other natural resources such as oil, gas, sulphur, and coal are protected.
4. The porosity, permeability, and areal extent of the receiving strata should be sufficient to accommodate the injected waste for several years.
5. There should be no adverse biological or seismic effects.

Four industries have drilled and completed disposal wells in Alabama. These are: Stauffer Chemical Company, Mobile County; Ciba-Geigy, Incorporated, Washington County; U.S. Steel Corporation, Jefferson County; and Reichhold Chemicals, Incorporated, Tuscaloosa County. The Geological Survey of Alabama has been directly involved in all four projects. The Survey serves as a research coordinator to the Alabama Water Improvement Commission on all deep-well disposal projects in the State. These projects are undertaken by the Survey as part of its continuing research effort to insure that the responsible state agencies are fully informed on this method of waste disposal. It is a policy in Alabama that subsurface disposal is permissible for some wastes if the well is properly designed and completed in an appropriate geologic environment and if conventional methods of waste treatment have been evaluated and proved to be inadequate.

Geologic and hydrologic conditions favorable to deep-well disposal may exist in Madison County. In order to determine whether they are favorable, the subsurface data obtained while drilling test wells or deep oil and gas wells (porosity, permeability, and other reservoir parameters, chemical compatibility, fracture gradients, and structural features) must be evaluated.

DIAGRAM SHOWING IDEAL HYDROGEOLOGICAL CONDITIONS FOR DEEP-WELL DISPOSAL

DEEP-WELL DISPOSAL WELLS COMPLETED IN ALABAMA

Spray Irrigation

Spray irrigation of waste effluent is an alternate method of disposal that should be considered when discharge of wastes to nearby surface waters is prohibited because of existing state water-quality standards. Criteria used to evaluate sanitary landfill sites may generally be used to determine the feasibility of this method, except that sufficient permeability of soils is required to absorb the effluent spray. Spray operations should be restricted to relatively dry periods when percolation rates of soils are high and evaporation and transpiration by plants exceeds rainfall. Effluent application rates must be regulated to prevent runoff from the site. A water-quality monitoring program may also be required to determine the effects of sprayed effluent on ground and surface waters in the area.

Septic Tanks

The septic tank is commonly used for disposal of domestic sewage in rural areas. According to the State Health Department, the septic tank is "* * *a water-tight structure so arranged as to favor the biological and physical factors utilized in sewage treatment * * *." Sewage wastes flow into the sewage tank and solid wastes settle out and are digested by bacterial processes. The liquid portion (effluent) flows out of the tank into a subsurface disposal field. Soils in this disposal field must be sufficiently permeable to absorb and purify the effluent. Percolation tests are generally required to determine soil absorption rates, and are most representative when conducted when water levels are highest.

The size, location, and construction of the septic tank and subsurface disposal field must meet State and County Health Department specifications; a final inspection and permit are required from the County Health Department. According to these specifications, the tank and disposal field must be located at least 100 feet from any source of domestic water supply and 200 feet or more from a source of public water supply. Greater distances may be required, however, depending upon local subsurface conditions.

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Names:
Liquid Waste Control

Places:
Madison Co., AL

Types:
atlas diagrams

Dates:
1975

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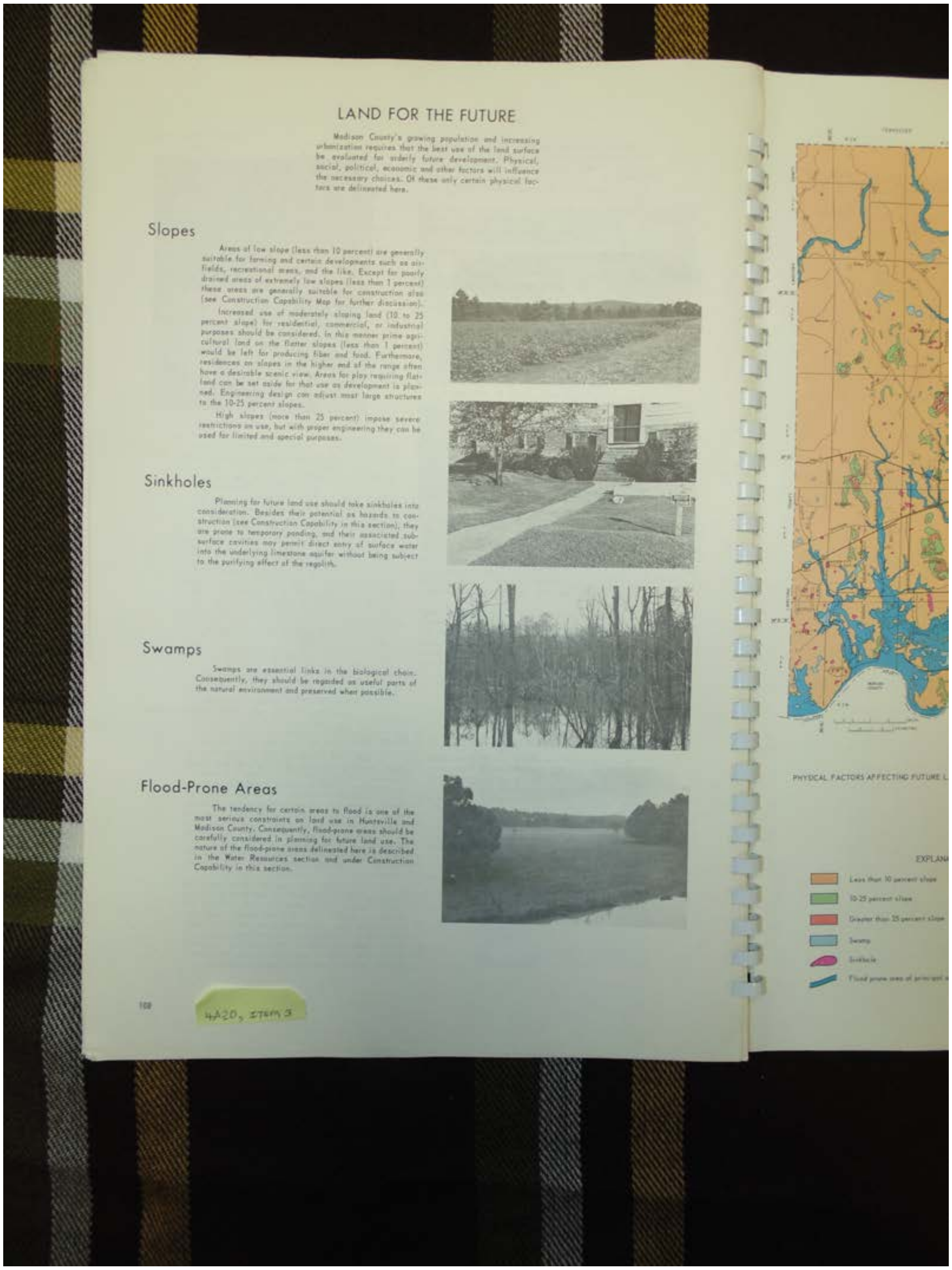
Environmental Geology and Hydrology, 1975
Image 111 r04a20-00-003-5174 Contents Index About



LAND FOR THE FUTURE

Madison County's growing population and increasing urbanization requires that the best use of the land surface be evaluated for orderly future development. Physical, social, political, economic and other factors will influence the necessary choices. Of these only certain physical factors are delineated here.

Slopes

Areas of low slope (less than 10 percent) are generally suitable for farming and certain developments such as airfields, recreational areas, and the like. Except for poorly drained areas of extremely low slopes (less than 1 percent) these areas are generally suitable for construction also (see Construction Capability Map for further discussion).

Increased use of moderately sloping land (10 to 25 percent slope) for residential, commercial, or industrial purposes should be considered. In this manner prime agricultural land on the flatter slopes (less than 1 percent) would be left for producing fiber and food. Furthermore, residences on slopes in the higher end of the range often have a desirable scenic view. Areas for play requiring flat-land can be set aside for that use as development is planned. Engineering design can adjust most large structures to the 10-25 percent slopes.

High slopes (more than 25 percent) impose severe restrictions on use, but with proper engineering they can be used for limited and special purposes.

Sinkholes

Planning for future land use should take sinkholes into consideration. Besides their potential as hazards to construction (see Construction Capability in this section), they are prone to temporary ponding, and their associated subsurface cavities may permit direct entry of surface water into the underlying limestone aquifer without being subject to the purifying effect of the regolith.

Swamps

Swamps are essential links in the biological chain. Consequently, they should be regarded as useful parts of the natural environment and preserved when possible.

Flood-Prone Areas

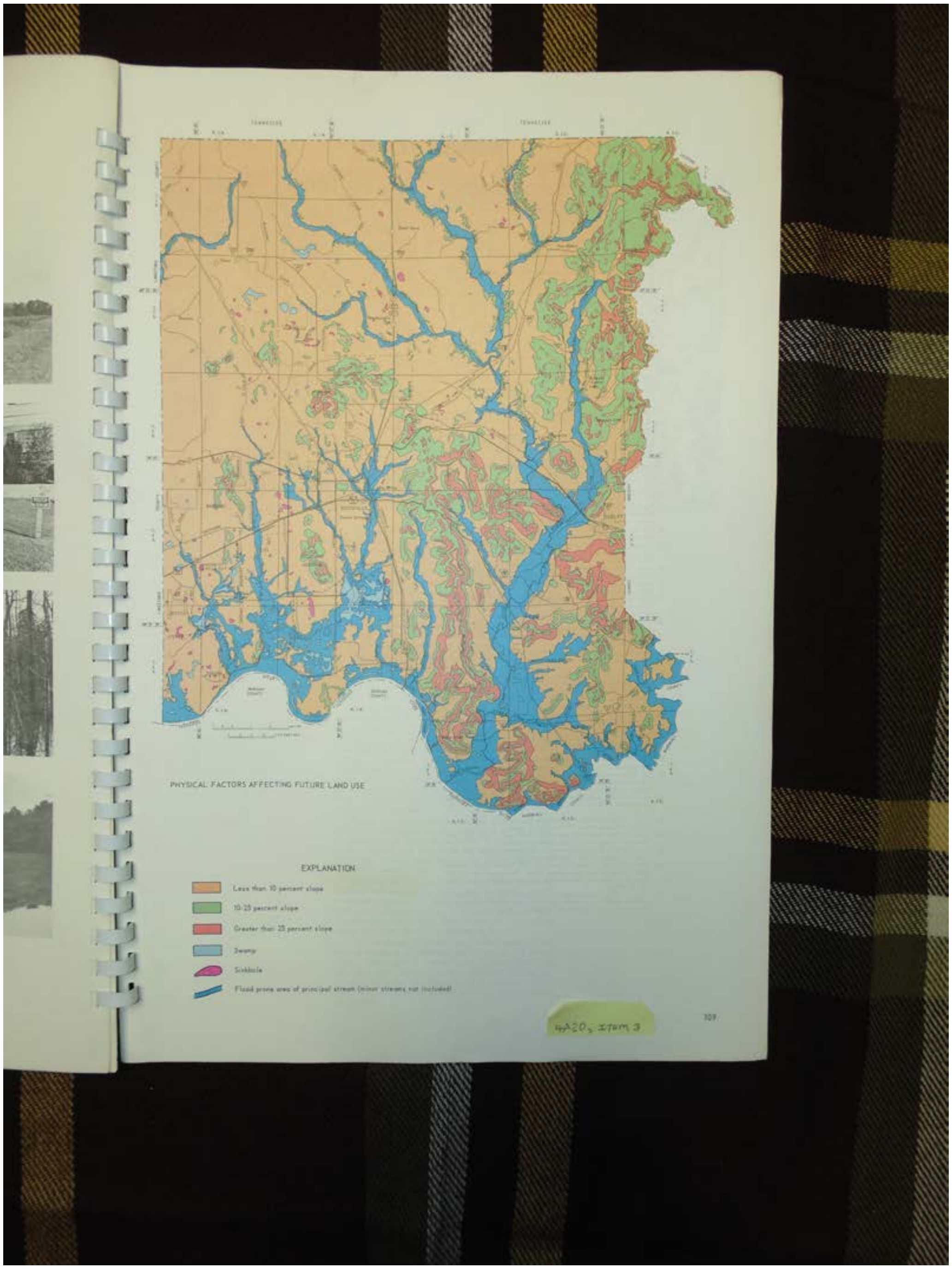
The tendency for certain areas to flood is one of the most serious constraints on land use in Huntsville and Madison County. Consequently, flood-prone areas should be carefully considered in planning for future land use. The nature of the flood-prone areas delineated here is described in the Water Resources section and under Construction Capability in this section.

Names:
Land For the Future

Places:
Madison Co., AL

Types:
atlas photographs

Dates:
1975



Names:
Physical Factors Affecting Future Land Use

Places:
Madison Co., AL

Types:
map

Dates:
1975

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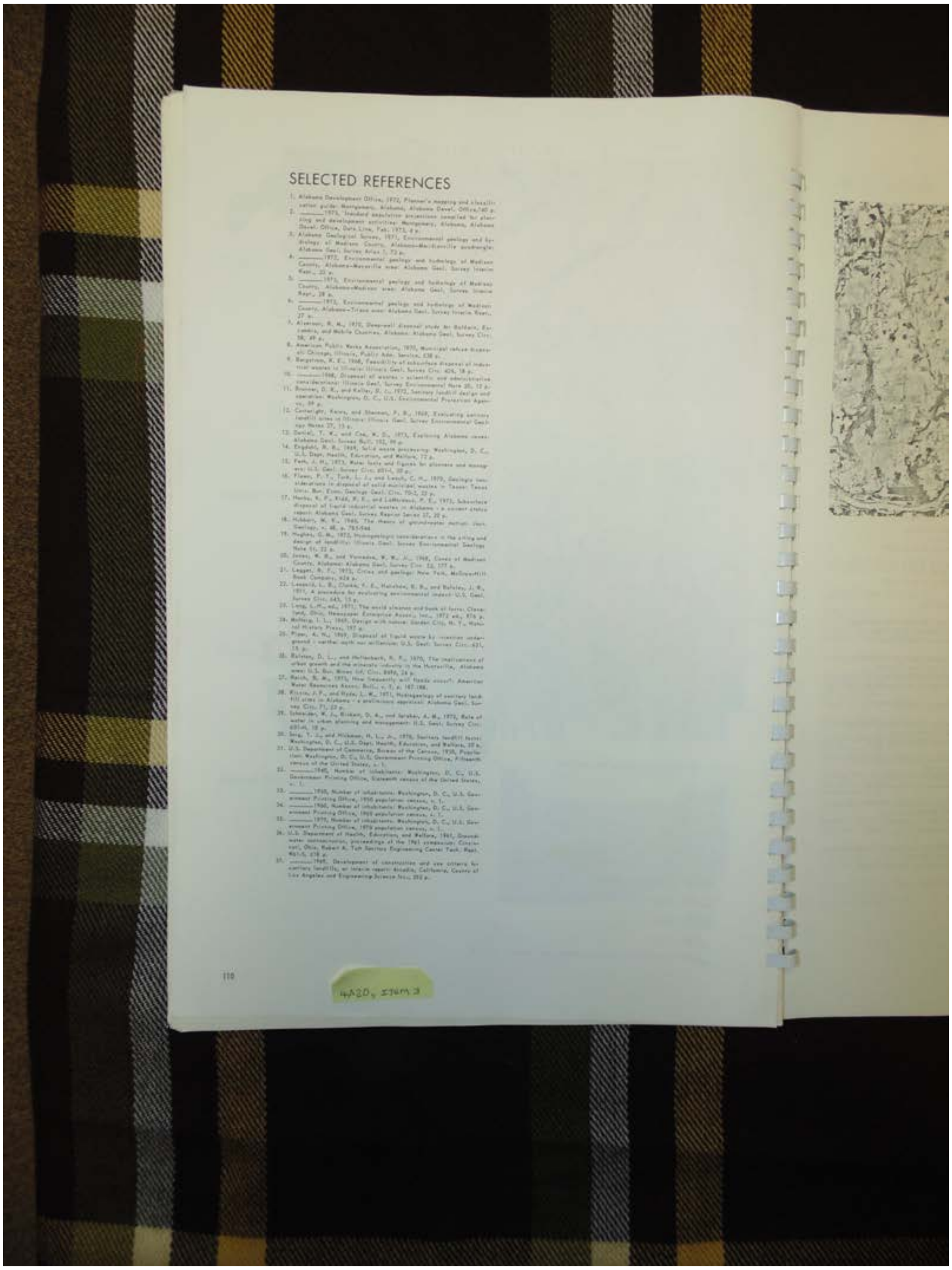

Names:
References

Places:
Madison Co., AL

Types:
atlas
list

Dates:
1975

OVERVIEW

The natural resources and physical setting of Huntsville and Madison County afford many advantages and impose few constraints on land use.

Mineral and energy resources can be extracted compatibly with the general good of all residents and can enhance the area's economy. Limestone, shale and clay, road metal, and water are important proven resources. The potential for oil and gas in the deeper rocks is promising.

The scenery of the county makes it attractive for urban, suburban and rural living. Activities that could detract from the visual beauty can be conducted in areas away from housing developments and recreation sites.

Water and woodland recreational facilities characterize the area. Paved roads throughout the county foster travel and commerce. Air and water transportation facilities complement the railroad and highway network to provide an efficient air-land-water transportation system.

Surface- and ground-water resources are plentiful and can be used most efficiently through proper management at the city and county level and at individual dwellings. The availability of ample ground-water resources makes suburban and rural living feasible and attractive. Water in a widespread limestone aquifer usually can be tapped for domestic supplies, as can the water contained in the overburden above. The recharge area to the aquifer is essentially the entire overlying land surface; accordingly, design of the water-waste system should be such that the water supply will not be contaminated.

Fertile soil occurring throughout the county is a valuable resource requiring careful conservation for the benefit of generations to follow. Construction of industries, commercial centers, and homes can be concentrated on the moderately sloping areas leaving the gentler slopes for agricultural development.

Effective land use also should take into account the land's natural constraints. Areas prone to flooding, having inadequate drainage, or underlain by caves or solution cavities are often not suitable for construction, but geologic investigations can identify the problems and engineering design can often adjust the structures to the site.

The Tennessee Valley is a prosperous, beautiful land that is becoming an important growth area in the United States. The people of Huntsville and Madison County are helping to chart a path of orderly, thoughtful development by considering the characteristics of the natural environment. Their vision of the future is guided by an appreciation of the earth.

Names:
Overview of Natural Resources

Places:
Madison Co., AL

Types:
atlas

Dates:
1975

FURTHER INFORMATION

WHERE TO GO FOR MORE INFORMATION

ENVIRONMENTAL PLANNING AND PROTECTION:

Geological Survey of Alabama (Tuscaloosa)
P. O. Drawer O
University, Alabama 35486

-or-

North Alabama Region Office
The University of Alabama in Huntsville
P. O. Box 1247
Huntsville, Alabama 35807

Alabama Conservancy
c/o Dr. Dan Hale
Apt. 4-D
1000 Airport Road
Huntsville, Alabama 35802

Center for Environmental Studies
The University of Alabama in Huntsville
P. O. Box 1247
Huntsville, Alabama 35807

North Alabama Conservation League
P. O. Box 1121
Huntsville, Alabama 35807

Alabama Department of Conservation
State Office Building
Montgomery, Alabama 36104

Alabama Environmental Quality Council
Box 11000
Montgomery, Alabama 36111

Alabama Conservancy (State Headquarters)
1816-E 28th Avenue
Birmingham, Alabama 35209

U.S. Environmental Protection Agency
Region IV
1421 Peachtree Street, N.E.
Atlanta, Georgia 30309

INDUSTRIAL DEVELOPMENT:

Huntsville Industrial Expansion Committee
305 Church Street, S.W.
Huntsville, Alabama 35804

Huntsville Chamber of Commerce
305 Church Street, S.W.
Huntsville, Alabama 35804

North Alabama Industrial Development Association
P. O. Box 1668
Decatur, Alabama 35601

Alabama Development Office
Industrial Development Division
Office of State Planning
Montgomery, Alabama 36104

LAND USE PLANNING:

City of Huntsville
Huntsville Planning Commission
Municipal Building
Huntsville, Alabama 35804

Top of Alabama Regional Council of Governments
Central Bank Building
Suite 350
Huntsville, Alabama 35801

Alabama Development Office
Office of State Planning
State Planning Division
Montgomery, Alabama 36104

Appalachian Regional Commission
1666 Connecticut Avenue
Washington, D. C. 20235

MINERAL AND ENERGY RESOURCES:

Geological Survey of Alabama (Tuscaloosa)
P. O. Drawer O
University, Alabama 35486

-or-

North Alabama Region Office
The University of Alabama in Huntsville
P. O. Box 1247
Huntsville, Alabama 35807

State Oil and Gas Board (Tuscaloosa)
P. O. Drawer O
University, Alabama 35486

U.S. Bureau of Mines (Tuscaloosa)
P. O. Box L
University, Alabama 35486

Tennessee Valley Authority
Room 329 Evans Building
524 Union Avenue
Knoxville, Tennessee 37902

WATER RESOURCES:

Geological Survey of Alabama (Tuscaloosa)
P. O. Drawer O
University, Alabama 35486

-or-

North Alabama Region Office
The University of Alabama in Huntsville
P. O. Box 1247
Huntsville, Alabama 35807

U.S. Geological Survey (Tuscaloosa)
P. O. Box V
University, Alabama 35486

-or-

Field Office
The University of Alabama in Huntsville
P. O. Box 1247
Huntsville, Alabama 35807

PUBLIC WORKS AND UTILITIES:

City of Huntsville
Public Works and Utilities
Municipal Building
Huntsville, Alabama 35804

Huntsville Utilities
P. O. Box 168
Huntsville, Alabama 35804

Madison County Engineering Department
814 Cook Avenue, N.W.
Huntsville, Alabama 35810

Madison County Water Systems
(See Map of Water Systems, p. 81)

SOILS:

U.S. Department of Agriculture
Soil Conservation Service
Madison County Courthouse
P. O. Box 859
Huntsville, Alabama 35804

-or-

Federal Building
Drawer L
Decatur, Alabama 35601

-or-

P. O. Box 311
Auburn, Alabama 36830

WILDLIFE:

Wheeler National Wildlife Refuge
U.S. Fish and Wildlife Service
Decatur, Alabama 35601

Alabama Department of Wildlife
Fish and Game Division
State Office Building
Montgomery, Alabama 36104

PUBLIC HEALTH:

Madison County Health Department
304 Eustis Avenue, S.E.
Huntsville, Alabama 35804

Alabama Health Systems Agency
Suite 880
Central Bank Building
Huntsville, Alabama 35801

Top of Alabama Health Planning Agency
606 Courthouse Annex
228 Holmes Avenue
Huntsville, Alabama 35801

Alabama Department of Public Health
State Office Building
Montgomery, Alabama 36104

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PUBLICATIO

CLIMATE:

National Weather Servic
Huntsville-Madison Cou
Huntsville, Alabama 358

GEOLOGIC MAPS AND
HYDROLOGIC MAPS
AND REPORTS:

Geological Survey of Ala
P. O. Drawer O
University, Alabama 354

U.S. Geological Survey (
P. O. Box V
University, Alabama 354

Tennessee Valley Autho
409 Evans Building
524 Union Avenue
Knoxville, Tennessee 3

U.S. Geological Survey
Branch of Distribution
1200 South Eads Street
Arlington, Virginia 2220

Superintendent of Docum
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Washington, D. C. 20250

WHERE TO C

BUILDING CONSTRUCT

City of Huntsville
Huntsville Planning Com
Municipal Building
Huntsville, Alabama 358

DISPOSAL WELLS:

Alabama Water Improveme
State Office Building
501 Dexter Avenue
Montgomery, Alabama 361

EFFLUENTS INTO WATE

Madison County Health D
304 Eustis Avenue, S.E.
Huntsville, Alabama 358

Alabama Water Improvem
State Office Building
501 Dexter Avenue
Montgomery, Alabama 361

EMISSION OF MATERIAL
INTO AIR:

Huntsville Air Pollution C
P. O. Box 308
Huntsville, Alabama 358

Alabama Air Pollution Co
645 South McDonough
Montgomery, Alabama 361

Names:
Further Information

Places:
Madison Co., AL

Types:
atlas list

Dates:
1975

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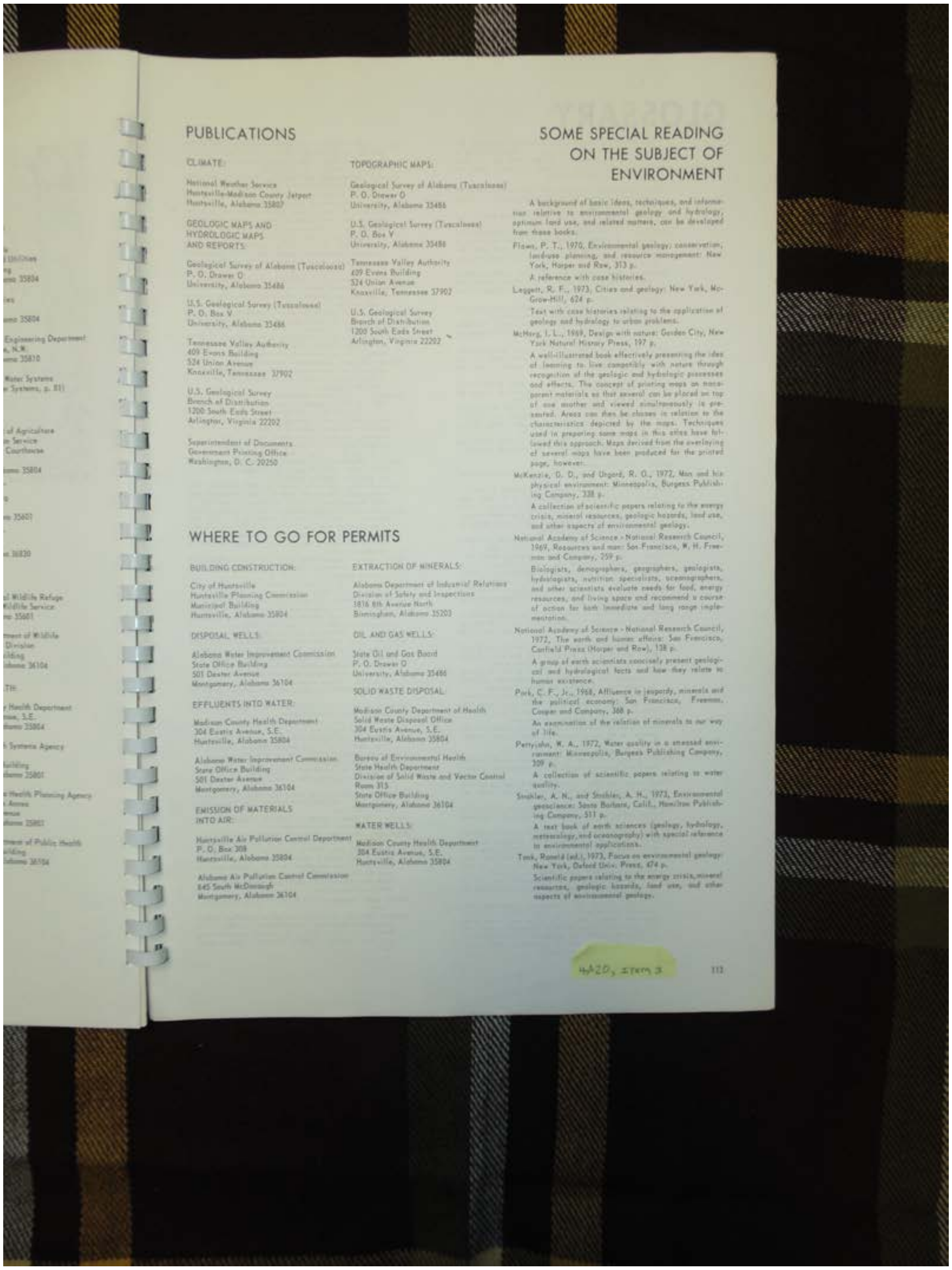
Environmental Geology and Hydrology, 1975
Image 116 r04a20-00-003-5179 Contents Index About



PUBLICATIONS

CLIMATE:

National Weather Service
Huntsville-Madison County Jetport
Huntsville, Alabama 35807

GEOLOGIC MAPS AND HYDROLOGIC MAPS AND REPORTS:

Geological Survey of Alabama (Tuscaloosa)
P. O. Drawer O
University, Alabama 35486

U.S. Geological Survey (Tuscaloosa)
P. O. Box V
University, Alabama 35486

Tennessee Valley Authority
409 Evans Building
524 Union Avenue
Knoxville, Tennessee 37902

U.S. Geological Survey
Branch of Distribution
1200 South Eads Street
Arlington, Virginia 22202

Superintendent of Documents
Government Printing Office
Washington, D. C. 20250

TOPOGRAPHIC MAPS:

Geological Survey of Alabama (Tuscaloosa)
P. O. Drawer O
University, Alabama 35486

U.S. Geological Survey (Tuscaloosa)
P. O. Box V
University, Alabama 35486

Tennessee Valley Authority
409 Evans Building
524 Union Avenue
Knoxville, Tennessee 37902

U.S. Geological Survey
Branch of Distribution
1200 South Eads Street
Arlington, Virginia 22202

WHERE TO GO FOR PERMITS

BUILDING CONSTRUCTION:

City of Huntsville
Huntsville Planning Commission
Municipal Building
Huntsville, Alabama 35804

DISPOSAL WELLS:

Alabama Water Improvement Commission
State Office Building
501 Dexter Avenue
Montgomery, Alabama 36104

EFFLUENTS INTO WATER:

Madison County Health Department
304 Eustis Avenue, S.E.
Huntsville, Alabama 35804

Alabama Water Improvement Commission
State Office Building
501 Dexter Avenue
Montgomery, Alabama 36104

EMISSION OF MATERIALS INTO AIR:

Huntsville Air Pollution Control Department
P. O. Box 308
Huntsville, Alabama 35804

Alabama Air Pollution Control Commission
645 South McDonough
Montgomery, Alabama 36104

EXTRACTION OF MINERALS:

Alabama Department of Industrial Relations
Division of Safety and Inspections
1816 8th Avenue North
Birmingham, Alabama 35203

OIL AND GAS WELLS:

State Oil and Gas Board
P. O. Drawer O
University, Alabama 35486

SOLID WASTE DISPOSAL:

Madison County Department of Health
Solid Waste Disposal Office
304 Eustis Avenue, S.E.
Huntsville, Alabama 35804

Bureau of Environmental Health
State Health Department
Division of Solid Waste and Vector Control
Room 315
State Office Building
Montgomery, Alabama 36104

WATER WELLS:

Madison County Health Department
304 Eustis Avenue, S.E.
Huntsville, Alabama 35804

SOME SPECIAL READING ON THE SUBJECT OF ENVIRONMENT

A background of basic ideas, techniques, and information relative to environmental geology and hydrology, optimum land use, and related matters, can be developed from these books.

Flawn, P. T., 1970, Environmental geology; conservation, land-use planning, and resource management: New York, Harper and Row, 313 p.

A reference with case histories.

Leggett, R. F., 1973, Cities and geology: New York, McGraw-Hill, 624 p.

Text with case histories relating to the application of geology and hydrology to urban problems.

McHarg, I. L., 1969, Design with nature: Garden City, New York Natural History Press, 197 p.

A well-illustrated book effectively presenting the idea of learning to live compatibly with nature through recognition of the geologic and hydrologic processes and effects. The concept of printing maps on transparent materials so that several can be placed on top of one another and viewed simultaneously is presented. Areas can then be chosen in relation to the characteristics depicted by the maps. Techniques used in preparing some maps in this atlas have followed this approach. Maps derived from the overlaying of several maps have been produced for the printed page, however.

McKenzie, D. D., and Utgard, R. O., 1972, Man and his physical environment: Minneapolis, Burgess Publishing Company, 338 p.

A collection of scientific papers relating to the energy crisis, mineral resources, geologic hazards, land use, and other aspects of environmental geology.

National Academy of Science - National Research Council, 1969, Resources and man: San Francisco, W. H. Freeman and Company, 259 p.

Biologists, demographers, geographers, geologists, hydrologists, nutrition specialists, oceanographers, and other scientists evaluate needs for food, energy resources, and living space and recommend a course of action for both immediate and long range implementation.

National Academy of Science - National Research Council, 1972, The earth and human affairs: San Francisco, Canfield Press (Harper and Row), 138 p.

A group of earth scientists concisely present geological and hydrological facts and how they relate to human existence.

Park, C. F., Jr., 1968, Affluence in jeopardy, minerals and the political economy: San Francisco, Freeman, Cooper and Company, 368 p.

An examination of the relation of minerals to our way of life.

Pettyjohn, W. A., 1972, Water quality in a stressed environment: Minneapolis, Burgess Publishing Company, 309 p.

A collection of scientific papers relating to water quality.

Strahler, A. N., and Strahler, A. H., 1973, Environmental geoscience: Santa Barbara, Calif., Hamilton Publishing Company, 511 p.

A text book of earth sciences (geology, hydrology, meteorology, and oceanography) with special reference to environmental applications.

Tank, Ronald (ed.), 1973, Focus on environmental geology: New York, Oxford Univ. Press, 474 p.

Scientific papers relating to the energy crisis, mineral resources, geologic hazards, land use, and other aspects of environmental geology.

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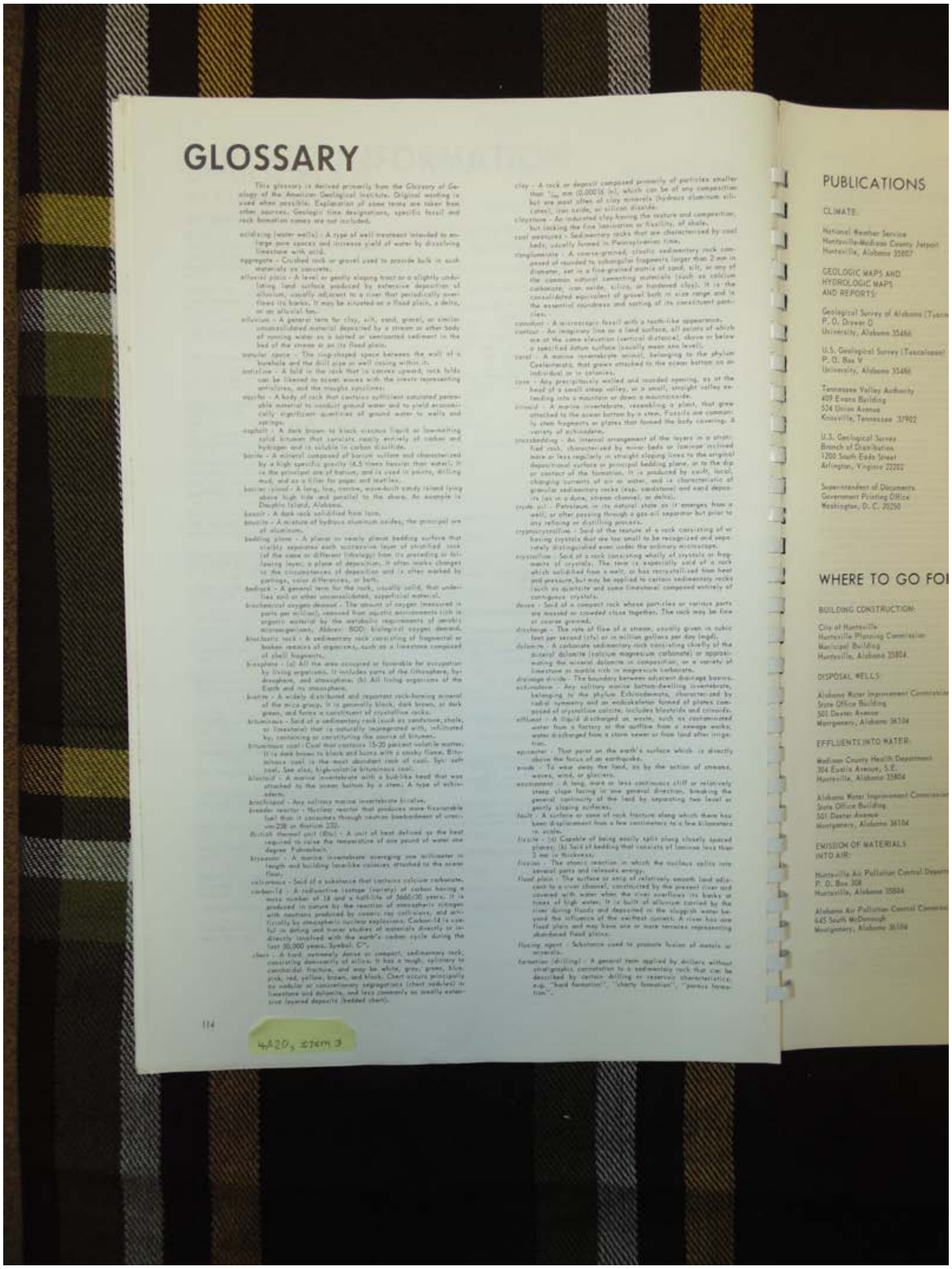
Names:
Environmental Reading
Permits
Publications

Places:
Madison Co., AL

Types:
atlas
list

Dates:
1975



GLOSSARY

This glossary is derived primarily from the Glossary of Geology of the American Geological Institute. Original wording is used when possible. Explanation of some terms are taken from other sources. Geologic time designations, specific fossil and rock formation names are not included.

acidizing (water wells) - A type of well treatment intended to enlarge pore spaces and increase yield of water by dissolving limestone with acid.

aggregate - Crushed rock or gravel used to provide bulk in such materials as concrete.

alluvial plain - A level or gently sloping tract or a slightly undulating land surface produced by extensive deposition of alluvium, usually adjacent to a river that periodically overflows its banks. It may be situated on a flood plain, a delta, or an alluvial fan.

alluvium - A general term for clay, silt, sand, gravel, or similar unconsolidated material deposited by a stream or other body of running water as a sorted or semisorted sediment in the bed of the stream or on its flood plain.

annular space - The ring-shaped space between the wall of a borehole and the drill pipe or well casing within it.

anticline - A fold in the rock that is convex upward; rock folds can be likened to ocean waves with the crests representing anticlines, and the troughs synclines.

aquifer - A body of rock that contains sufficient saturated permeable material to conduct ground water and to yield economically significant quantities of ground water to wells and springs.

asphalt - A dark brown to black viscous liquid or low-melting solid bitumen that consists nearly entirely of carbon and hydrogen and is soluble in carbon disulfide.

barite - A mineral composed of barium sulfate and characterized by a high specific gravity (4.5 times heavier than water). It is the principal ore of barium, and is used in paints, drilling mud, and as a filler for paper and textiles.

barrier island - A long, low, narrow, wave-built sandy island lying above high tide and parallel to the shore. An example is Dauphin Island, Alabama.

basalt - A dark rock solidified from lava.

bauxite - A mixture of hydrous aluminum oxides, the principal ore of aluminum.

bedding plane - A planar or nearly planar bedding surface that visibly separates each successive layer of stratified rock (of the same or different lithology) from its preceding or following layer; a plane of deposition. It often marks changes in the circumstances of deposition and is often marked by partings, color differences, or both.

bedrock - A general term for the rock, usually solid, that underlies soil or other unconsolidated, superficial material.

biochemical oxygen demand - The amount of oxygen (measured in parts per million), removed from aquatic environments rich in organic material by the metabolic requirements of aerobic microorganisms. Abbrev: BOD; biological oxygen demand.

bioclastic rock - A sedimentary rock consisting of fragmental or broken remains of organisms, such as a limestone composed of shell fragments.

biosphere - (a) All the area occupied or favorable for occupation by living organisms. It includes parts of the lithosphere, hydrosphere, and atmosphere. (b) All living organisms of the Earth and its atmosphere.

biotite - A widely distributed and important rock-forming mineral of the mica group. It is generally black, dark brown, or dark green, and forms a constituent of crystalline rocks.

bituminous - Said of a sedimentary rock (such as sandstone, shale, or limestone) that is naturally impregnated with, infiltrated by, containing or constituting the source of bitumen.

bituminous coal - Coal that contains 15-20 percent volatile matter. It is dark brown to black and burns with a smoky flame. Bituminous coal is the most abundant rank of coal. Syn: soft coal. See also, high-volatile bituminous coal.

blastoid - A marine invertebrate with a bud-like head that was attached to the ocean bottom by a stem. A type of echinoderm.

brachiopod - Any solitary marine invertebrate bivalve.

breeder reactor - Nuclear reactor that produces more fissionable fuel than it consumes through neutron bombardment of uranium-238 or thorium 232.

British thermal unit (Btu) - A unit of heat defined as the heat required to raise the temperature of one pound of water one degree Fahrenheit.

bryozoan - A marine invertebrate averaging one millimeter in length and building lacelike colonies attached to the ocean floor.

calcareous - Said of a substance that contains calcium carbonate.

carbon-14 - A radioactive isotope (variety) of carbon having a mass number of 14 and a half-life of 5660±30 years. It is produced in nature by the reaction of atmospheric nitrogen with neutrons produced by cosmic ray collisions, and artificially by atmospheric nuclear explosions. Carbon-14 is useful in dating and tracer studies of materials directly or indirectly involved with the earth's carbon cycle during the last 50,000 years. Symbol: C^{14}.

chert - A hard, extremely dense or compact, sedimentary rock, consisting dominantly of silica. It has a tough, splintery to conchoidal fracture, and may be white, gray, green, blue, pink, red, yellow, brown, and black. Chert occurs principally as nodular or concretionary segregations (chert nodules) in limestone and dolomite, and less commonly as areally extensive layered deposits (bedded chert).

clay - A rock or deposit composed primarily of particles smaller than [illegible] mm (0.00016 in), which can be of any composition but are most often of clay minerals (hydrous aluminum silicates), iron oxide, or silicon dioxide.

claystone - An indurated clay having the texture and composition, but lacking the fine lamination or fissility, of shale.

coal measures - Sedimentary rocks that are characterized by coal beds, usually formed in Pennsylvanian time.

conglomerate - A coarse-grained, clastic sedimentary rock composed of rounded to subangular fragments larger than 2 mm in diameter, set in a fine-grained matrix of sand, silt, or any of the common natural cementing materials (such as calcium carbonate, iron oxide, silica, or hardened clay). It is the consolidated equivalent of gravel both in size range and in the essential roundness and sorting of its constituent particles.

conodont - A microscopic fossil with a tooth-like appearance.

contour - An imaginary line on a land surface, all points of which are at the same elevation (vertical distance), above or below a specified datum surface (usually mean sea level).

coral - A marine invertebrate animal, belonging to the phylum Coelenterata, that grows attached to the ocean bottom as an individual or in colonies.

cove - Any precipitously walled and rounded opening, as at the head of a small steep valley, or a small, straight valley extending into a mountain or down a mountainside.

crinoid - A marine invertebrate, resembling a plant, that grew attached to the ocean bottom by a stem. Fossils are commonly stem fragments or plates that formed the body covering. A variety of echinoderm.

crossbedding - An internal arrangement of the layers in a stratified rock, characterized by minor beds or laminae inclined more or less regularly in straight sloping lines to the original depositional surface or principal bedding plane, or to the dip or contact of the formation. It is produced by swift, local, changing currents of air or water, and is characteristic of granular sedimentary rocks (esp. sandstone) and sand deposits (as in a dune, stream channel, or delta).

crude oil - Petroleum in its natural state as it emerges from a well, or after passing through a gas-oil separator but prior to any refining or distilling process.

cryptocrystalline - Said of the texture of a rock consisting of or having crystals that are too small to be recognized and separately distinguished even under the ordinary microscope.

crystalline - Said of a rock consisting wholly of crystals or fragments of crystals. The term is especially said of a rock which solidified from a melt, or has recrystallized from heat and pressure, but may be applied to certain sedimentary rocks (such as quartzite and some limestone) composed entirely of contiguous crystals.

dense - Said of a compact rock whose particles or various parts are massed or crowded close together. The rock may be fine or coarse grained.

discharge - The rate of flow of a stream, usually given in cubic feet per second (cfs) or in million gallons per day (mgd).

dolomite - A carbonate sedimentary rock consisting chiefly of the mineral dolomite (calcium magnesium carbonate) or approximating the mineral dolomite in composition, or a variety of limestone or marble rich in magnesium carbonate.

drainage divide - The boundary between adjacent drainage basins.

echinoderm - Any solitary marine bottom-dwelling invertebrate, belonging to the phylum Echinodermata, characterized by radial symmetry and an endoskeleton formed of plates composed of crystalline calcite. Includes blastoids and crinoids.

effluent - A liquid discharged as waste, such as contaminated water from a factory or the outflow from a sewage works; water discharged from a storm sewer or from land after irrigation.

epicenter - That point on the earth's surface which is directly above the focus of an earthquake.

erode - To wear away the land, as by the action of streams, waves, wind, or glaciers.

escarpment - A long, more or less continuous cliff or relatively steep slope facing in one general direction, breaking the general continuity of the land by separating two level or gently sloping surfaces.

fault - A surface or zone of rock fracture along which there has been displacement from a few centimeters to a few kilometers in scale.

fissile - (a) Capable of being easily split along closely spaced planes. (b) Said of bedding that consists of laminae less than 2 mm in thickness.

fission - The atomic reaction in which the nucleus splits into several parts and releases energy.

flood plain - The surface or strip of relatively smooth land adjacent to a river channel, constructed by the present river and covered with water when the river overflows its banks at times of high water. It is built of alluvium carried by the river during floods and deposited in the sluggish water beyond the influence of the swiftest current. A river has one flood plain and may have one or more terraces representing abandoned flood plains.

fluxing agent - Substance used to promote fusion of metals or minerals.

formation (drilling) - A general term applied by drillers without stratigraphic connotation to a sedimentary rock that can be described by certain drilling or reservoir characteristics, e.g. "hard formation", "cherty formation", "porous formation".

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PUBLICATIONS

CLIMATE:

National Weather Service
Huntsville-Madison County Jetport
Huntsville, Alabama 35807

GEOLOGIC MAPS AND HYDROLOGIC MAPS AND REPORTS:

Geological Survey of Alabama (Tusca...
P. O. Drawer O
University, Alabama 35486

U.S. Geological Survey (Tuscaloosa)
P. O. Box V
University, Alabama 35486

Tennessee Valley Authority
409 Evans Building
524 Union Avenue
Knoxville, Tennessee 37902

U.S. Geological Survey
Branch of Distribution
1200 South Eads Street
Arlington, Virginia 22202

Superintendent of Documents
Government Printing Office
Washington, D. C. 20250

WHERE TO GO FO...

BUILDING CONSTRUCTION:

City of Huntsville
Huntsville Planning Commission
Municipal Building
Huntsville, Alabama 35804

DISPOSAL WELLS:

Alabama Water Improvement Commissio...
State Office Building
501 Dexter Avenue
Montgomery, Alabama 36104

EFFLUENTS INTO WATER:

Madison County Health Department
304 Eustis Avenue, S.E.
Huntsville, Alabama 35804

Alabama Water Improvement Commissio...
State Office Building
501 Dexter Avenue
Montgomery, Alabama 36104

EMISSION OF MATERIALS INTO AIR:

Huntsville Air Pollution Control Depar...
P. O. Box 308
Huntsville, Alabama 35804

Alabama Air Pollution Control Commis...
645 South McDonough
Montgomery, Alabama 36104

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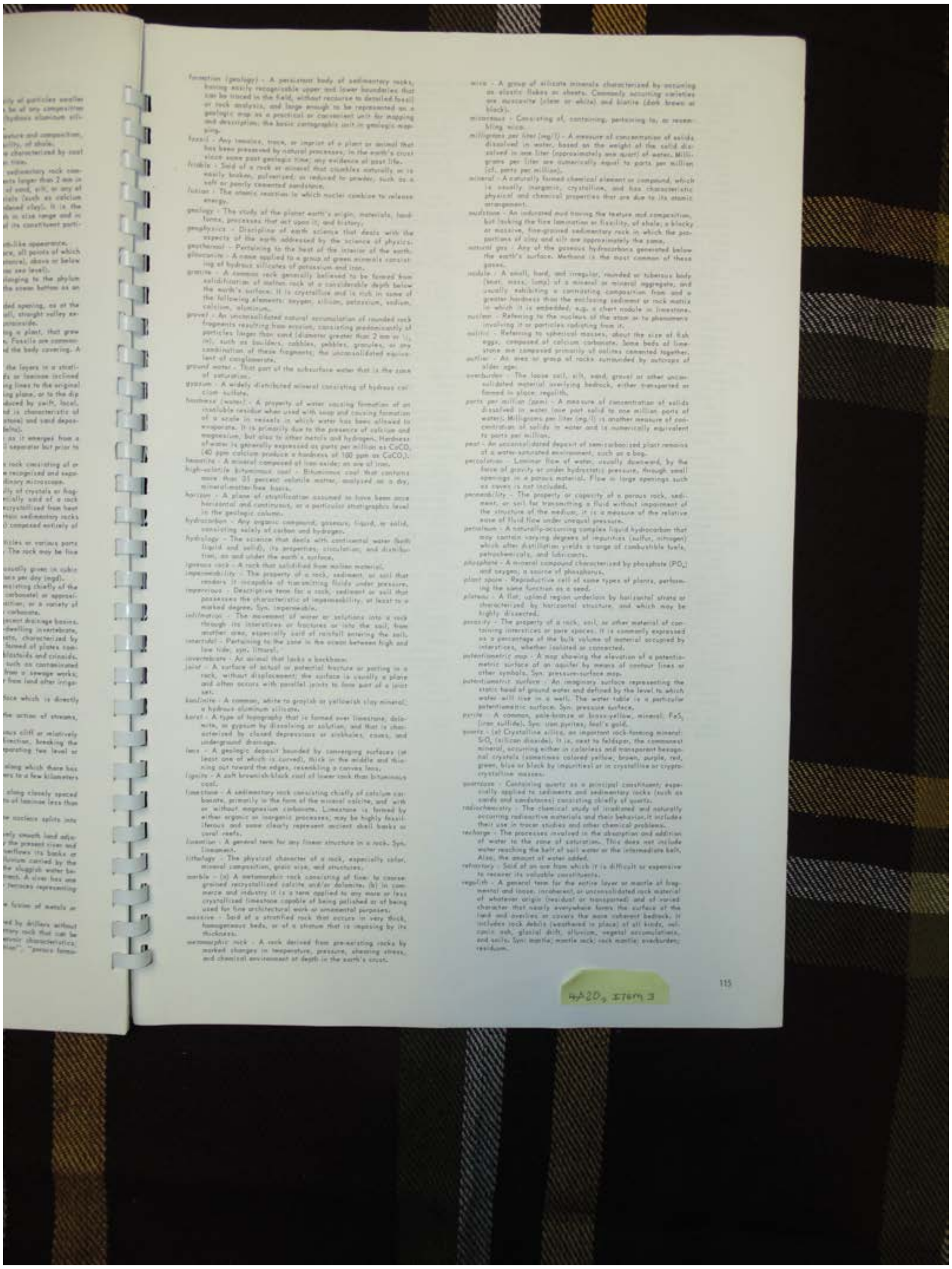

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Environmental Geology and Hydrology, 1975
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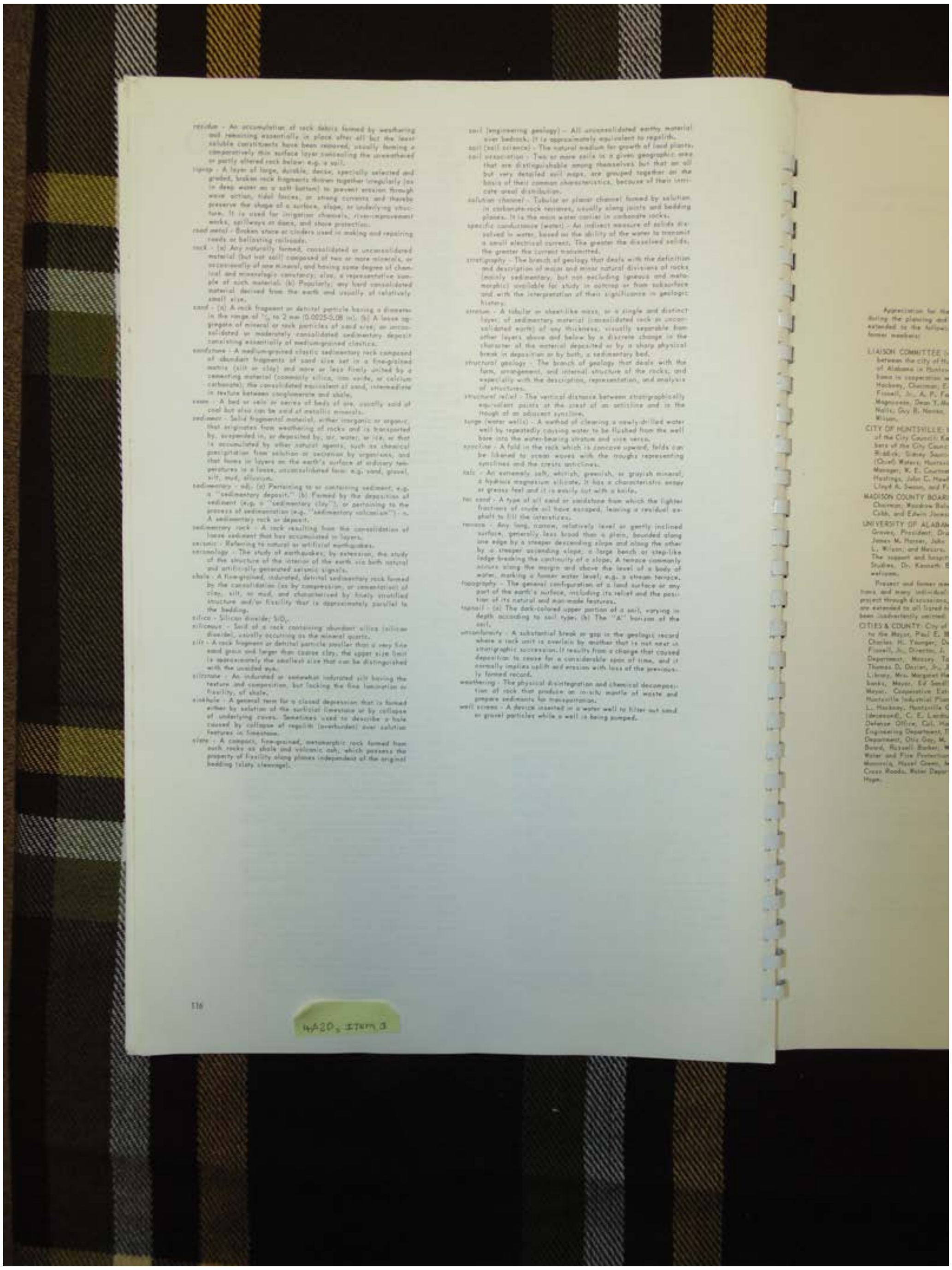

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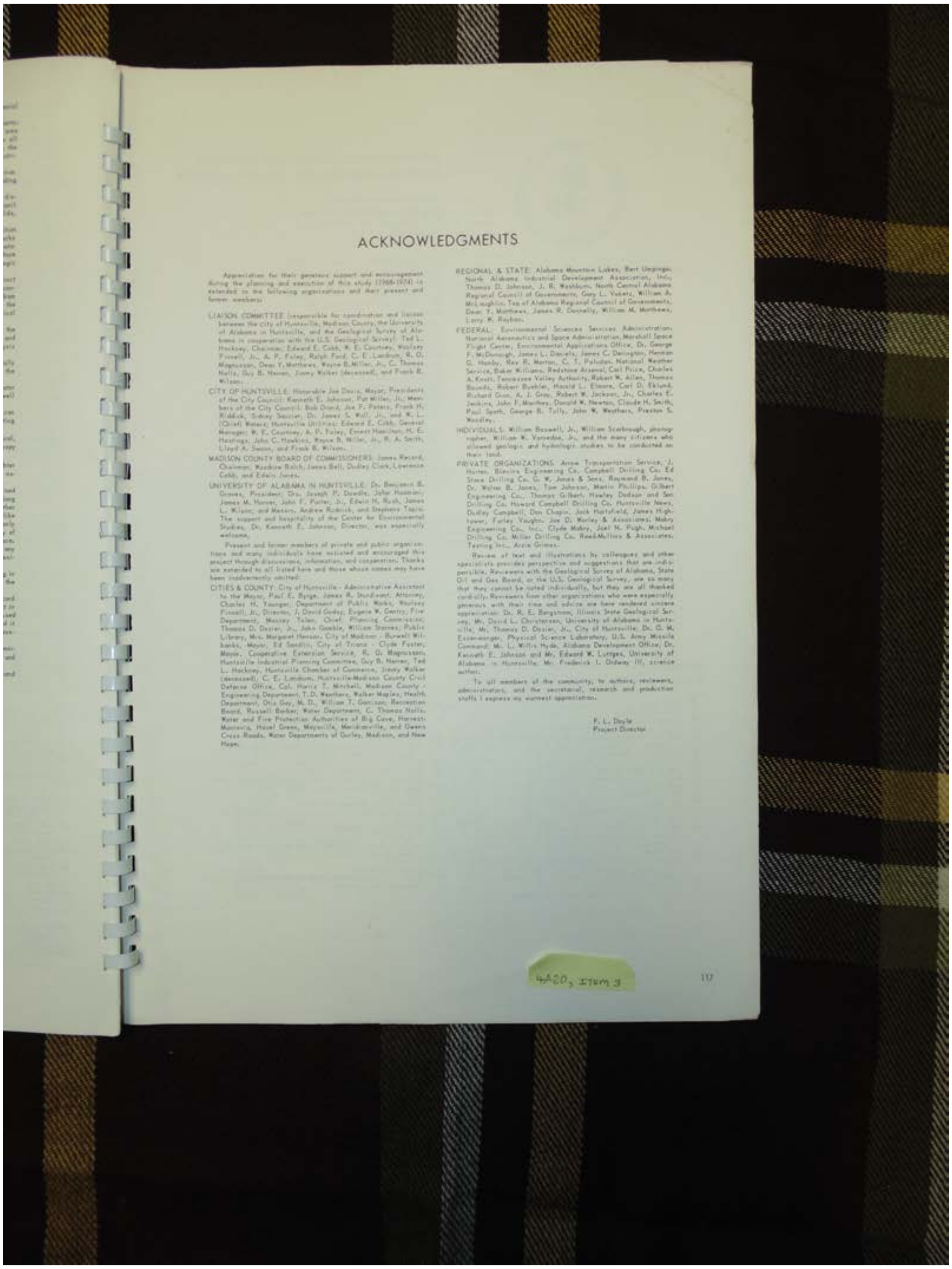

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Doyle, F. L.

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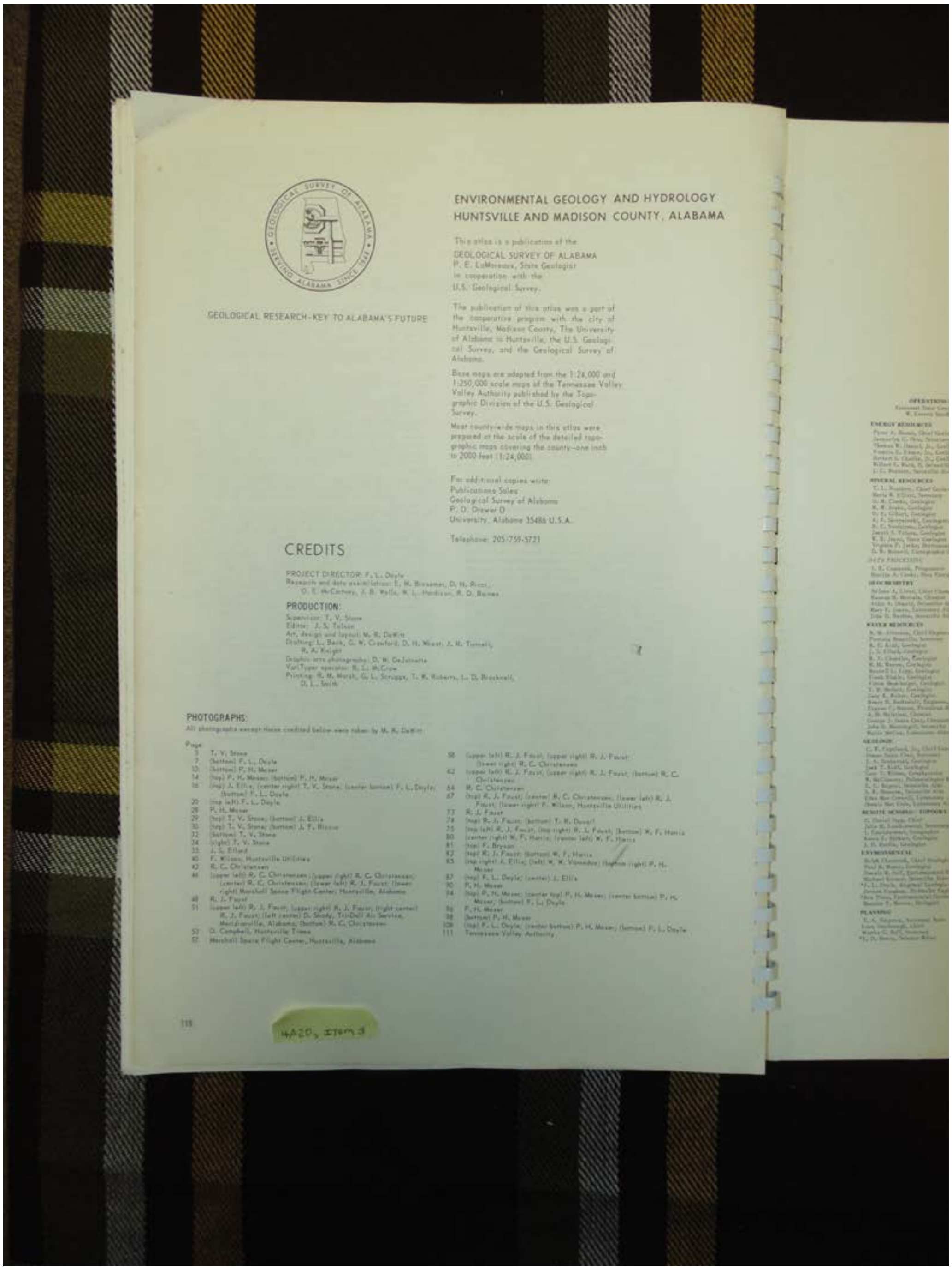

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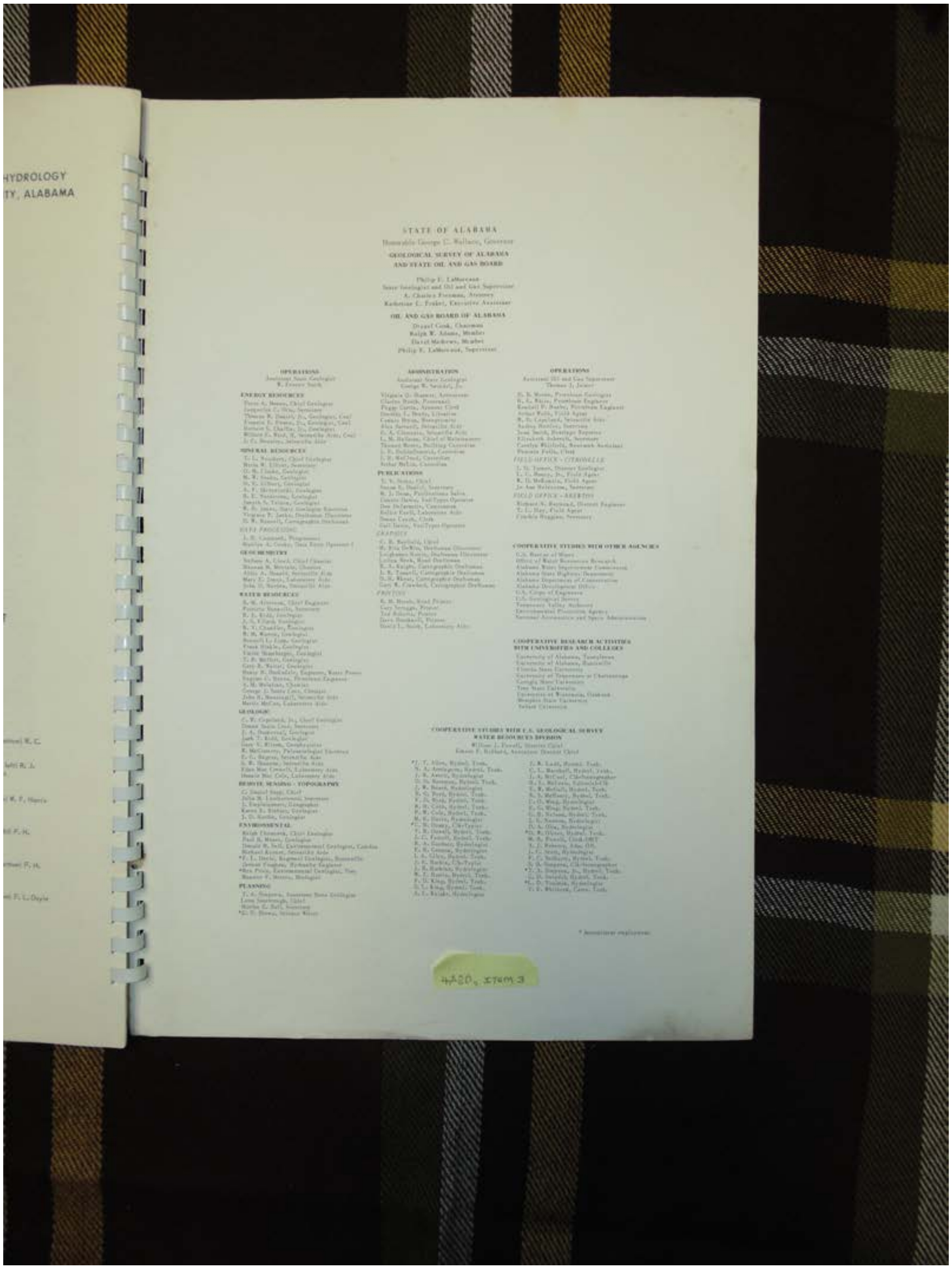

Names:
- Administration & Operations Personnel
- Cooperative Research & Studies
- Geological Survey of Alabama
- Oil & Gas Board of Alabama

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- United States

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Frances Cabaniss Roberts Collection

Preferred Citation: Frances Cabaniss Roberts Collection, Archives and Special Collections, M. Louis Salmon Library, University of Alabama in Huntsville, Huntsville, AL.

Collection Scope and Content: The Collection of 114 Linear ft. includes a total of 156 Archival Boxes. The Frances Cabaniss Roberts collection covers the historical records of the Cabaniss Roberts family. This collection contains extensive correspondence records of the Cabaniss Roberts family circa 1830 to 1930.

Archives/Special Collections Access Restrictions: None

Provenance: Gift of Johanna Shields on October 28, 2006.

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