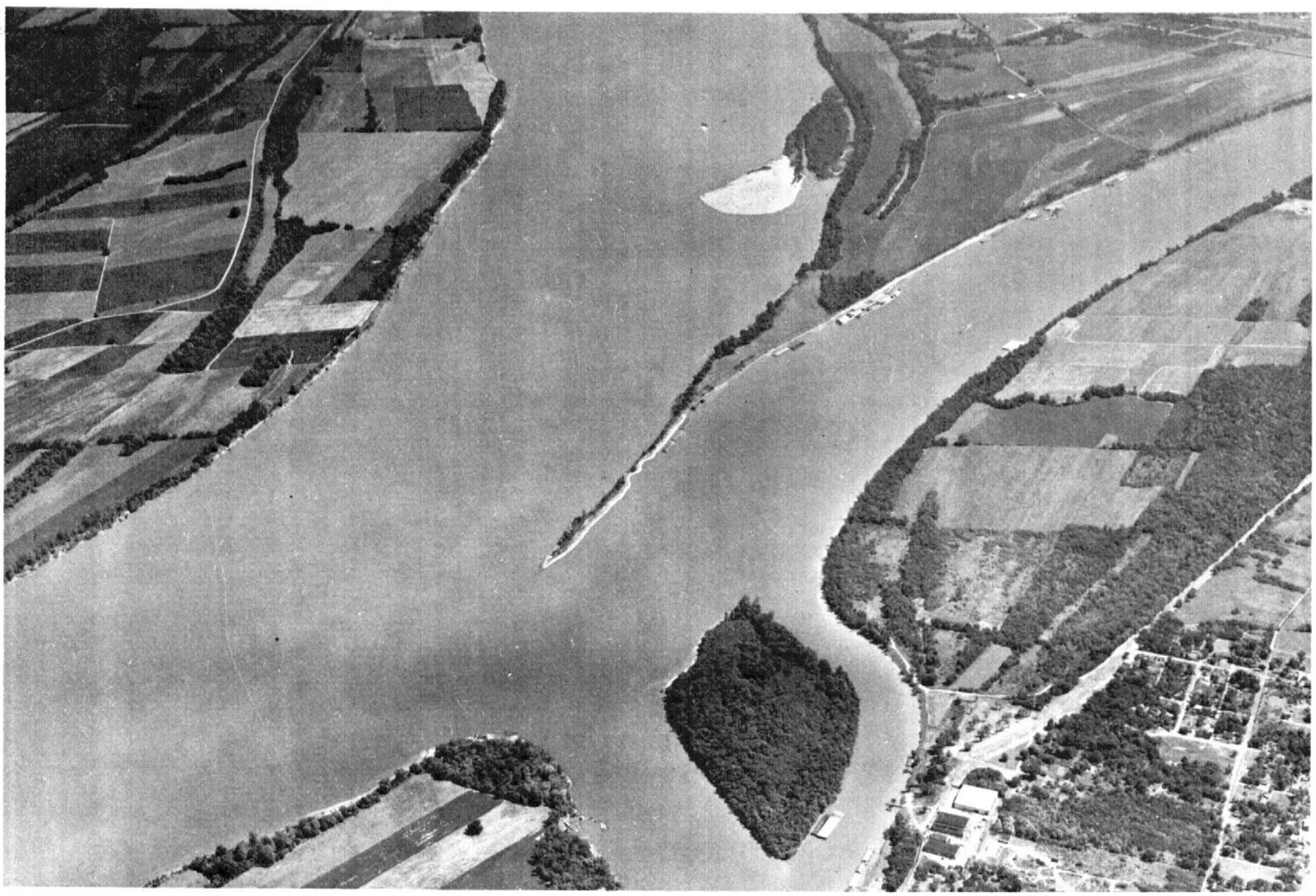
SOIL SURVEY OF

Ballard and McCracken Counties, Kentucky



United States Department of Agriculture
Soil Conservation Service
In cooperation with the
Kentucky Agricultural Experiment Station

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in the period 1967-71. Soil names and descriptions were approved in 1971. Unless otherwise indicated, statements in the publication refer to conditions in the survey area in 1971. This survey was made by the Soil Conservation Service and the Kentucky Agricultural Experiment Station. It is part of the technical assistance furnished to the Ballard County and McCracken County Soil and Water Conservation Districts.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Ballard and McCracken Counties are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability clasification, the pasture and hayland groups, and the woodland group of each. It also shows the page where each soil is described.

Individual colored maps that show the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those that have a moderate limitation can be colored yellow, and those that have a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the capability units, the pasture and hayland groups, and the woodland groups.

Foresters and others can refer to the section "Use of Soils for Woodland," where the soils of the two counties are grouped according to their suitability for trees.

Game managers and others can find information about soils and wildlife in the section "Use of Soils for Wildlife."

Community planners and others can read about soil properties that affect the choice of sites for dwellings, industrial buildings, and recreation in the section "Engineering Uses of the Soils."

Engineers and builders can find, under "Engineering Uses of the Soils," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation, Morphology, and Classification of Soils."

Newcomers in Ballard and McCracken Counties may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the counties in the section "General Nature of the Area."

Contents

Issued February 1976

Cover: Aerial view, looking east, of the confluence of the Tennessee (right) and Ohio (left) Rivers. Cuba Towhead (island) and suburbs of Paducah are in foreground. Nolin and Newark soils are dominant on Cuba Towhead and in cultivated areas. Rosebloom soils are dominant in the wooded area north of the floodwall (on the right). Henry, Okaw, and Wheeling soils are south of the floodwall. (Photograph courtesy of Billy Davis, chief photographer of *The Courier-Journal* and *Louisville Times*.)

SOIL SURVEY OF BALLARD AND McCRACKEN COUNTIES, KENTUCKY

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UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE KENTUCKY AGRICULTURAL EXPERIMENT STATION

BALLARD AND McCRACKEN COUNTIES are in the northwestern part of Kentucky (fig. 1). The Mississippi and Ohio Rivers form the western and northern boundaries of Ballard County. McCracken County is east of Ballard County. The Ohio and Tennessee Rivers form the northern boundary of McCracken County.

Ballard County has a land area of 165,760 acres, or 259 square miles, and McCracken County 160,000 acres, or 250 square miles. Wickliffe is the county seat of Ballard County. Paducah is the county seat of McCracken County and is the largest city in both counties. Although the two counties differ considerably in density of population and resources, the topography and soil associations are similar.

Ballard and McCracken are two of the eight counties that make up the Jackson Purchase physiographic region of Kentucky. It is the youngest region in Kentucky, geologically as well as historically. The northern and central parts of both counties drain into streams that flow into the Ohio River. A small area in the eastern part of McCracken County drains into the Tennessee River. The southern part of Ballard County and much of the southern part of McCracken County drain through Mayfield Creek into the Mississippi River.

The southern parts of both counties are greatly dissected by natural drainageways and have narrow ridgetops and strongly sloping to steep side slopes. They are mostly used for part-time farming. The nearly level first and second bottoms near the Ohio, Tennessee, and Mississippi Rivers are mainly used for corn and soybeans.

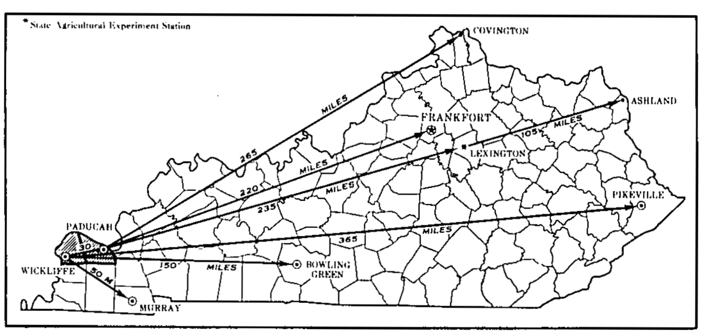

Figure 1.—**Location of Ballard and McCracken Counties in Kentucky.**

The central parts of both counties have nearly level to sloping topography. The soils of this area formed in thick loess, and the dominant soils are moderately well drained to poorly drained. This area is used mainly by full-time farmers in Ballard County for general farming and by part-time farmers in McCracken County to supplement income from industrial or other urban employment.

Near Clarks River in the eastern part of McCracken County, the nearly level soils are dominantly poorly drained or somewhat poorly drained. The northern part of this area includes the city of Paducah and is used for urban development. The southern part is used mostly for part-time farming.

The climate is a rather mild, temperate, humid, continental type. Winters are short and are characterized by short cold spells, frequent sharp changes in temperature, and high humidity. Summer is longer than winter, but hot periods are generally brief. Precipitation is usually well distributed throughout the year. Brief periods of drought occur in summer, and periods of excess moisture occur in winter and spring.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Ballard and McCracken Counties, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes; the size and speed of streams; the kinds of native plants or crops; the kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Memphis and Calloway, for example, are the names of two soil series. All the soils in the United States that have the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Some soils are similar to soils in a defined series but are outside the range of the series in at least one important characteristic. The differences in these soils are as great as is common between different series, but the extent of the soils is too small to warrant naming a new series. These soils are called variants. They are given the name of the established soil series as modified by the principal distinguishing characteristic. An example of a soil variant is Dubbs silty clay loam, clayey subsoil variant.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Grenada silt loam, 2 to 6 percent slopes, is one of several phases within the Grenada series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series or of different phases within one series. Two such kinds of mapping units are shown on the soil map of Ballard and McCracken Counties: soil complexes and undifferentiated groups.

A soil complex consists of areas of two or more soils, so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. Generally, the name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Nolin-Robinsonville silt loams is an example.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils or of two or more. If two or more dominant series are represented in the group, the name of the group ordinarily consists of the names of the dominant soils, joined by "and." Saffell and Flomaton soils, 20 to 60 percent slopes, is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, so severely eroded, or so variable that it has not been classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Gullied land is a land type in this survey area.

While a soil survey is in progress, soil scientists take soil samples needed for laboratory measurements and for engineering tests. Laboratory data from the same kind of soil in other places are also assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kind of soil. Yields under defined management are estimated for all the soils.

Soil scientists observe how soils behave when used as a growing place for native and cultivated plants and as material for structures, foundations for structures, or covering for structures. They relate this behavior to properties of the soils. For example, they observe that filter fields for onsite disposal of sewage fail on a given kind of soil, and they relate this to the slow permeability of the soil or a high water table. They see that streets, road pavements, and foundations for houses are cracked on a named kind of soil, and they relate this failure to the high shrink-swell potential of the soil material. Thus, they use observation and knowledge of soil properties, together with available research data, to predict limitations or suitability of soils for present and potential uses.

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. They then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under current methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Ballard and McCracken Counties. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association can occur in another, but in a different pattern.

A map that shows soil associations is useful to people who want a general idea of the soils in an area, who want to compare different parts of an area, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field or for selecting the exact location of a road, building, or other structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The terms for texture used in the descriptive titles of the associations apply to the texture of the surface layer of the major soils. For example, in the title of association 1, the words "medium textured and moderately fine textured" refer to the texture of the surface layer.

The soil survey area of Ballard and McCracken Counties is adjacent to the survey areas of Calloway and Marshall Counties, Kentucky, and Graves County, Kentucky. The soil survey of Calloway and Marshall Counties was published in 1974, and the survey of Graves County was published in 1953. The soil boundary lines join with the Calloway and Marshall Counties survey, but the soil association names and mapping unit names do not fully agree. This is because of a change in concept of some soil series and because the major soils of the associations in this survey are not, in every case, major soils of the adjacent associations in Calloway and Marshall Counties. The soil maps of this survey do not join those of Graves County because of a change in concept of some soil series and because of a change in slope classes. Fieldwork was completed on the Graves County Soil Survey in 1943.

The seven soil associations in Ballard and McCracken Counties are discussed in the pages that follow.

1. Nolin-Newark association

Nearly level, well drained and somewhat poorly drained, medium textured and moderately fine textured soils on flood plains

This association consists of nearly level soils that are on low ridges and in swales on the flood plains along the Ohio, Mississippi, and Tennessee Rivers. Most of the association is in the western part of Ballard County, where it is slightly more than 3 miles wide along the Ohio River. It is less than one-fifth mile wide in some areas in the northern part of Ballard and McCracken Counties. A small area of this association is next to the Mississippi River in the southwestern part of Ballard County. Soils of the association are also found along the Tennessee River in the eastern part of McCracken County, but they are in very narrow, discontinuous areas and therefore are not shown on the general soil map.

This association occupies about 12 percent of Ballard County, 4 percent of McCracken County, and 8 percent of the total survey area. The Nolin soils make up about 26 percent of the association; Newark soils, 12 percent; and minor soils, the remaining 62 percent.

The well-drained Nolin soils are on low ridges. Where they are adjacent to the river, they have a surface layer and a subsoil of brown silt loam. Where they are not adjacent to the river, they have a surface layer and a subsoil of dark-brown silty clay loam.

The somewhat poorly drained Newark soils are in swales. They have a surface layer and a subsoil of brown silty clay loam. The subsoil has gray mottles in the upper part and generally is dominantly gray in the lower part.

The minor soils of this association are the Sharkey, Bruno, Lindside, and Robinsonville soils and Alluvial land, steep. The Sharkey and Lindside soils are in some of the swales. The Bruno and Robinsonville soils and Alluvial land, steep, are adjacent to the rivers.

Most of the acreage in this association is used for soybeans and corn, though floods during the growing season occasionally damage these crops. Large areas in the northern part of Ballard County have recently been cleared. Pasture and meadow crops are planted on only a limited acreage because most areas are flooded in winter and early in spring. In some years the floods last long enough to destroy pasture or meadow plants.

2. Rosebloom-Wheeling-Dubbs association

Nearly level to sloping, poorly drained and well drained, medium textured and moderately fine textured soils on flood plains and stream terraces

This association consists of broad swales and low ridges that are parallel to the Ohio and Tennessee Rivers. Most of the association is in the western part of Ballard County, where it is about 2 miles wide. It is less than one-half mile wide in the northern part of Ballard and McCracken Counties.

This association occupies about 12 percent of Ballard County, 5 percent of McCracken County, and 9 percent of the total survey area. The Rosebloom soils make up about 20 percent of the association; Wheeling soils, 19 percent; Dubbs soils, 16 percent; and minor soils, the remaining 45 percent.

The Rosebloom soils are in broad swales nearest the uplands. They have a surface layer of dark-gray or dark grayish-brown heavy silt loam and a subsoil of gray or light-gray heavy silt loam and silty clay.

The Wheeling soils are in low ridges. They have a surface layer of dark grayish-brown silt loam. The upper part of the subsoil is strong-brown silty clay loam, and the lower part is clay loam or sandy loam.

The Dubbs soils are on low ridges at a slightly lower elevation than Wheeling soils. The Dubbs soils have a surface layer of dark-brown silty clay loam and a subsoil of brown and dark yellowish-brown silty clay loam, silty clay, and clay loam.

The minor soils of this association are Arkabutla, Molena, Dundee, Chavies, Henry, Calloway, Grenada, and Cascilla soils. Alluvial land, steep, and Swamp are also in this association. The Arkabutla soils are on flood plains near the uplands. The sandy Molena soils are on low ridges, mainly near Monkeys Eyebrow in Ballard County. The Dundee, Chavies, Henry, Calloway, and Grenada soils and Alluvial land, steep, are on low terraces throughout the association. Most of the acreage of the well-drained Cascilla soils is on the lower flood plain of Massac Creek in McCracken County. Most areas of Swamp are in the western part of Ballard County, near the uplands.

Most of the acreage in this association is used for soybeans and corn. Some large areas are still wooded, but several areas have been cleared in recent years. Floods during the growing season seldom damage crops, but flooding in winter and early in spring damages pasture and hay crops on some of the soils on the low ridges and prevents the growing of pasture and hay crops in the swales.

3. Grenada-Calloway association

Nearly level to sloping, moderately well drained and somewhat poorly drained, medium-textured soils on uplands

This association consists of nearly level to sloping soils on broad, slightly dissected uplands (fig. 2). It occupies a large, continuous area across the west-central part of McCracken County and the central part of Ballard County. It also is in smaller areas on smooth uplands in the central, southern, and eastern parts of McCracken County. The broad ridges generally range from 380 to 490 feet above sea level; the lower lying ridges are in the northern and western parts of the association. The dominant soils formed in loess. The loess averages between 5 and 15 feet thick on nearly level uplands in the eastern part of McCracken County and from 20 to 30 feet thick on nearly level uplands in the western part of Ballard County.

This association occupies about 30 percent each of Ballard and McCracken Counties and 30 percent of the total survey area. The Grenada soils make up about 75 percent of the association; Calloway soils, 10 percent; and minor soils, the remaining 15 percent.

The moderately well drained Grenada soils have a surface layer of brown silt loam. The upper part of the subsoil is yellowish-brown heavy silt loam. A compact fragipan is at a depth of about 25 inches in slightly eroded areas. These soils are nearly level to gently sloping and have a convex surface on the top of ridges and are gently sloping to sloping on the sides of ridges.

The somewhat poorly drained Calloway soils have a surface layer of dark grayish-brown silt loam. The upper part of the subsoil is friable, yellowish-brown silt loam mottled with gray. Between depths of about 19 and 26 inches, the subsoil is light brownish-gray silt loam mottled with brown. Below a depth of 26 inches is a compact fragipan of dominantly gray silty

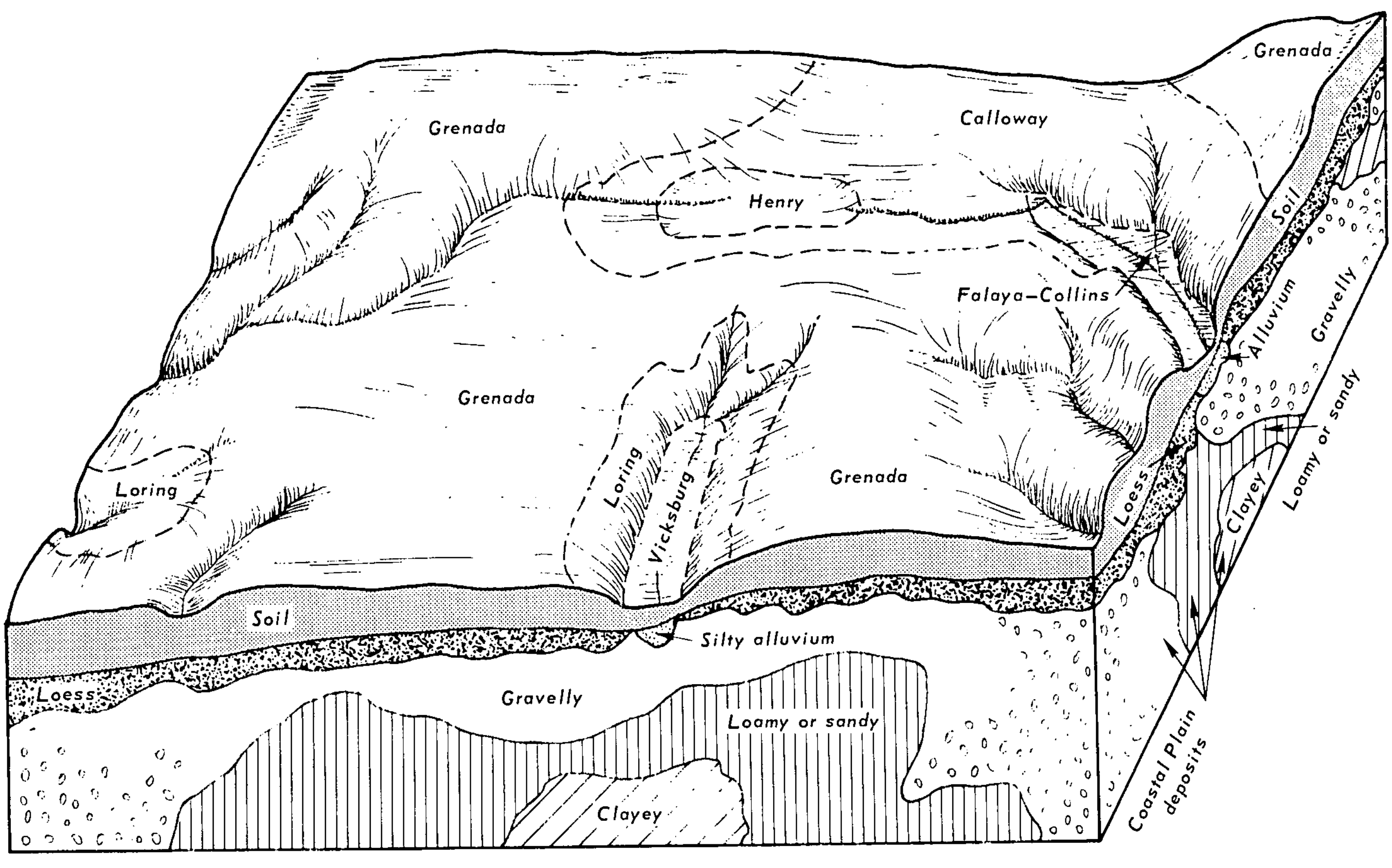

Figure 2.—**Typical pattern of soils and underlying material in association 3.**

clay loam. These soils are nearly level and have a slightly concave surface on the broad ridge tops and are gently sloping on the side slopes near the heads of drainageways.

The minor soils of this association are the Loring, Falaya, Collins, Vicksburg, Memphis, Henry, Brandon, and Waverly soils. The Loring, Memphis, and Brandon soils are on uplands. The Falaya, Collins, Vicksburg, and Waverly soils are on flood plains of the branches and creeks. A small acreage of Grenada and Calloway soils is on the terraces of these small streams.

The soils of this association are used for cultivated crops and rotation pasture and meadow. Wooded tracts are small and are gradually being cleared. Large farm machinery is easy to use on these nearly level to sloping soils. The main limitations are a moderate to severe hazard of erosion and wetness. Most farms of this association in Ballard County are operated by the owner on a full-time basis. Many of the farms in McCracken County are owned by part-time farmers who at times rent their land to others.

Urban development is an important use of the soils of this association, especially near the city of Paducah. The soils have some characteristics that make them attractive as building sites, but care must be taken in locating septic-tank disposal systems if houses are built beyond the reach of a central sewage system. During winter and spring, effluent from a septic-tank system often comes to the surface. Water districts have been developed that supply water for domestic and industrial use to many rural areas as well as to urban areas. Gravel for road construction and other commercial uses is obtained from this association. Several feet of soil material must be removed to get the gravel.

4. *Calloway-Henry association*

Nearly level, somewhat poorly drained and poorly drained, medium-textured soils on uplands

This association consists of somewhat poorly drained and poorly drained, medium-textured soils on uplands. Elevation ranges mainly from 360 to 380 feet. A few natural drainageways dissect the association, but they are not deep (fig. 3). The association occupies a large, continuous area in the northeastern part of Ballard County that extends through the northwestern part of McCracken County.

This association occupies about 8 percent of Ballard County, 15 percent of McCracken County, and 11 percent of the total survey area. The Calloway soils make up about 50 percent of the association; Henry soils, 17 percent; and minor soils, the remaining 33 percent.

The somewhat poorly drained Calloway soils are mainly nearly level, but in some areas near the natural drainageways, these soils have slopes of as much as 4 percent. They have a surface layer of dark grayish-brown silt loam. The upper part of the subsoil is yellowish-brown silt loam that has gray mottles. Between depths of about 19 and 26 inches, the subsoil is light brownish-gray silt loam mottled with brown. Below a depth of about 26 inches is a compact fragipan of dominantly gray silty clay loam.

The Henry soils have a surface layer of grayish-brown silt loam mottled with gray. The subsoil is gray or light-gray silt loam to a depth of about 26 inches. A

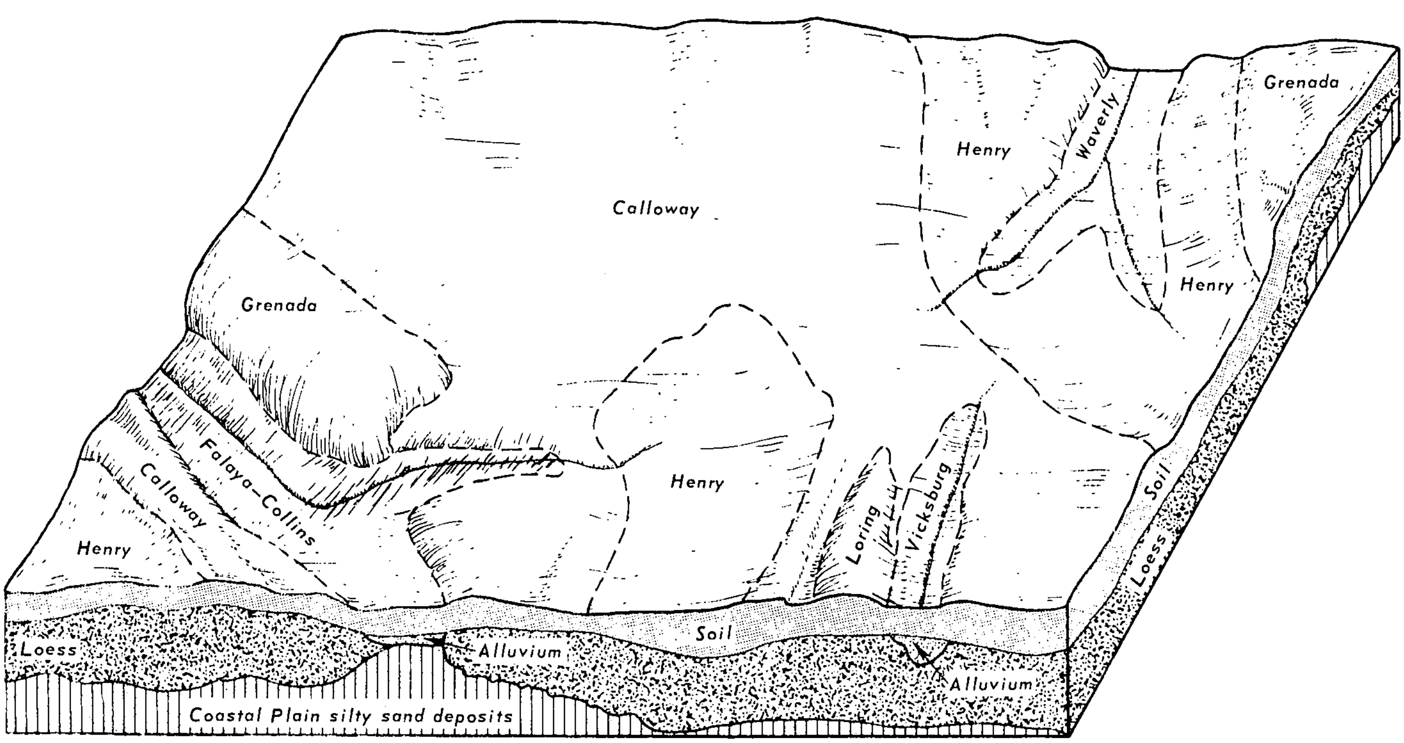

Figure 3.—**Typical pattern of soils and underlying material in association 4.**

compact and brittle fragipan of silty clay loam is below that depth.

The minor soils of this association are the Grenada, Falaya, Collins, Waverly, Vicksburg, Loring, and Brandon soils. The Grenada, Loring and Brandon soils are on uplands near branches and creeks. The Falaya, Collins, Waverly, and Vicksburg soils are on the flood plains of the branches and creeks.

The soils of this association are used for cultivated crops and rotation pasture and meadow. Little of the acreage is wooded, and forested areas are generally tracts of less than 100 acres. The dominant soil in the wooded tracts is the poorly drained Henry soil. Because of the nearly level slopes, the use of farm machinery is easy and the hazard of erosion is slight. Wetness often delays tillage operations. Better machinery and other improvements in technology have increased the usefulness of the soils of this association for farming in recent years. Most of the farms are operated by full-time farmers, but some are operated by part-time farmers who are employed off the farm or who have retired from other employment.

During World War II, a large acreage in the northeastern part of McCracken County was bought by the Federal government and used as the Kentucky Ordinance Works for the storage of ammunition. Most of this area was in this soil association. It has been divided, and part is now owned by the State government. The part owned by the Federal government is used by the Energy Research and Development Administration or the Tennessee Valley Authority for the Shawnee Steam Plant. The part owned by the Commonwealth of Kentucky is used by the West Kentucky Wildlife Management Area.

5. *Falaya-Waverly-Vicksburg association*

Nearly level, well drained and poorly drained, medium-textured soils on flood plains

This association consists of first and second bottoms of the larger creeks in Ballard and McCracken Counties (fig. 4). Most of the association is along Mayfield Creek or its tributaries, but other areas are on the bottom lands of Massac Creek in McCracken County and Humphrey, Clanton, Shawnee, and Cane Creeks in Ballard County. Small areas are along branches and creeks in other parts of the survey area.

This association occupies about 17 percent of Ballard County, 12 percent of McCracken County, and 14 percent of the total survey area. The Falaya soils make up about 45 percent of the association; Waverly soils, 17 percent; Vicksburg soils, 16 percent; and minor soils, the remaining 22 percent.

The somewhat poorly drained Falaya soils are brown silt loam in the surface layer and the upper part of the subsoil. These soils are dominantly gray below a depth of about 16 inches.

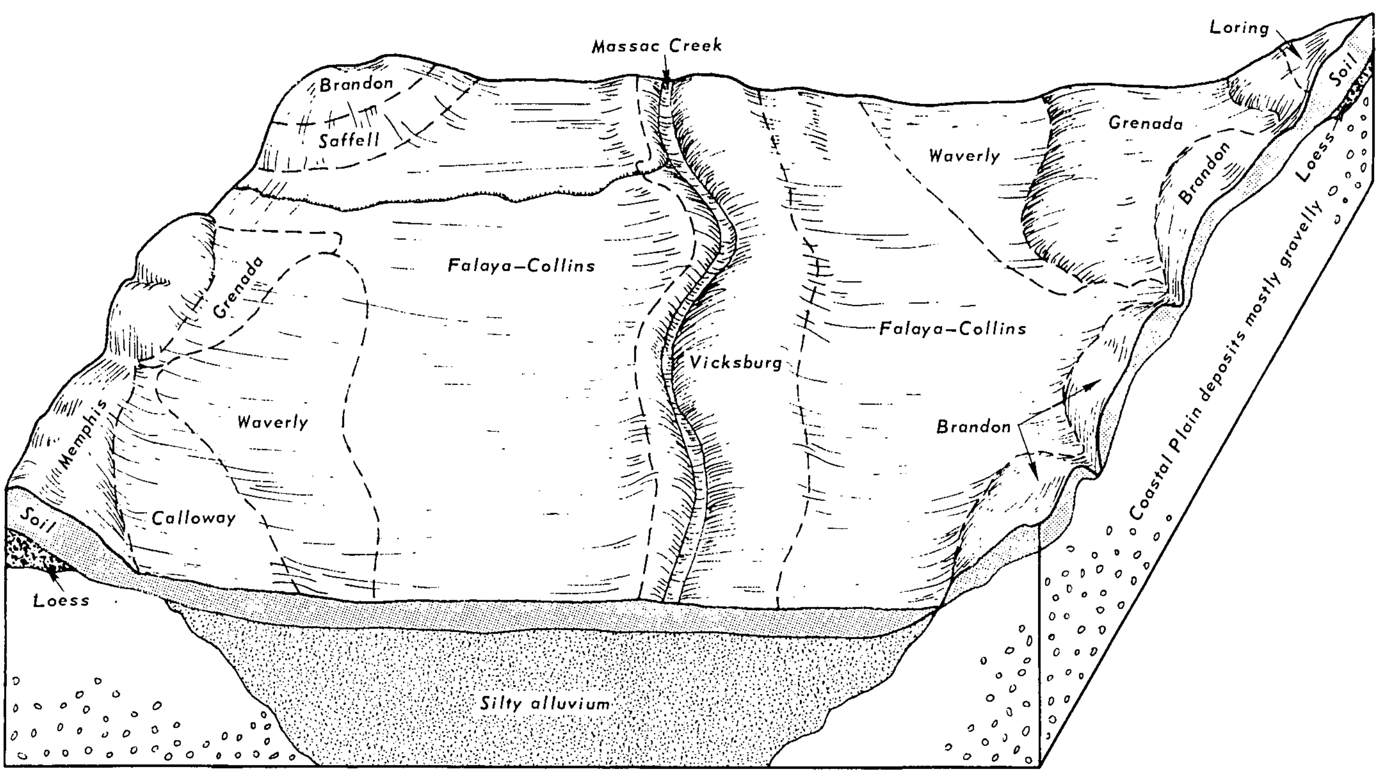

Figure 4.—Typical pattern of soils and underlying material in association 5. Some of the soils in adjoining associations—Brandon, Saffell, Memphis, and Loring soils—are shown on the diagram.

Waverly soils have a surface layer of grayish-brown silt loam mottled with gray and a subsoil of light-gray and gray, friable silt loam mottled with brown.

Vicksburg soils have a surface layer and underlying material of brown silt loam.

The minor soils of this association are the Grenada, Calloway, Henry, Arkabutla, Rosebloom, Cascilla, and Collins soils and Swamp. The Grenada, Calloway, and Henry soils are on first bottoms, generally on the lower reaches of the creeks. They contain more clay than the major soils of this association. The Collins soils are also on first bottoms. Most areas of Swamp are on the lower part of Mayfield Creek in Ballard County.

Much of the acreage in this association has been cleared and is used for cultivated crops and rotation pasture and meadow. Some areas are flooded too often for pasture or meadow crops, but in most areas the floods do not last long enough to damage grasses and legumes. Some areas are wooded. A large percentage of the forest is along Mayfield Creek, and many wooded areas are mostly on the poorly drained Waverly soils. Large areas on the lower reaches of Mayfield Creek are covered by swamp water. All but the cypress trees have been killed, and the swamp areas are used for fishing.

The major soils of this association are flooded so frequently that the only houses and business buildings on them are at the higher elevations.

6. *Loring-Memphis-Brandon association*

Gently sloping to steep, well drained and moderately well drained, medium-textured soils on uplands

This association is deeply dissected by many natural drainageways. Lying above these are long, sloping to steep side slopes and narrow, gently sloping to sloping ridgetops (fig. 5). Most of the acreage is in the watershed of Mayfield Creek in southern Ballard and McCracken Counties. In southwestern Ballard County, however, a small acreage is dissected by streams that flow into the Mississippi River. In south-central McCracken County, streams from this association flow into the Clarks River and Island Creek.

This association occupies about 21 percent of Ballard County, 13 percent of McCracken County, and 18 percent of the total survey area. The Loring soils make up about 50 percent of the association; Memphis soils, 25 percent; Brandon soils, 18 percent; and minor soils, the remaining 7 percent. The percentage of Loring soils is about the same in both counties. The percentage of Memphis soils is higher in Ballard County than in McCracken County, and the percentage of Brandon soils is higher in McCracken County than in Ballard County.

The sloping and strongly sloping Loring soils are on ridgetops and side slopes. They have a surface layer of dark-brown silt loam. The subsoil is brown, friable silt loam in the upper part; in the lower part it is a com-

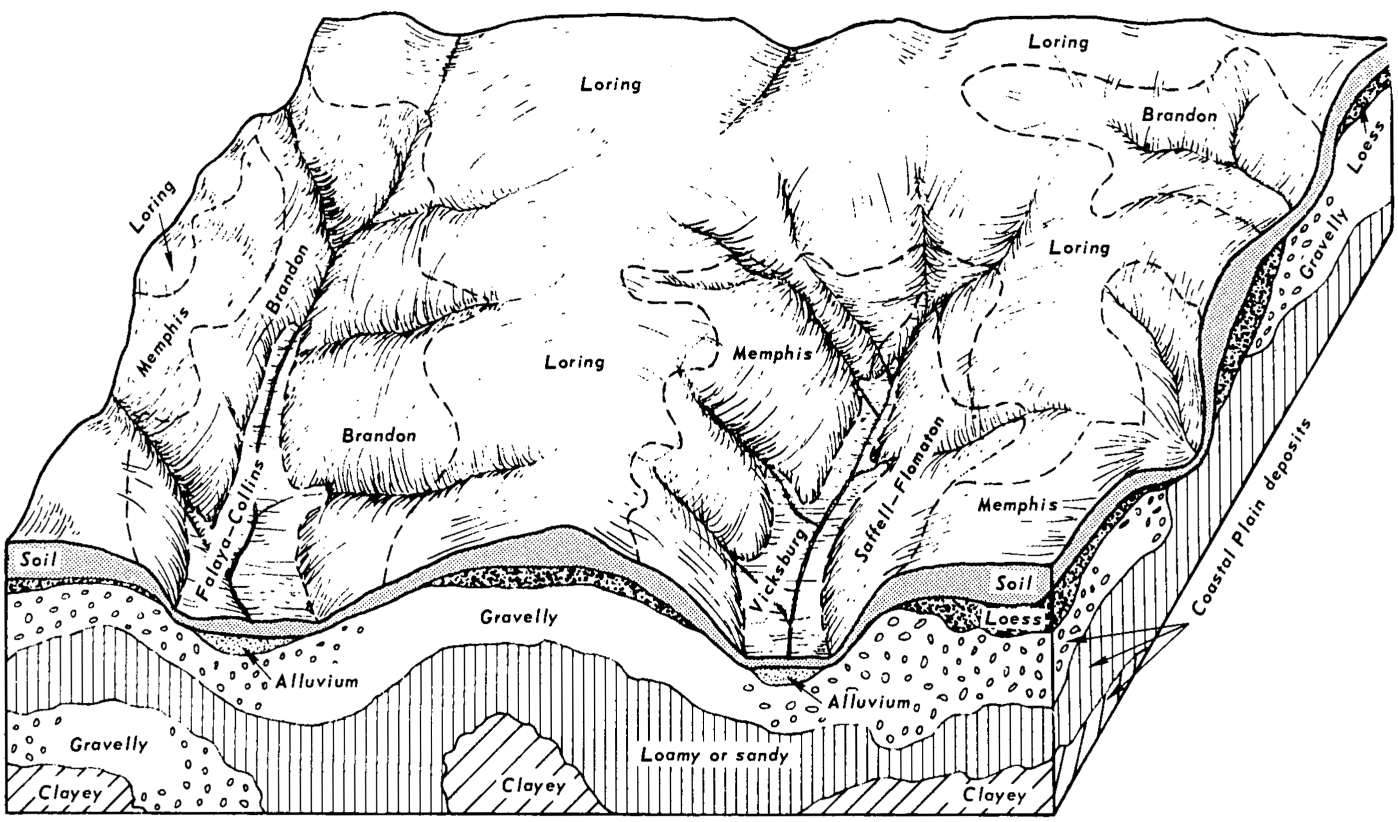

Figure 5.—**Typical pattern of soils and underlying material in association 6.**

pact and brittle fragipan, which is at a depth of about 34 inches in areas where the soils are only slightly eroded.

The Memphis soils are gently sloping and sloping on ridgetops and are sloping to steep on side slopes. They have a surface layer of brown, friable silt loam. The subsoil is brown, friable and firm silty clay loam and silt loam that extends to a depth of 47 inches.

The strongly sloping to steep Brandon soils are on side slopes. The surface layer is gray silt loam, and the subsoil is yellowish-brown silt loam and yellowish-red silty clay loam. Very gravelly Coastal Plain deposits underlie the subsoil at a depth of 20 to 48 inches.

Among the minor soils are the Falaya, Collins, Grenada, Vicksburg, and Waverly soils on first bottoms along branches and creeks and Grenada and Calloway soils in small areas on stream terraces and uplands.

The soils of this association are used for pasture, meadow, cultivated crops, and woodland. About 25 percent of the acreage is wooded. The strong slopes and numerous natural drainageways make the use of large machinery difficult. Some areas that have been cultivated are now idle or have been allowed to grow back to trees. There are some full-time commercial farms, but most of the farms of this association are owned by part-time farmers. In this association are many pits where gravel has been mined and a few pits where sand or clay has been mined.

7. *Henry-Okaw association*

Nearly level, poorly drained, medium-textured soils on stream terraces

This association consists of nearly level, poorly drained soils that formed in loamy and clayey alluvium (fig. 6). It is on high terraces in the east-central and northern parts of McCracken County. Elevation ranges from 330 to 355 feet. Narrow flood plains of Clarks River and other tributaries of the Ohio and Tennessee Rivers cut 20 to 40 feet into these terrace sediments. It is believed that these sediments are of Pleistocene age and were deposited in an ancient lake (*11*).[1] Gravel bars that have crests about 355 feet above sea level are in this association and are thought to be the shoreline of the ancient lake.

This association occupies about 21 percent of McCracken County and 10 percent of the total survey area. The Henry soils make up about 30 percent of the association; Okaw soils, 24 percent; and minor soils, the remaining 46 percent.

The Henry and Okaw soils both are nearly level and poorly drained. These soils have a surface layer of grayish-brown, friable silt loam mottled with gray and a gray subsoil. The subsoil of the Henry soils is silt loam to a depth of about 26 inches and is a compact and brittle fragipan of gray silty clay loam below that

[1] Italic numbers in parentheses refer to Literature Cited, page 78.

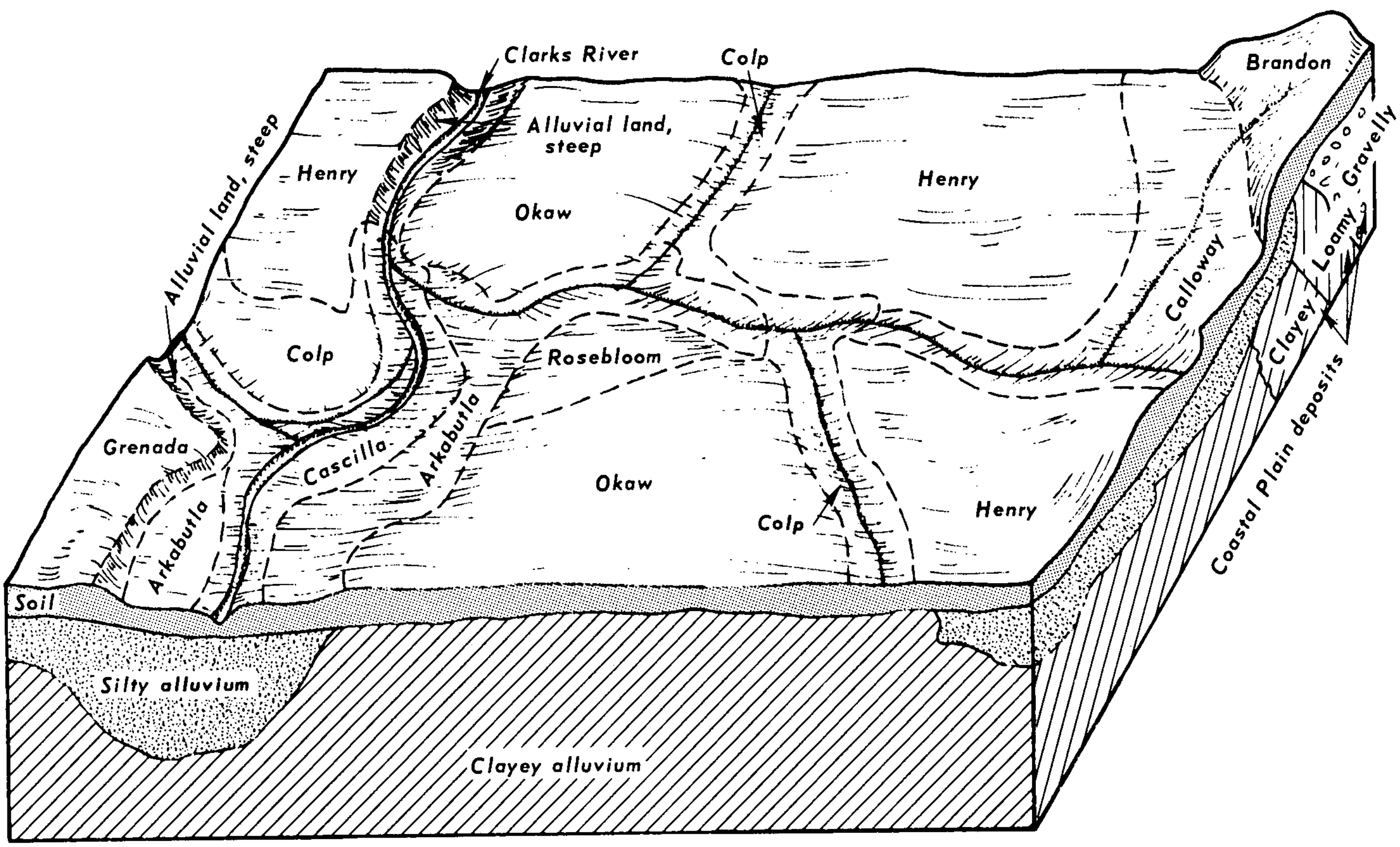

Figure 6.—Typical pattern of soils and underlying material in association 7.

depth. The subsoil of the Okaw soils is silt loam to a depth of about 18 inches and silty clay or clay below that depth.

The minor soils of this association are the Wheeling, Saffell, Calloway, Colp, Rosebloom, and Grenada soils and Alluvial land, steep, on terraces and the Arkabutla, Alligator, Cascilla, and Rosebloom soils on first bottoms. The Calloway and Colp soils are similar to Henry and Okaw soils but have better aeration and drainage.

The soils of this association are used for urban development in the vicinity of Paducah. Much of the city of Paducah is on this soil association. About 50 percent of the acreage not used for urban development is wooded. Some areas have been cultivated or are used for pasture and hay. A floodwall around Paducah protects the city from floods. The soils on terraces outside the floodwall are seldom flooded during the growing season, and floods seldom last long enough to damage pasture or hay crops on the terraces. The soils on flood plains have a very severe hazard of flooding. Cultivated crops are seldom planted before June 1 on these flood plains.

Descriptions of the Soils

In this section the soils of Ballard and McCracken Counties are described in detail and suggestions are given for their use and management. Each soil series is described in detail, and then, briefly, the mapping units in that series. Unless specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second is much more detailed and is for those who need to make thorough and precise studies of soils. Color terms are for moist soil unless otherwise stated. The profile described in the soil series is representative of mapping units in that series. If a given mapping unit has a profile in some ways different from the one described in the series, these differences are stated in the description of the mapping unit, or they are apparent in the name of the mapping unit.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Alluvial land, steep, for example, does not belong to a soil series but, nevertheless, is listed in alphabetic order along with the soil series.

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit are the capability unit, woodland group, and pasture and hayland group in which the mapping unit has been placed.

In this survey the management of soils by groups called capability units is not discussed, but the system of capability classification is explained in the section "Use and Management of the Soils." A table in the section "Use of Soils for Woodland" shows the soils of the county in woodland groups and gives information helpful in managing the soils for trees.

The approximate acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*25*).

Alligator Series

The Alligator series consists of poorly drained soils in depressions on bottom lands.

In a representative profile the surface layer is dark-gray silty clay about 8 inches thick. The subsoil, to a depth of about 42 inches, is gray, very firm clay that is mottled with strong brown. The substratum is gray clay that is mottled with yellowish red and strong brown and extends to a depth of 60 inches or more.

In undrained areas the Alligator soils have a seasonal water table at the surface. The high content of clay causes the soils to be very sticky and plastic. These properties and the very slow permeability make drainage and cultivation difficult. Crop growth and response to lime and fertilizer are limited by wetness and poor workability. These soils are very strongly acid throughout.

Representative profile of Alligator silty clay, about 1 1/4 miles west of Oaks, 250 feet north of the Blizzard Ponds Drainage Canal:

A1—0 to 8 inches, dark-gray (10YR 4/1) silty clay; moderate, fine, granular structure; firm; very strongly acid; clear, wavy boundary.

B2g—8 to 42 inches, gray (10YR 5/1) clay; few, fine, prominent, strong-brown (7.5YR 5/6) mottles; moderate, fine and medium, angular blocky structure and some weak, prismatic; very firm; few slickensides; less than 1 percent iron-manganese concretions; very strongly acid; clear, wavy boundary.

Cg—42 to 60 inches +, gray (10YR 5/1) clay; few, medium, prominent, yellowish-red (5YR 5/6) and strong-brown (7.5YR 5/6) mottles; massive; very firm; less than 1 percent iron-maganese concretions; very strongly acid.

The alluvium is clayey to a depth of 6 to 10 feet or more and is more than 50 feet thick. The solum generally is more than 40 inches thick. During dry seasons, cracks at least 12 inches long and one-half inch wide develop on the surface and extend to a depth of 20 inches or more.

The A horizon is 3 to 5 in value and 1 or 2 in chroma. The B2g horizon has a hue of 10YR, 2.5Y, or 5Y, a value of 4 to 6, and a chroma of 0 to 2. Yellowish-brown to yellowish-red mottles are few to common in the A and B2g horizons but are more numerous in the B2g horizon. The Cg horizon has the same colors as the Bg horizon and the same texture in the upper 2 feet or more. It has weak, medium, prismatic structure in places.

Alligator soils are near Rosebloom, Henry, and Okaw soils. They are more clayey throughout than the Rosebloom and Henry soils. They have more clay in the upper 12 to 24 inches and are at a slightly lower elevation than the Okaw soils.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Ballard County		McCracken County		Entire Survey Area	
	Area	Extent	Area	Extent	Area	Extent
	Acres	*Percent*	*Acres*	*Percent*	*Acres*	*Percent*
Alligator silty clay	315	0.2	510	0.3	825	0.3
Alluvial land, steep	960	.6	1,960	1.2	2,920	.9
Arkabutla silt loam	1,420	.9	2,080	1.3	3,500	1.1
Brandon silt loam, 10 to 20 percent slopes	65	(1)	1,170	.7	1,235	.4
Brandon silt loam, 20 to 30 percent slopes	600	.4	1,030	.6	1,630	.5
Brandon silty clay loam, 10 to 30 percent slopes, severely eroded	810	.5	6,215	3.9	7,025	2.2
Brandon and Memphis silt loams, 30 to 60 percent slopes	1,385	.8	40	(1)	1,425	.4
Bruno loamy fine sand	840	.5	195	.1	1,035	.3
Calloway silt loam, 0 to 2 percent slopes	7,670	4.6	14,240	8.9	21,910	6.7
Calloway silt loam, 2 to 6 percent slopes	5,115	3.1	5,110	3.2	10,225	3.1
Cascilla silt loam	(2)	----------	2,585	1.6	2,585	.8
Chavies fine sandy loam, 0 to 4 percent slopes	710	.4	170	.1	880	.3
Colp silt loam, 0 to 2 percent slopes	(2)	----------	1,105	.7	1,105	.3
Colp silt loam, 2 to 12 percent slopes	(2)	----------	1,615	1.0	1,615	.5
Dubbs silty clay loam, clayey subsoil variant	3,000	1.8	1,615	1.0	4,615	1.4
Dundee silty clay loam, clayey subsoil variant	660	.4	525	.3	1,185	.4
Falaya-Collins silt loams	14,285	8.6	12,885	8.1	27,170	8.3
Grenada silt loam, 0 to 2 percent slopes	4,335	2.6	3,640	2.3	7,975	2.4
Grenada silt loam, 2 to 6 percent slopes	19,300	11.6	17,085	10.7	36,385	11.2
Grenada silt loam, 2 to 6 percent slopes, severely eroded	10,140	6.1	11,265	7.0	21,405	6.6
Grenada silt loam, 6 to 12 percent slopes, severely eroded	8,960	5.4	7,930	5.0	16,890	5.2
Gullied land	155	.1	150	.1	305	.1
Henry silt loam	3,840	2.3	16,800	10.5	20,640	6.3
Loring silt loam, 2 to 6 percent slopes	7,235	4.4	4,810	3.0	12,045	3.7
Loring silt loam, 6 to 12 percent slopes	370	.2	455	.3	825	.3
Loring silt loam, 6 to 12 percent slopes, severely eroded	6,280	3.8	8,795	5.5	15,075	4.6
Loring silt loam, 12 to 20 percent slopes	750	.5	150	.1	900	.3
Loring silt loam, 12 to 20 percent slopes, severely eroded	8,700	5.2	1,880	1.2	10,580	3.2
Memphis silt loam, 2 to 6 percent slopes	3,310	2.0	1,435	1.9	4,745	1.5
Memphis silt loam, 6 to 12 percent slopes	2,345	1.4	635	.4	2,980	.9
Memphis silt loam, 12 to 20 percent slopes	220	.1	240	.2	460	.1
Memphis silt loam, 20 to 30 percent slopes	2,020	1.2	15	(1)	2,035	.6
Memphis silty clay loam, 6 to 12 percent slopes, severely eroded	250	.2	795	.5	1,045	.3
Memphis silty clay loam, 12 to 30 percent slopes, severely eroded	6,105	3.7	1,250	.8	7,355	2.3
Molena loamy fine sand, 0 to 6 percent slopes	1,230	.8	15	(1)	1,245	.4
Newark-Lindside silty clay loams	5,320	3.2	815	.5	6,135	1.9
Nolin silty clay loam	4,655	2.8	1,235	.8	5,890	1.8
Nolin-Robinsonville silt loams	5,685	3.4	1,390	.9	7,075	2.2
Okaw silt loam	(2)	----------	8,130	5.1	8,130	2.5
Rosebloom silt loam	5,260	3.2	2,655	1.7	7,915	2.4
Saffell gravelly loam, 0 to 12 percent slopes	25	(1)	290	.2	315	.1
Saffell and Flomaton soils, 20 to 60 percent slopes	710	.4	740	.5	1,450	.4
Sharkey silty clay	2,010	1.2	480	.3	2,490	.8
Swamp	3,870	2.3	375	.2	4,245	1.3
Vicksburg silt loam	7,020	4.2	5,635	3.5	12,655	3.9
Waverly silt loam	2,780	1.8	5,595	3.5	8,375	2.6
Wheeling silt loam, 0 to 2 percent slopes	2,430	1.5	1,350	.8	3,780	1.2
Wheeling silt loam, 2 to 6 percent slopes	725	.4	500	.3	1,225	.4
Wheeling silt loam, 6 to 12 percent slopes	165	.1	175	.1	340	.1
Water	1,725	1.1	240	.1	1,965	.5
Total	165,760	100.0	160,000	100.0	325,760	100.0

1 Less than 0.05 percent.
2 These soils were not mapped in this county.

Alligator silty clay (Ag).—This nearly level, clayey soil is on bottom lands. Included with it in mapping were areas of Rosebloom silt loam that grade gradually to Alligator soils south of the Blizzard Ponds Drainage Canal. Also included were small areas of Okaw and Colp soils, some of which are too small to delineate but are easily recognized by a slight increase in elevation. Small swamplike areas and a few areas where the surface layer is clay were also included.

This Alligator soil is limited by wetness, poor workability, and flooding. The water table extends to the surface in wet seasons because internal drainage is slow. The high content of clay in the surface layer makes tillage difficult. The soil is poorly suited to most of the commonly grown crops.

Most of the acreage is in forest. Some areas are idle, and a few are used for corn, soybeans, and pasture. (Capability unit IIIw-5; woodland group 1w2; pasture and hayland group 4)

Alluvial Land, Steep

Alluvial land, steep (Av) consists mainly of well drained and moderately well drained soils that have short, steep slopes and of narrow strips of adjoining nearly level, alluvial soils. A few areas are sandy and excessively drained. Both the alluvial soils and the soils on the lower parts of slopes are subject to overflow from backwater of the Ohio River and its tributaries. Most mapped areas are long, somewhat narrow, and parallel to the major streams. Many of the soils on the adjoining terraces and flood plains occur in this unit, but many of the soils are too variable to be classified as soil series. The profiles vary from place to place.

Included with this land type in mapping were small areas behind the floodwall at Paducah that do not receive overflow from the Ohio River. Also included were areas that are strongly sloping or moderately steep.

The soil properties vary, but most soils in this unit have a deep or moderately deep root zone, moderate permeability, and medium to low organic-matter content. They range from very strongly acid to slightly alkaline.

Most of the acreage is wooded, has short, steep slopes, and is not suitable for meadow or cultivated crops. Very little of the acreage is used for pasture. (Capability unit VIIe-1; woodland group 3r1; pasture and hayland group 8)

Arkabutla Series

The Arkabutla series consists of somewhat poorly drained soils that formed in alluvium. These soils are on flood plains of major streams.

In a representative profile the surface layer is dark grayish-brown heavy silt loam about 7 inches thick. The upper part of the subsoil is 29 inches of dark grayish-brown and light brownish-gray, friable heavy silt loam that is mottled with shades of gray and brown. The lower part of the subsoil, to a depth of 60 inches or more, is gray, friable silty clay loam that has mottles of yellowish brown and dark grayish brown.

The Arkabutla soils have a seasonal water table that is 6 to 8 inches below the surface. They have a deep root zone, high available moisture capacity, and moderate permeability. They are strongly acid or very strongly acid in all horizons except where the surface layer has been limed. Natural fertility is moderate, and the organic-matter content is medium. If the soils are adequately drained, crops respond well to lime and fertilizer. Flooding, mainly in winter and spring, delays planting and prevents the use of many areas for any crops between the middle of May and December.

Representative profile of Arkabutla silt loam, about five-eighths mile south of the Ohio River, 100 feet east of the road to Dam 52:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) heavy silt loam; weak, fine, granular structure; friable; medium acid; clear, wavy boundary.

B21—7 to 15 inches, dark grayish-brown (10YR 4/2) heavy silt loam; common, medium, distinct, light brownish-gray (10YR 6/2) and yellowish-brown (10YR 5/4) mottles; weak, medium, subangular blocky structure; friable; strongly acid; clear, wavy boundary.

B22g—15 to 36 inches, light brownish-gray (10YR 6/2) heavy silt loam; common, medium, distinct, gray (10YR 6/1) and yellowish-brown (10YR 5/4) mottles; weak, medium, subangular blocky structure; friable; strongly acid; clear, wavy boundary.

B3—36 to 60 inches +, (10YR 6/1) silty clay loam; common, medium, distinct, yellowish-brown (10YR 5/4) and dark grayish-brown (10YR 4/2) mottles; massive; friable; strongly acid.

The alluvial deposits are 4 to more than 20 feet thick. The soil is strongly acid or very strongly acid throughout, except where the surface layer has been limed. The A horizon is 4 to 5 in value and 2 to 4 in chroma. It contains few or common gray mottles in some places. The matrix of the B21 horizon is 4 or 5 in value and 2 to 4 in chroma. The dominant color is brown, and mottles in shades of gray are few to many. The B22g horizon ranges from 10YR to 5Y in hue, from 4 to 7 in value, and from 1 to 6 in chroma. The dominant color is gray, and mottles in shades of brown are few to many. This horizon ranges from weak to moderate, granular to subangular blocky in structure. The B21 and B22g horizons are silt loam or silty clay loam. The B3 horizon is mainly gray and is massive. It ranges from sandy loam to silty clay, but it is generally heavy silt loam or silty clay loam that has strata where the content of sand or clay is high enough that the texture is sandy loam, clay loam, loam, or silty clay.

Arkabutla soils are closely associated with Cascilla, Rosebloom, Newark, Falaya, Calloway, and Grenada soils. They are not so well drained as the Cascilla soils, but they are better drained than the Rosebloom soils. They have the same internal drainage as the Newark and Falaya soils, but they are more acid throughout the profile than the Newark soils and have more clay throughout than the Falaya soils. They do not have a fragipan, which is characteristic of the Calloway and Grenada soils.

Arkabutla silt loam (Ay).—This nearly level soil is on flood plains. Included with it in mapping were small areas of Rosebloom, Falaya, Collins, Newark, and Lindside soils and small areas of a soil that has thin sandy loam or clayey strata in the upper 3 feet. Also included were areas of a soil that has fewer gray mottles in the subsoil and is better drained than this Arkabutla soil and areas of a soil that has a surface layer of silty clay loam.

Drainage and lowering the water table increase the suitability of this soil for most farm crops. Additional drainage is impractical in many places because of flooding or a high water level in the rivers during the growing season. Erosion is not a hazard on this soil.

Over half of the acreage is used for soybeans and corn. Some areas were cleared of forest during the late 1960's. (Capability unit IIw-1; woodland group 1w1; pasture and hayland group 2)

Brandon Series

The Brandon series consists of well-drained, strongly sloping to steep soils that formed in loess and are underlain by gravelly Coastal Plain deposits. These soils are in areas greatly dissected by natural drainageways.

In a representative profile the surface layer is about 2 inches of dark-gray silt loam over about 6 inches of brown silt loam. The subsoil is yellowish-brown, friable silt loam to a depth of about 12 inches. The next layer is yellowish-red, friable silty clay loam about 20 inches thick. The underlying material is yellowish-brown very gravelly sandy loam that extends to a depth of 75 inches or more.

The Brandon soils are strongly acid to very strongly acid throughout the profile. The subsoil has moderate permeability above the very gravelly material. Permeability of the very gravelly Coastal Plain material is mostly moderately rapid, but it varies with the compactness and cementation of the gravel. Crops respond well to lime and fertilizer. The available moisture capacity is only moderate, and summer rainfall is partly lost as surface runoff. As a result, droughtiness limits the suitability of these soils.

Representative profile of Brandon silt loam, 10 to 20 percent slopes, about 1¼ miles northeast of the Ballard-McCracken County line, 10 yards east of U.S. Highway 62, across highway from Kimmel Cemetery:

A1—0 to 2 inches, dark-gray (10YR 4/1) silt loam; moderate, fine, granular structure; very friable; many fine roots; strongly acid; abrupt, smooth boundary.

A2—2 to 8 inches, brown (10YR 5/3) silt loam; weak, fine, granular structure; very friable; many fine roots; very strongly acid; clear, wavy boundary.

B1—8 to 12 inches, yellowish-brown (10YR 5/6) silt loam; weak, medium, subangular blocky structure; friable; few fine roots; very strongly acid; clear, wavy boundary.

B2t—12 to 32 inches, yellowish-red (5YR 5/6) silty clay loam; moderate, medium, subangular blocky structure; friable; patchy clay films on most peds; brown silt coatings on some peds; lower 10 inches has a few pebbles; very strongly acid; clear, wavy boundary.

IIC—32 to 75 inches +, yellowish-brown (10YR 5/4) very gravelly sandy loam; massive; friable to cemented; gravel makes up 75 percent of the volume; pebbles range from 2 millimeters to 2 inches in length but average about one-half inch on the longest axis; very strongly acid.

In cultivated areas the Ap horizon is generally dark grayish-brown (10YR 4/2) or brown (10YR 4/3 or 5/3) silt loam. Much of the acreage has not been cleared, and there the soils have A1 and A2 horizons. The A1 horizon is 3 to 5 in value and 1 to 2 in chroma. The A2 horizon is 4 or 5 in value and 2 or 3 in chroma.

The B1 horizon has a hue of 10YR or 7.5YR, a value of 4 or 5, and a chroma of 4 to 6. The texture of the B1 horizon is silt loam or silty clay loam, and in some places clay films are visible on peds. The B1 horizon is missing in some places.

The B2t horizon has a hue of 7.5YR and 5YR, a value of 4 or 5, and a chroma of 4 to 6. Pale-brown or gray mottles are in the lower 4 to 8 inches of the B2t horizon in some places. This horizon generally is silty clay loam, but where the lower part is mottled it is heavy silt loam.

Thickness of the loess ranges from 24 to 48 inches, and the loess is generally thickest on north- and east-facing slopes. In some places the loess cap is 1 to 10 percent gravel.

The IIC horizon varies widely in color, texture, and percentage of coarse fragments. Most of the coarse fragments are chert but some are quartz. The finer material is generally sandy or loamy. Cemented layers of various thickness are common but are discontinuous. The IIC horizon is generally very gravelly for a thickness of 10 feet or more. The volume of gravel generally ranges from 50 to 75 percent, but some places have 20 to 50 percent gravel. In some areas the very gravelly material is 1 to 3 feet thick over loamy, sandy, or clayey Coastal Plain deposits.

Brandon soils are closely associated with Memphis, Loring, Grenada, and Saffell soils. Brandon soils formed partly in very gravelly material that Memphis, Loring, and Grenada soils don't have. They are better drained than the Loring and Grenada soils, and they lack a fragipan. Brandon soils are finer textured in the upper part of the profile than the Saffell soils, which are gravelly throughout.

Brandon silt loam, 10 to 20 percent slopes (BdD).—This soil has a moderately deep root zone in the dissected parts of the survey area where the loess is less than 48 inches thick. It has the profile described as representative of the series.

Included with this soil in mapping were areas of moderately eroded soils where the present surface layer is a mixture of the original surface layer and some of the subsoil. Also included were small areas that are severely eroded and are marked by a few gullies, small areas having slopes of slightly less than 10 percent, and areas having slopes of more than 20 percent. Small areas of Memphis, Loring, and Saffell soils and of alluvial soils along natural drainageways were included in most places. Some soils on the lower slopes are underlain by sandy material.

This soil has a moderately deep root zone over very gravelly material that is unfavorable for root growth. Natural fertility and the organic-matter content are low. The hazard of erosion is too high for cultivated crops, and proper management is needed to reduce soil loss where pasture and meadows are established. Pasture and meadows respond to fertilizer, but the erosion hazard and summer drought limit the production potential of this soil for these uses.

Much of the acreage of this soil has never been cleared or was farmed for only a short period and then allowed to grow back to trees. Many of the cleared areas are used for permanent pasture (fig. 7). Some of these are well managed, and others are reverting to bushes and trees. (Capability unit VIe–2; woodland group 3o1; pasture and hayland group 7)

Brandon silt loam, 20 to 30 percent slopes (BdE).—This soil is on side slopes in the more deeply dissected parts of the survey area, where the loess is less than 48 inches thick. It has a profile similar to the one described as representative of the series, but generally the depth to gravel is 3 to 6 inches less.

Included with this soil in mapping were small areas of moderately eroded Brandon soils and areas where slopes are slightly less than 20 percent or are more than 30 percent. Small areas of Memphis and Saffell soils and of alluvial soils along natural drainageways also were included. Sandy material is at a shallow depth on the lower part of some slopes.

This soil has a moderately deep root zone over very gravelly material that is unfavorable for root growth. The organic-matter content and natural fertility are low. The hazard of erosion is too high for cultivated crops, and good management is required to establish and maintain pastures and meadows.

Most of the acreage of this soil has never been cleared and is forested. Improper cutting practices and poor management have resulted in hardwood stands of poor quality. (Capability unit VIIe–1; woodland group 3r1; pasture and hayland group 7)

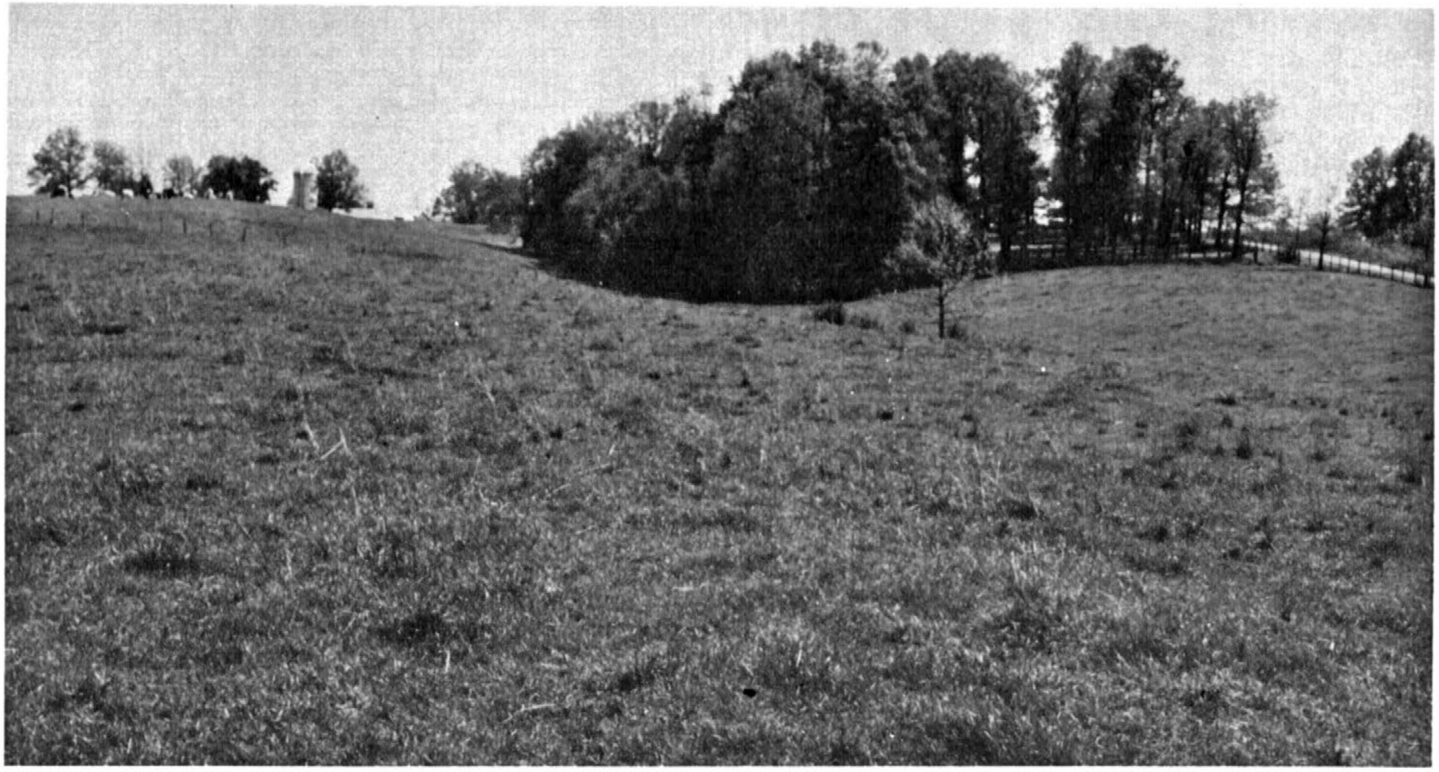

Figure 7.—**Pasture of fescue, Ladino clover, and lespedeza on Brandon silt loam, 10 to 20 percent slopes.**

Brandon silty clay loam, 10 to 30 percent slopes, severely eroded (BrD3).—This soil is on side slopes in the more deeply dissected parts of the survey area, where the loess is less than 48 inches thick. Much of the original surface layer has been removed through erosion. The profile of this soil is similar to the one described as representative of the series, but the present surface layer of silty clay loam is mostly subsoil material and the very gravelly layer is closer to the surface.

Included with this soil in mapping were small areas of moderately eroded soils and some areas that have a few gullies. These gullies are generally eroded to the Coastal Plain gravel. All of the loess mantle on the lower part of some slopes has been eroded away, and this has exposed Coastal Plain gravel in some areas. Near the junction of Clear Creek and Champion Creek in McCracken County, sandstone boulders are exposed. In some places the soils on the lower slopes are underlain by sandy material, especially along Mayfield Creek. Also included were small areas of Memphis and Saffell soils and some areas having slopes of more than 30 percent.

This soil has a moderately deep to shallow root zone over very gravelly material that is unfavorable for root growth. Natural fertility, the organic-matter content, and potential for growing crops are very low. The erosion hazard is too high for cultivated crops, and good management is required to establish and maintain pastures and meadows. The soil has to be worked within a narrow range of moisture content to prevent clodding. Surface crusting results in poor germination of seeds and poor survival of seedlings, especially those planted in spring.

All of the acreage has been cleared and cultivated in the past, but much of it is now idle or has reverted to forest. Some areas have been fertilized and seeded to improve pasture, and some areas are in unimproved pasture. (Capability unit VIIe-3; woodland group 4r1; pasture and hayland group 10)

Brandon and Memphis silt loams, 30 to 60 percent slopes (BsF).—These soils are on side slopes in deeply dissected areas. The two soils have similar limitations that affect their use.

Some areas of this mapping unit contain both soils in about equal proportion, but in other areas one of the two soils makes up 75 percent or more of the acreage. North of Mayfield Creek, the Brandon soil makes up most of the mapping unit. In steep areas east of the flood plains along the Mississippi and Ohio Rivers, the Memphis soil makes up most of the unit.

The Brandon and Memphis soils account for about 75 percent of the acreage of this mapping unit, but included with them in mapping were gravelly Saffell and Flomaton soils, which occupy about 25 percent of most areas. The pattern of these soils is intricate and cannot be accurately predicted, but in some places the Brandon and Memphis soils are on the upper and lower parts of the slopes and the Saffell and Flomaton soils are on the middle part. Generally, the Brandon and Memphis soils make up a larger percentage of the mapping unit on slopes facing north and east than they do on slopes facing south and west.

These soils have a moderately deep or deep rooting zone. The organic-matter content is low. Natural fertility is low in the Brandon soil but is high in the Memphis soil. Both soils are strongly acid or very strongly acid. Steep slopes cause very rapid runoff, but in many places the growth of trees indicates that the soils are not droughty. Slopes are too steep, however, and the erosion hazard is too high for any use except woodland and limited pasture.

Most of the acreage of these soils is in forest and has never been cleared. Improper cutting practices and poor management have generally reduced the quality of the trees. (Capability unit VIIe-1; woodland group 3r1; pasture and hayland group 7)

Bruno Series

The Bruno series consists of excessively drained, nearly level to gently sloping soils that formed in alluvium. The soils are on a natural levee of the Ohio River.

In a representative profile the surface layer is about 6 inches of brown loamy fine sand over about 3 inches of very dark grayish-brown fine sandy loam. Below this is about 19 inches of brown, very friable loamy sand. The next layer, to a depth of about 46 inches, is dark grayish-brown, very friable fine sandy loam and brown loamy sand. Below this is about 10 inches of dark-brown loam. The underlying material, to a depth of 66 inches or more, is brown loamy fine sand.

The Bruno soils have a deep root zone, rapid permeability, very low available water capacity, low natural fertility, and low organic-matter content. They are mildly alkaline to medium acid throughout. Because they are easily leached beyond the reach of plant roots, lime and fertilizer should be applied frequently and in small amounts. These soils are easy to work. Plants that grow early in spring generally get enough moisture because most of the moisture in the soil is available to plant roots.

Representative profile of Bruno loamy fine sand, about 5¼ miles north of Rossington, 400 feet south of the Ohio River, 3¼ miles west of Shawnee Steam Plant, in McCracken County:

Ap—0 to 6 inches, brown (10YR 4/3) loamy fine sand; weak, fine and medium, granular structure; very friable; visible mica flakes; slightly acid; abrupt, broken boundary.

A1—6 to 9 inches, very dark grayish-brown (10YR 3/2) fine sandy loam, dark brown (10YR 3/3) when crushed; moderate, fine, granular structure; very friable; visible mica flakes; neutral; abrupt, broken boundary.

C1—9 to 28 inches, brown (10YR 5/3) loamy sand; massive; very friable; visible mica flakes; neutral; abrupt, broken boundary.

C2—28 to 34 inches, 70 percent dark grayish-brown (10YR 4/2) fine sandy loam and 30 percent brown (10YR 5/3) loamy sand; weak, fine, granular structure parting to single grained; very friable; visible mica flakes; neutral; gradual, broken boundary.

C3—34 to 46 inches, 70 percent brown (10YR 5/3) loamy sand and 30 percent dark grayish-brown (10YR 4/2) fine sandy loam; weak, fine, granular structure parting to single grained; very friable; visible mica flakes; neutral; abrupt, broken boundary.

IIAB—46 to 56 inches, dark-brown (10YR 3/3) loam; weak, fine, granular structure; friable; visible mica flakes; neutral; abrupt, broken boundary.

IIIC—56 to 66 inches +, brown (10YR 5/3) loamy fine sand; single grained; very friable; visible mica flakes; slightly acid.

The sandy alluvial material ranges from 3 to more than 10 feet in thickness. The Ap horizon is 3 to 5 in value and 2 to 4 in chroma. The C horizon is 4 to 6 in value and 2 to 6 in chroma. In some places it contains strata of fine sandy loam, loam, or silt loam, but these strata are thin and discontinuous and occur at varying depths.

Bruno soils are closely associated with the well-drained Nolin soils and the somewhat excessively drained Newark soils. They are sandier than those soils.

Bruno loamy fine sand (Bu).—This sandy soil generally has slopes of 0 to 4 percent. Included in mapping were small areas having slopes of as much as 15 percent.

The high content of sand and the hazard of overflow make the establishment of grasses and legumes for meadow or pasture very difficult on this soil. The soil is easy to till, but droughtiness makes it poorly suited to crops.

Most of the acreage has been cleared and is used for cultivated crops. In some years the soil is left idle and the adjoining better soils are cultivated. Some areas of this soil are forested, and sand for commercial use is obtained from others. (Capability unit IIIs-1; woodland group 3s1; pasture and hayland group 14)

Calloway Series

The Calloway series consists of somewhat poorly drained soils that have a fragipan. These soils formed in loess on smooth uplands and in alluvium mainly derived from loess on stream terraces.

In a representative profile the surface layer is about 8 inches of dark grayish-brown silt loam that has light brownish-gray mottles. The upper part of the subsoil, to a depth of about 26 inches, is yellowish-brown, light yellowish-brown, and light brownish-gray, friable silt loam that has mottles of gray and brown. Between depths of 26 and 50 inches, the subsoil is a firm, compact and brittle fragipan of gray silty clay loam that has mottles in shades of brown and gray. Below this is mottled gray and yellowish-brown silt loam that extends to a depth of 70 inches or more.

The Calloway soils have moderate permeability above the fragipan and slow permeability in the pan. The fragipan hinders the downward movement of roots and water and causes a seasonal water table that is perched within 6 to 18 inches of the surface late in winter and early in spring. These soils are strongly acid or very strongly acid in the surface layer unless they have been limed. They have moderate available moisture capacity. Crops that tolerate wetness or have a short growing season respond well to lime and fertilizer.

Representative profile of Calloway silt loam, 0 to 2 percent slopes, about 1⅛ miles south-southwest of the Ohio River at the railroad bridge to Metropolis, Illinois; 10 yards south of the Carneal Road; and 1,100 feet west of the junction of the Carneal Road and the Metropolis Road:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam; few, fine, distinct, light brownish-gray

(10YR 6/2) mottles in the lower 2 inches; moderate, fine, granular structure; very friable; less than 1 percent iron-manganese concretions; 2 percent worm casts; strongly acid; clear, wavy boundary.

B21—8 to 14 inches, yellowish-brown (10YR 5/4) silt loam; common, fine, faint, grayish-brown (10YR 5/2) mottles; weak, fine and medium, subangular blocky structure; friable; 3 percent worm casts; few iron-manganese accumulations; strongly acid; clear, wavy boundary.

B22—14 to 19 inches, light yellowish-brown (10YR 6/4) silt loam; many, medium, distinct, light-gray (10YR 7/1) mottles; moderate, medium, subangular blocky structure; friable; few iron-manganese concretions; very strongly acid; clear, wavy boundary.

A'2—19 to 26 inches, light brownish-gray (10YR 6/2) silt loam; many, medium, distinct, light-gray (10YR 7/1) and light yellowish-brown (10YR 6/4) mottles; weak, fine and medium, subangular blocky structure; friable; few iron-manganese concretions; very strongly acid; clear, wavy boundary.

B'x1—26 to 40 inches, gray (10YR 6/1) silty clay loam; common, medium, distinct, light yellowish-brown (10YR 6/4), yellowish-brown (10YR 5/6), and light-gray (10YR 7/1) mottles; moderate, coarse, prismatic and medium subangular blocky structure; firm, compact and brittle; clay films on most peds; pockets of 3 percent iron-manganese accumulations; very strongly acid; gradual, wavy boundary.

B'x2—40 to 50 inches, gray (10YR 6/1) silty clay loam; many, medium, distinct, strong-brown (7.5YR 5/6) mottles; firm, compact and brittle; patchy clay films on peds; polygonal cracks filled with gray silty material; few concretions; very strongly acid; gradual, irregular boundary.

B31g—50 to 58 inches, gray (10YR 6/1) heavy silt loam; many, medium, distinct, strong-brown (7.5YR 5/6) mottles; weak, fine, granular structure; friable; slightly compact; few concretions; strongly acid; gradual, irregular boundary.

B32—58 to 70 inches +, yellowish-brown (10YR 5/6) silt loam, common, medium, distinct, light-gray (10YR 7/1) mottles; weak, fine, granular structure; friable; few concretions; strongly acid.

The loess deposits on uplands range from 6 to 25 feet thick, and the alluvium on terraces generally ranges from 4 to 12 feet thick. Coastal Plain marine deposits underlie both. Soft and hard iron-manganese accumulations occur throughout the profile. The Ap horizon is 4 or 5 in value and 2 to 4 in chroma. The B2 horizon is 10YR or 2.5Y in hue, 4 to 6 in value, and 4 to 6 in chroma. Mottles in shades of gray are present. The texture is silt loam in most places but ranges to light silty clay loam in a few places. The A'2 horizon is 10 YR or 2.5Y in hue, 5 to 7 in value, and 1 to 3 in chroma. It is nearly continuous horizontally and is slightly compact and brittle in some places.

The B'x horizon is 10YR or 2.5Y in hue, 5 to 7 in value, and 1 to 6 in chroma. The dominant color is generally a shade of gray that has mottles of brown and yellow. The B3 horizon is mainly gray heavy silt loam in the upper part and brown silt loam in the lower part. The Ap horizon is strongly acid or very strongly acid unless it has been limed, the lower part of the solum ranges from strongly acid to medium acid, and the rest of the profile ranges from strongly acid to very strongly acid.

Calloway soils are closely associated with Grenada and Henry soils on uplands and with Henry, Okaw, Colp, and Grenada soils on stream terraces. They have a texture similar to the Grenada and Henry soils, but they are not so well drained as the moderately well drained Grenada soils and are better drained than the poorly drained Henry soils. Calloway soils have less clay in the lower part of the subsoil than the Okaw and Colp soils, and they are better drained than the Okaw soils.

Calloway silt loam, 0 to 2 percent slopes (CaA).—This soil is on high, slightly concave uplands and slightly concave stream terraces of branches, creeks, and rivers. On uplands the soil has the profile described as representative of the series.

Included with this soil in mapping were small areas of Grenada and Henry soils. Also included along streams and drainageways were small areas of Colp soils and soils on first bottoms. Some small highly alkaline areas where plants cannot grow and some larger areas where the soil is alkaline below a depth of about 2 feet were included near Clanton Creek in the northeastern part of Ballard County.

This soil has a shallow to moderately deep root zone over the fragipan, which hinders root growth. The organic-matter content and natural fertility are low. The hazard of erosion is none to slight. The soil has moderate to high suitability for crops that tolerate wetness or have a short growing season. It is suitable for continuous cultivation if management practices are used that maintain and build the fertility level and the organic-matter content. (Capability unit IIIw–3; woodland group 1w1; pasture and hayland group 12)

Calloway silt loam, 2 to 6 percent slopes (CaB).—This soil is on uplands at the head of natural drainageways and on stream terraces near the larger streams. Slopes are mostly 2 to 3 percent. This soil has a profile similar to the one described as representative of the series, but the surface layer is about 3 inches thinner.

Included with this soil in mapping were small areas of Grenada soils and small areas of alluvial soils along natural drainageways. Also included were some places where erosion has removed some of the original surface layer and the present plow layer is a mixture of material from the surface layer and subsoil.

This soil has a shallow to moderately deep root zone over the fragipan, which hinders root growth and water movement and creates a perched water table in wet periods. The organic-matter content and natural fertility are low. This soil has moderate to high suitability for crops that tolerate wetness or have a short growing season. The hazard of erosion is moderate if the soil is used for cultivated crops. Management practices are needed to control erosion and to build and maintain the fertility and organic-matter content. (Capability unit IIIw–7; woodland group 1w1; pasture and hayland group 12)

Cascilla Series

The Cascilla series consists of well-drained soils on bottom lands. These soils formed in acid alluvium, mainly near stream channels on flood plains of creeks.

In a representative profile the surface layer is brown silt loam about 7 inches thick. The upper part of the subsoil, to a depth of about 25 inches, is brown, friable silt loam. The lower part of the subsoil is brown and dark yellowish-brown, friable silt loam that has mottles of light brownish gray and extends to a depth of 65 inches or more.

The Cascilla soils have a deep root zone, moderate permeability, high available moisture capacity, and medium organic-matter content. They are strongly acid or very strongly acid throughout. In wet seasons the water table in some areas rises to 24 inches, but in many areas it is below a depth of 40 inches. These soils are easy to till, and crops respond well to lime and fertilizer. A hazard of overflow delays planting in some areas and somewhat limits the usefulness of the soils for cultivated crops and meadow.

Representative profile of Cascilla silt loam, about 500 feet southwest of where the Noble Road crosses Massac Creek, in McCracken County:

Ap—0 to 7 inches, brown (10YR 5/3) heavy silt loam; moderate, fine, granular structure; friable; strongly acid; abrupt, smooth boundary.

B21—7 to 25 inches, brown (10YR 4/3) heavy silt loam; weak, fine and medium, subangular blocky and moderate, fine, granular structure; friable; very strongly acid; clear, wavy boundary.

B22—25 to 46 inches, brown (10YR 4/3) heavy silt loam; common, medium, distinct, light brownish-gray (10YR 6/2) mottles; weak, fine and medium, subangular blocky and moderate, fine, granular structure; friable; very strongly acid; clear, broken boundary.

B23g—46 to 65 inches +, dark yellowish-brown (10YR 4/4) heavy silt loam; many, medium, distinct, light brownish-gray (10YR 6/2) mottles; weak, medium, subangular blocky and weak, fine, granular structure; friable; very strongly acid.

The alluvium ranges from 10 to more than 50 feet in thickness. The A horizon is 4 to 5 in value and 2 to 4 in chroma. The B horizon is 4 to 5 in value and 3 to 5 in chroma. Gray mottles are below a depth of 24 inches in some places, but in many places no gray mottles occur above a depth of 40 inches. The B horizon has weak or medium, fine, granular or weak, fine or medium, subangular blocky structure. Some loamy, sandy, or clayey strata are below a depth of 40 inches in some places.

Cascilla soils are near Arkabutla and Rosebloom soils. They are similar in texture to those soils but are better drained. They are similar to the Vicksburg soils, but they have more clay between depths of 10 and 40 inches.

Cascilla silt loam (Cc).—This nearly level soil is on flood plains. Most of the acreage is on a somewhat narrow flood plain that is entrenched about 15 to 30 feet below the surrounding terraces.

Included with this soil in mapping were small areas of Arkabutla, Calloway, Grenada, Vicksburg, and Falaya soils. Also included were some small areas where slopes are 2 to 4 percent; some small areas where the surface layer, subsoil, or both are silty clay loam; and a few areas of soils that have thin strata of sandy loam or loam above a depth of 40 inches.

This soil has little to no hazard of erosion. Some areas are subject to overflow; consequently, the planting of cultivated crops should be delayed until June 1.

Much of the acreage of this soil is forested. Many areas have been cleared and are used for cultivated crops and pasture. (Capability unit I–1; woodland group 1o1; pasture and hayland group 1)

Chavies Series

The Chavies series consists of deep, well-drained soils that formed in alluvium. These soils are on low stream terraces in river valleys.

In a representative profile the surface layer is very dark grayish-brown fine sandy loam about 12 inches thick. The subsoil, to a depth of about 44 inches, is brown, very friable fine sandy loam. The underlying material is yellowish-brown sandy loam that extends to a depth of 72 inches or more.

The Chavies soils have moderately rapid permeability. They are medium acid to very strongly acid throughout, but crops respond well to lime and fertilizer. These soils are easy to work and can be tilled throughout a wide range of moisture content. They are well suited to early spring planting. The favorable physical properties of these porous soils are partly offset by the limited capacity to retain fertility.

Representative profile of Chavies fine sandy loam, 0 to 4 percent slopes, about 2⅛ miles north of Rossington, 2½ miles west-northwest of Shawnee Steam Plant, and 1,000 yards south of the Ohio River, in McCracken County:

Ap—0 to 12 inches, very dark grayish-brown (10YR 3/2) fine sandy loam, brown (10YR 4/3) when crushed; moderate, fine, granular structure; very friable; medium acid; clear, wavy boundary.

B2t—12 to 44 inches, brown (10YR 4/3) find sandy loam; weak, medium, subangular blocky structure; very friable; few clay films; strongly acid; clear, wavy boundary.

C—44 to 72 inches +, yellowish-brown (10YR 5/4) sandy loam; massive; very friable; strongly acid.

The moderately coarse textured material is generally more than 10 feet thick but ranges from 3 to 40 feet in thickness. The solum ranges from 30 to 48 inches in thickness. The A horizon is 3 or 4 in value and 2 or 3 in chroma. The B2t horizon ranges from 10YR through 5YR in hue but is generally 7.5YR; is 4 or 5 in value; and ranges from 3 to 8 in chroma. The B2t horizon is generally fine sandy loam or loam. The C horizon ranges from 10YR to 7.5YR in hue, from 4 through 6 in value, and from 4 through 8 in chroma.

Chavies soils are closely associated with Molena, Wheeling, Grenada, and Calloway soils. They are less sandy throughout than the Molena soils. They have more sand and less clay in the upper part of the profile than the Wheeling soils and have more sand throughout than the others. They are better drained than the Grenada and Calloway soils and do not have a fragipan, which is characteristic of those soils.

Chavies fine sandy loam, 0 to 4 percent slopes (ChA).—This deep, loamy soil is on low stream terraces. Included in mapping were small areas of Wheeling and Molena soils, areas of a soil that has loamy sand below a depth of about 2½ feet, and areas of soils that have a surface layer of loam, loamy sand, or silt loam.

This soil has good workability and is well suited to early spring planting of corn, soybeans, and truck crops. If supplemental irrigation is used, this soil is especially suited to high-value truck crops. Wetness and water erosion are not hazards, but abrasion of seedlings by windblown sand is a hazard at times. Because the soil is porous, a high level of management is needed to maintain fertility and the organic-matter content.

Most of the acreage has been cleared and is used for cultivated crops. (Capability unit I–6; woodland group 2o1; pasture and hayland group 6)

Collins Series

The Collins series consists of moderately well drained soils that formed in alluvium derived mainly from loess. These soils are on flood plains on branch and creek bottoms.

In a representative profile the surface layer is brown silt loam about 9 inches thick. Below this, and extending to a depth of 75 inches or more, is brown, very friable silt loam that has grayish and brownish mottles.

These soils have high available moisture capacity, moderate permeability, moderate natural fertility, and low organic-matter content. They are strongly acid or very strongly acid throughout unless they have been limed. These soils have a seasonal water table 18 to 24 inches below the surface. Many commonly grown crops respond well to lime and fertilizer, and artificial drainage increases the suitability of these soils for some crops.

The Collins soils in Ballard and McCracken Counties are mapped only in a complex with Falaya soils.

Representative profile of Collins silt loam, in an area of Falaya-Collins silt loams, about one-fourth mile east of Rossington, 100 yards south of the Ogden Landing Road on the flood plain of Bayou Creek, in McCracken County:

Ap—0 to 9 inches, brown (10YR 4/3) silt loam; moderate, fine, granular structure; very friable; medium acid; clear, wavy boundary.

C1—9 to 48 inches, brown (10YR 5/3) silt loam; many, medium, distinct, light brownish-gray (10YR 6/2), pale-brown (10YR 6/3), dark grayish-brown (10YR 4/2), and yellowish-brown (10YR 5/6) mottles; massive or weak, fine, granular and weak, medium, subangular blocky structure; thin horizontal bedding planes and strata of sandy loam about 2 inches thick; very friable; few concretionary stains; strongly acid; gradual, smooth boundary.

C2—48 to 75 inches +, brown (10YR 4/3) silt loam; common, medium, distinct, light brownish-gray (10YR 6/2), yellowish-brown (10YR 5/4), and pale-brown (10YR 6/3) mottles; weak, medium, subangular blocky and moderate, fine, granular structure; thin horizontal bedding planes and strata of sandy loam about 2 inches thick; very friable; few concretionary stains; strongly acid.

The alluvium ranges from 3 to more than 15 feet in thickness. Loamy, sandy, clayey, or gravelly strata are below a depth of 40 inches in some places. The soil is strongly acid or very strongly acid in all horizons except where the surface horizon has been limed. The Ap horizon is 4 or 5 in value and 2 to 4 in chroma. The C horizon above a depth of 20 inches ranges from 10YR to 7.5YR in hue and from 3 to 5 in value and is 3 to 4 in chroma. It has few to many mottles in shades of gray. Below a depth of 20 inches, brown is also dominant in some places, but in many other places gray is dominant or the lower part of the C horizon is mottled with shades of brown and gray.

Collins soils are near Vicksburg, Falaya, Waverly, Arkabutla, Cascilla, Grenada, and Calloway soils. They are similar in texture throughout to the Vicksburg, Falaya, and Waverly soils, but they are not so well drained as the Vicksburg soils and are better drained than the Falaya and Waverly soils. They have less clay in the subsoil than the Arkabutla and Cascilla soils, are better drained than the Arkabutla soils, and are not so well drained as the Cascilla soils. They do not have a fragipan that is characteristic of the Grenada and Calloway soils and are on flood plains instead of stream terraces.

Colp Series

The Colp series consists of somewhat poorly drained soils that have medium-textured horizons that are underlain by clayey horizons in the lower part of the subsoil. These soils formed in medium-textured and clayey sediments on stream terraces.

In a representative profile the surface layer is dark grayish-brown silt loam about 7 inches thick. The upper part of the subsoil is about 11 inches of brown and yellowish-brown, friable silt loam that is mottled with brown and gray. Between depths of about 18 and 65 inches, the subsoil is dark yellowish-brown or brown, very firm silty clay that has common to many mottles in shades of gray and brown.

The Colp soils have moderate permeability in the surface layer and the upper part of the subsoil. Slow permeability in the lower part of the subsoil causes a perched water table 6 to 18 inches below the surface. These soils are very strongly acid or strongly acid in the surface layer and subsoil, except where the surface layer has been limed.

Representative profile of Colp silt loam, 0 to 2 percent slopes, about five-eighths mile east of High Point, 250 feet north of Noble Road, in McCracken County:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, fine, granular structure; very friable; very strongly acid; abrupt, smooth boundary.

B1—7 to 12 inches, brown (10YR 5/3) silt loam; many, coarse, distinct, yellowish-brown (10YR 5/6) and gray (10YR 6/1) mottles; weak, medium, subangular blocky structure; friable; less than 1 percent soft and hard accumulations; very strongly acid; clear, wavy boundary.

B21—12 to 18 inches, yellowish-brown (10YR 5/6) heavy silt loam; many, medium, distinct, light brownish-gray (10YR 6/2) mottles and common, medium, faint, strong-brown (7.5YR 5/6) mottles; weak, medium, subangular blocky structure; friable; less than 1 percent hard and soft accumulations; very strongly acid; clear, wavy boundary.

IIB22t—18 to 40 inches, dark yellowish-brown (10YR 4/4) silty clay; common, medium, distinct, gray (10YR 6/1) mottles; moderate, fine and medium, subangular blocky structure; very firm; patchy clay films on most surfaces; 1 percent hard and soft accumulations; very strongly acid; clear, wavy boundary.

IIB3t—40 to 46 inches, brown (7.5YR 4/4) silty clay; many, medium, distinct, grayish-brown (10YR 5/2) mottles; weak, medium, subangular blocky structure; very firm; few patchy clay films; pockets that are 3 percent hard and soft iron-manganese accumulations; strongly acid; clear, wavy boundary.

IIC—46 to 65 inches +, brown (7.5YR 4/4) silty clay; common, medium, distinct, light brownish-gray (10YR 6/2) mottles; massive to weak, fine, subangular blocky structure; very firm; strongly acid.

The medium-textured alluvium ranges from 12 to 24 inches in thickness in the less sloping areas, but on some sloping areas it has been removed by erosion. The clayey alluvium is 2 to 10 feet or more in thickness. It is strongly acid or very strongly acid above a depth of 4 feet and strongly acid to mildly alkaline below a depth of 4 feet.

The Ap horizon is 4 or 5 in value and 2 to 4 in chroma. It has a few gray mottles in some places. The matrix of the medium-textured B horizon is 4 to 6 in value and 3 to 6 in chroma. The matrix of the clayey B horizon ranges from 10YR to 7.5YR in hue, from 4 to 6 in value, and from 3 to 6 in chroma. The B horizon contains common to many mottles in shades of gray. In most places the structure is subangular blocky, but in some it is weak prismatic and in others it is angular blocky. The IIC horizon is similar in color to the IIBt horizon, but in some places it is dominantly gray. It generally is silty clay or clay but has loamy, sandy, and gravelly strata in some places.

Colp soils are closely associated with Okaw, Henry, and Calloway soils. They are better drained than the Okaw and Henry soils and are heavier textured in the lower part of the subsoil than the Henry soils. They have a clayey texture in the lower part of the subsoil and do not have a fragipan that is characteristic of the Calloway soils.

Colp silt loam, 0 to 2 percent slopes (CpA).—This soil has the profile described as representative of the series. Included with it in mapping were small areas of Okaw, Henry, and Calloway soils. Also included were small areas of soils that do not have gray mottles in the upper 10 inches of the subsoil and small areas of soils, mostly near Saffell soils, that have 10 to 35 percent gravel in the surface layer.

This Colp soil is easy to work, but wetness delays cultivation in many years. The soil has low natural fertility and organic-matter content. The root zone is deep, and the available moisture capacity is high. Crops that tolerate some wetness or have a short growing season respond well to lime and fertilizer.

In the vicinity of Paducah, much of the acreage is used for urban development. Some areas are in small orchards, and some are used for cultivated crops or rotation pasture and meadow. (Capability unit IIIw–2; woodland group 3w2; pasture and hayland group 12)

Colp silt loam, 2 to 12 percent slopes (CpC)—This soil is on side slopes along draws where a drainage pattern has developed in the clayey deposition. The soil has a profile similar to the one described as representative of the series, but the surface layer is thinner and the clayey layer in the subsoil is closer to the surface.

Included with this soil in mapping were some areas of severely eroded soils that have a plow layer of silty clay loam or silty clay and some areas where slopes are more than 12 percent. Included areas in which slopes are more than 22 percent are shown on the detailed soil map by the symbol for a short steep slope. Also included were some small areas of soils that have an alkaline subsoil and lime nodules within 2 feet of the surface and small areas of alluvial soils along natural drainageways.

This Colp soil has very low natural fertility and organic-matter content. Wetness is a limitation, and the hazard of erosion is very severe where the soil is used for cultivated crops. The small areas of severely eroded soils are difficult to work because the plow layer is clayey. Very intensive conservation measures are needed to build and maintain the fertility, organic-matter content, and tilth. Most of the acreage is in pasture or meadow. (Capability unit IVe–6; woodland group 3w2; pasture and hayland group 12)

Dubbs Variant

The Dubbs variant is a well-drained soil that formed in sediment on terraces of the Ohio and Tennessee Rivers.

In a representative profile the surface layer is dark-brown silty clay loam about 9 inches thick. The subsoil is brown, firm silty clay loam to a depth of 13 inches; brown and dark yellowish-brown, very firm silty clay between depths of 13 and 38 inches; and grayish-brown, very firm clay loam between depths of 38 and 52 inches. The lower part of the subsoil, to a depth of about 65 inches, is reddish-brown sandy loam. The underlying material is yellowish-brown and brown fine sand and sand that extends to a depth of 85 inches or more.

The content of clay and the compact subsoil make permeability slow. During winter, freezing and thawing cause the surface layer to have moderate to strong, granular structure, but tillage often causes clods and plowpans to form in these clayey soils. Crops are damaged by short periods of drought late in spring or in summer, even though the texture, structure, and depth of the soil seem to indicate a high available moisture capacity. Such crops as small grains and grasses that grow mostly in winter or early in spring are better suited than others. Chisel plowing to a depth of 14 to 18 inches controls surface ponding of rainwater and seems to keep the soil from being so droughty in some areas.

Representative profile of Dubbs silty clay loam, clayey subsoil variant, about 0.15 mile west of Massac Creek and 0.45 mile north of High Point, in McCracken County:

Ap—0 to 9 inches, dark-brown (10YR 3/3) silty clay loam, brown (10YR 4/3) when rubbed, brown (10YR 5/3) when dry; weak, fine, granular structure; friable; common small roots; slightly acid; abrupt, wavy boundary.

B21t—9 to 13 inches, brown (7.5YR 5/4) silty clay loam; weak, medium, subangular blocky structure; firm; common small roots; thin patchy clay films; few, very small, black concretions; strongly acid; clear, smooth boundary.

B22t—13 to 26 inches, brown (7.5YR 4/4) silty clay; moderate, fine and medium, subangular blocky structure; very firm; nearly continuous thin clay films; few, very small, black concretions; very strongly acid; gradual, smooth boundary.

B23t—26 to 38 inches, dark yellowish-brown (10YR 4/4) silty clay; moderate, fine and medium, subangular blocky structure; very firm; nearly continuous thin clay films; few, very small, black concretions; strongly acid; clear, smooth boundary.

B24t—38 to 52 inches, grayish-brown (10YR 5/2) clay loam; insides of peds are brown (7.5YR 4/4); weak, coarse, subangular blocky structure; very firm; very strongly acid; abrupt, smooth boundary.

IIB3—52 to 65 inches, reddish-brown (5YR 4/4) sandy loam; massive; friable; few small mica flakes; very strongly acid; abrupt, smooth boundary.

IIB&C—65 to 79 inches, yellowish-brown (10YR 5/6) fine sand; 1- to 5-centimeter bands of brown (7.5YR 4/4 sandy loam 2 to 3 inches apart; massive; very friable; few small mica flakes; strongly acid; clear, smooth boundary.

IIC—79 to 85 inches +, brown (10YR 5/3) and yellowish-brown (10YR 5/6) sand; single grained; loose; few small mica flakes; medium acid.

The sediment ranges from 2 to 10 feet or more in thickness. The A horizon in most places is less than 10 inches thick. It is 3 or 4 in value and 2 or 3 in chroma; when crushed it is 4 in value. It is medium acid to neutral. The B horizon is 10YR or 7.5YR in hue, 4 or 5 in value, and 3 to 6 in chroma. This horizon has weak prismatic and moderate subangular blocky structure and has clay films on peds and in pores. In some places gray mottles are between depths of 20 and 40 inches, but in many places they do not occur above a depth of 40 inches. The B horizon is strongly acid or very strongly acid. In some places it extends to a depth of more than 6 feet, and clay films and prismatic structure are as evident in the lower 2 feet as in the upper part. In other places the B horizon is only 20 to 30 inches thick. The C horizon is mainly yellowish-brown or strong-brown clay to fine sand that contains some gravelly strata.

The Dubbs variant is closely associated with the Dundee variant and with Nolin, Newark, and Lindside soils. It is better drained than the Dundee variant, but the texture in the upper part is similar. The Dubbs variant has the same internal drainage as Nolin soils, but it has a finer textured subsoil and is more acid than Nolin soils. It is better drained, has finer texture in part of the subsoil, and is more acid than Newark and Lindside soils.

Dubbs silty clay loam, clayey subsoil variant (Db).—This nearly level soil is on stream terraces. It is generally distinguished from soils on the first bottoms more by soil development than by a rise in elevation.

Included with this soil in mapping were small, narrow areas where slopes are between 6 and 17 percent. These areas are 20 to 100 feet wide and are 100 yards to about 1 mile long. Also included were small areas of Wheeling soils and of the Dundee variant and, in a few narrow swales, Arkabutla soils. Included in a few places were areas of a soil that has an extremely acid subsoil.

This soil is subject to occasional overflow, but overflows seldom occur during the growing season and generally do not last long enough to damage winter wheat. Wheat and other small grains grow well, and corn and soybeans are suited to this soil except during short periods of dry weather.

In McCracken County most of the acreage has been cleared and is used for cultivated crops (fig. 8). In Ballard County large areas are in forest, but in recent years several large tracts have been cleared and are used for cultivated crops. (Capability unit IIs-3; woodland group 2o1; pasture and hayland group 5)

Dundee Variant

The Dundee variant is a somewhat poorly drained soil that formed in alluvium on stream terraces of the Ohio and Tennessee Rivers.

In a representative profile the surface layer is dark-brown silty clay loam about 8 inches thick. The subsoil is firm or very firm silty clay loam or silty clay. The upper 25 inches is brown, grayish brown, and yellowish brown. The lower part of the subsoil, to a depth of 81 inches or more, is mainly light brownish gray and contains common to many mottles in shades of brown.

The Dundee variant is mainly strongly acid or very strongly acid, but its surface layer in many places is slightly acid. This soil has slow permeability. The high

Figure 8.—**Corn and soybeans growing on Dubbs silty clay loam, clayey subsoil variant.**

content of clay in the surface layer makes seedbed preparation difficult and causes the soil to crust. It also causes the soil to hold moisture in a form not readily available to plant roots. Compaction of the clayey subsoil and a water table only 6 to 18 inches below the surface in wet seasons also limit the response to fertilizer.

Representative profile of Dundee silty clay loam, clayey subsoil variant, about 100 feet west of farm road and one-half mile south of Dam 52 on the Ohio River:

Ap—0 to 8 inches, dark-brown (10YR 3/3) silty clay loam, brown (10YR 4/3) when rubbed; weak, fine and medium, granular structure; friable; many small roots; slightly acid; abrupt, smooth boundary.

B21t—8 to 17 inches, brown (10YR 4/3) heavy silty clay loam; common, medium, faint, grayish-brown (10YR 5/2) mottles; weak, medium, subangular blocky structure; firm; thin patchy clay films; strongly acid; gradual, smooth boundary.

B22t—17 to 25 inches, mottled grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/4) heavy silty clay loam; weak, medium and coarse, subangular blocky structure; firm; thin clay films; few, small, black concretions; very strongly acid; gradual, smooth boundary.

B23t—25 to 36 inches, light brownish-gray (10YR 6/2) silty clay; many, medium, distinct, brown (7.5YR 4/4) mottles; weak, medium and coarse, subangular blocky structure; firm; thin clay films; few, small, black concretions; very strongly acid; gradual, smooth boundary.

B24t—36 to 52 inches, light brownish-gray (10YR 6/2) silty clay; many, medium, distinct, brown (7.5YR 4/4) mottles; weak, fine, angular blocky structure; very firm; thin clay films; 2 percent small black concretions; very strongly acid; gradual, smooth boundary.

B31t—52 to 65 inches, light brownish-gray (10YR 6/2) heavy silty clay loam; common, medium, distinct, strong-brown (7.5YR 5/6) and dark yellowish-brown (10YR 4/4) mottles; weak, coarse, subangular blocky structure parting to weak, fine, angular blocky; very firm; few very patchy clay films; 2 percent small and large black concretions; very strongly acid; gradual, smooth boundary.

B32t—65 to 81 inches +, mottled light brownish-gray (10YR 6/2) and brown (10YR 5/3 and 7.5YR 4/4) light silty clay; weak, fine, angular blocky structure; very firm; thin patchy clay films; very strongly acid.

The alluvium ranges from 5 to 10 feet or more in thickness. The soil is generally strongly acid or very strongly acid, except for the surface layer which is medium acid to neutral. The A horizon is 3 or 4 in value and 2 or 3 in chroma. It is 4 in value when rubbed. It is less than 10 inches thick. The upper 10 to 20 inches of the B2t horizon is dominantly grayish brown (10YR 5/2), dark grayish brown (10YR 4/2), or brown (10YR 5/3, 4/3) and has common to many mottles in shades of gray. The lower part of the B2t horizon ranges from 2.5Y to 7.5YR in hue, from 4 to 6 in value, and from 2 to 6 in chroma. It is generally dominantly gray and has common to many mottles in shades of brown. The B2t horizon is silty clay loam or silty clay. In many places the structure is medium to coarse prismatic parting to moderate, medium to fine, subangular blocky.

The Dundee variant is near the Dubbs variant and Nolin, Wheeling, Newark, and Arkabutla soils. It is more poorly drained than the Dubbs variant. It has a finer textured subsoil than that of Nolin and Wheeling soils and is not so well drained. Unlike Newark and Arkabutla soils, it is on stream terraces instead of first bottoms and has a more clayey subsoil.

Dundee silty clay loam, clayey subsoil variant (Du). —This soil is on terraces. Most of the acreage is nearly level, except for small areas along overflow channels or where there is a small drop in elevation to the first bottoms.

Included with this soil in mapping were areas of soils that are not dominantly gray below a depth of 25 inches. Also included were narrow areas of Newark, Arkabutla, and Rosebloom soils; small, narrow areas of soils that have slopes of more than 6 percent; and areas of soils that have a surface layer of silt loam or silty clay.

This soil has a clayey surface layer that often clods and crusts. Rainfall and flooding during winter and spring saturate this soil. Later, tillage results in clodding and compaction even where the surface seems dry enough for cultivation. Only a few floods occur during the growing season. Wetness in spring delays planting in many years and gives weeds a chance to grow. Repeated tillage to control weeds during this period tends to destroy soil structure and to compact the soil. Crop response to fertilizer has been low in many years.

Most of the acreage has been cleared and is used for row crops (fig. 9) or is seeded down. Some large tracts in Ballard County are in forest, but in recent years some of these tracts have been sold and new owners are clearing the land for cultivated crops. (Capability unit IIw-6; woodland group 1w1; pasture and hayland group 5)

Falaya Series

The Falaya series consists of somewhat poorly drained soils on flood plains along branches and creeks. These soils formed in sediments washed mainly from loess.

In a representative profile the surface layer is about 8 inches of brown silt loam that has a few grayish-brown mottles. The subsoil to a depth of 16 inches is dark grayish-brown, very friable silt loam that has gray mottles. Below that to a depth of 54 inches or more, it is gray and has brown mottles.

The Falaya soils have high available moisture capacity, moderate permeability, moderate natural fertility, and medium organic-matter content. They are strongly acid or very strongly acid throughout, except

Figure 9.—**A field of Dundee silty clay loam, clayey subsoil variant, planted to corn.**

where the surface layer has been limed. A seasonal water table 6 to 18 inches below the surface often delays cultivation in spring and limits the crops that are suitable. Many of the commonly grown crops respond well to lime and fertilizer on these soils, but artificial drainage is needed for good growth of some crops.

The Falaya soils in Ballard and McCracken Counties are mapped only in a complex with Collins soils.

Representative profile of Falaya silt loam, in an area of Falaya-Collins silt loams, one-fourth mile east of Rossington, 150 feet south of the Ogden Landing Road on the flood plain of Bayou Creek, in McCracken County:

Ap—0 to 8 inches, brown (10YR 4/3) silt loam; few, fine, faint, grayish-brown (10YR 5/2) mottles; moderate, fine, granular structure; very friable; slightly acid; clear, wavy boundary.

B21—8 to 16 inches, dark grayish-brown (10YR 4/2) silt loam; many, medium, distinct, light brownish-gray (10YR 6/2) mottles and few, fine, distinct, yellowish-brown (10YR 5/6) mottles; weak, fine, subangular blocky and weak, fine, granular structure; very friable; less than 1 percent iron-manganese concretions; strongly acid; clear, wavy boundary.

B22g—16 to 30 inches, light brownish-gray (10YR 6/2) silt loam; many, medium, distinct, dark grayish-brown (10YR 4/2), brown (10YR 4/3), and yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky and weak, fine, granular structure; very friable; few, hard and soft, iron-manganese accumulations; strongly acid; clear, wavy boundary.

B23g—30 to 54 inches +, gray (2.5Y 5/1) silt loam; common, medium, distinct, light yellowish-brown (10YR 6/4) and dark grayish-brown (10YR 4/2) mottles; weak, medium, subangular blocky and weak, fine, granular structure; very friable; few, hard and soft, iron-manganese accumulations; strongly acid; abrupt, irregular boundary.

The alluvium ranges from about 3 to more than 15 feet in thickness. Sandy, clayey, or gravelly strata are below a depth of 3 feet in some places. In places along small branches where the alluvium is thin, loess underlies the alluvium. In the valleys of larger branches and creeks, Coastal Plain deposits underlie the alluvium. The soil is strongly acid or very strongly acid throughout, except where the surface layer has been limed. The Ap horizon is 4 or 5 in value and 2 to 4 in chroma. It contains a few mottles in shades of gray. The B21 horizon is dominantly brown and has few to many mottles in shades of gray. The B22g and B23g horizons are dominantly gray and have few to many mottles in shades of brown.

Falaya soils are near Vicksburg, Waverly, Cascilla, Rosebloom, Calloway, Grenada, and Arkabutla soils. They are similar in texture throughout to the Vicksburg and Waverly soils. They are not so well drained as the Vicksburg and Cascilla soils and are better drained than the Waverly and Rosebloom soils. Falaya soils do not have a fragipan that is characteristic of the Calloway and Grenada soils, and they are on first bottoms instead of stream terraces. They have less clay throughout than the Cascilla, Arkabutla, and Rosebloom soils and are generally on higher reaches of the flood plains than those soils. They are similar in drainage to the Arkabutla soils but have less clay in the subsoil.

Falaya-Collins silt loams (Fc).—These nearly level soils are on flood plains of creeks and branches. They are extensive throughout a large part of the survey area.

These soils are mapped together as a complex because their mixed pattern makes separation impractical at the scale used in mapping. Falaya soils make up about 60 percent of the complex and Collins soils about 25 percent, but in some areas either soil can make up as much as 85 percent. The Collins soils are generally nearer to the channel than the Falaya soils, but in some areas the soils on one side of the channel are mostly Falaya soils and those on the other side of the channel are mostly Collins soils.

The Falaya and Collins soils together make up about 85 percent of the total acreage of this mapping unit. Included with them in mapping were small areas of Vicksburg, Waverly, Grenada, Calloway, and Loring soils, small areas of soils that have thin strata of sandy or gravelly material within a depth of 30 feet, and small areas of soils that have a compacted layer more than 30 inches below the surface.

A seasonal water table is at a depth of about 6 to 18 inches in the Falaya soils and 18 to 24 inches in the Collins soils. Artificial drainage lowers the water table so that crops can be planted early in spring. Drainage is more important on the Falaya soils than on the Collins soils. The soils are subject to flooding, but floods are of short duration.

Most of the acreage of these soils has been cleared and is used for continuous cultivation, meadow, and rotation pasture. A small acreage is in forest. (Capability unit IIw–1; woodland group 1w1; pasture and hayland group 2)

Flomaton Series

The Flomaton series consists of excessively drained, very gravelly, steep and moderately steep soils on uplands. These soils formed in Coastal Plain gravel.

In a representative profile the surface layer is dark-gray gravelly loam about 1 inch thick. The subsurface layer is about 10 inches of pale-brown gravelly loam and about 15 inches of light yellowish-brown very gravelly sand. This is underlain by brownish-yellow very gravelly sand mixed with yellowish-red very gravelly sandy loam that extends to a depth of 80 inches or more.

The Flomaton soils have rapid permeability, very low available moisture capacity and natural fertility, and low organic-matter content. They are strongly acid or very strongly acid throughout. Crops that start growth early in spring, when there is plenty of moisture, respond to lime and fertilizer until moisture becomes a limitation. Droughtiness and the ease with which plant foods are leached beyond the reach of plant roots limit the use of lime and fertilizer and make it desirable to apply them frequently and in small amounts. The gravel in these soils dulls tillage implements.

The Flomaton soils in Ballard and McCracken Counties are mapped only in an undifferentiated group with Saffell soils.

Representative profile of Flomaton gravelly loam, in an area of Saffell and Flomaton soils, 20 to 60 percent slopes, about 3,400 feet north of Mayfield Creek, 9,600 feet northeast of Melber, and 8,000 feet west-southwest of St. Johns Church, in McCracken County:

A1—0 to 1 inch, dark-gray (10YR 4/1) gravelly loam; weak, very fine and fine, granular structure; very friable; common small and medium roots; 35 percent pebbles less than 1 inch in diameter; strongly acid; abrupt, smooth boundary.

A21—1 inch to 11 inches, pale-brown (10YR 6/3) gravelly loam; weak, fine, granular structure; very friable; common small and medium roots; 40 percent pebbles, mostly less than 1 inch in diameter; very strongly acid; gradual, smooth boundary.

A22—11 to 26 inches, light yellowish-brown (10YR 6/4) very gravelly sand; single grained; loose; few small and medium roots; 70 percent pebbles less than 2 inches in diameter; very strongly acid; abrupt, smooth boundary.

A23 and B2t—26 to 80 inches +, brownish-yellow (10YR 6/6) very gravelly sand and lamellae of yellowish-red (5YR 4/6) very gravelly sandy loam that are 1 to 2 inches thick and 2 or 3 inches apart; single grained; sand is loose, sandy loam is very friable; 70 percent pebbles less than 2 inches in diameter, mostly rounded, a few angular; some lamellae are discontinuous, and some are connected vertically; very strongly acid.

The gravelly or very gravelly Coastal Plain deposits range from 6 to 40 feet or more in thickness. The size of the gravel ranges from 2 millimeters to 4 inches in diameter and averages about one-half inch. It is mostly chert, but in some places it is quartz and ferruginous sandstone. Ledges of conglomerate and ferruginous sandstone are on the surface in some sloping areas and occur on discontinuous layers in the subsoil in a few places.

The A1 horizon has a value of 3 or 4 and a chroma of 1 or 2. The A2 horizon has a value of 6 or 7 and a chroma of 3 to 6. The gravel content of the A horizon ranges from 25 to 70 percent, by volume, and the fine earth ranges from silt loam to sand. Where present, the silt loam is in the upper 5 to 10 inches of the A horizon, and the sand is below a depth of 10 inches. The B2t horizon occurs as lamellae in the A2 horizon, generally at a depth of more than 2 feet. The B2t horizon has a hue of 7.5YR or 5YR and value and chroma of 4 to 6. It ranges from sandy loam to sandy clay loam.

Flomaton soils in Ballard and McCracken Counties contain less sand in the upper 10 inches of the A horizon than the defined range for the series, but this difference does not alter the usefulness and behavior of the soils.

Flomaton soils are near Saffell, Brandon, and Memphis soils. Their B horizon is not so well developed as that of the Saffell soils and of the Brandon soils. They contain more sand in the lower part of the solum than the Saffell soils and more gravel in the upper part of the profile than the Brandon soils. They contain more gravel throughout than the Memphis soils.

Grenada Series

The Grenada series consists of moderately well drained soils that have a fragipan. These soils formed in loess on relatively smooth uplands and in alluvium washed mostly from loess on stream terraces.

In a representative profile the surface layer is brown silt loam about 7 inches thick. The upper part of the subsoil, to a depth of about 25 inches, is yellowish-brown, friable silt loam that has mottles of pale brown, light yellowish brown, and light gray below a depth of about 20 inches. Between depths of 25 and 50 inches, the subsoil is a compact and brittle fragipan of silt loam that is mottled with shades of gray and brown. The underlying material is brown silt loam that has mottles of gray and yellowish brown and extends to a depth of 67 inches or more.

The Grenada soils are moderately permeable in the layers above the fragipan, but permeability in the fragipan is slow. The fragipan hinders the downward movement of roots and water and causes a seasonal water table late in winter and early in spring. These soils are strongly acid or very strongly acid throughout, and they have moderate available moisture capacity. Crops respond well to lime and fertilizer.

Representative profile of Grenada silt loam, 2 to 6 percent slopes, about 450 feet west of U.S. Highway 45 at the junction of Krebs Road:

Ap—0 to 7 inches, brown (10YR 4/3) silt loam; weak, fine, granular structure; very friable; many fine roots, worm holes and worm casts; strongly acid; abrupt, smooth boundary.

B21—7 to 13 inches, yellowish-brown (10YR 5/6) heavy silt loam; weak, medium, angular blocky structure; friable; few fine roots; few, small, black concretions; strongly acid; clear, wavy boundary.

B22—13 to 20 inches, yellowish-brown (10YR 5/6) heavy silt loam; moderate, fine and medium, angular blocky structure; friable; few, small, black concretions; few roots; strongly acid; clear, wavy boundary.

B23—20 to 23 inches, yellowish-brown (10YR 5/4 to 10YR 5/6) heavy silt loam; few, fine, faint, pale-brown (10YR 6/3) mottles and few, fine, distinct, light-gray (10YR 7/1) mottles; moderate, fine and medium, angular blocky structure; friable; few roots and few small concretions; strongly acid; gradual, wavy boundary.

B&A'2—23 to 25 inches, light yellowish-brown (10YR 6/4) silt loam; many, fine, distinct, light-gray (10YR 7/1) and yellowish-brown (10YR 5/4) mottles; weak, fine, angular blocky structure; friable to slightly brittle; few small concretions; strongly acid; clear, wavy boundary.

Bx1—25 to 38 inches, yellowish-brown (10YR 5/4) heavy silt loam; common, medium, distinct, light brownish-gray (10YR 6/2) and brown (7.5YR 4/4) mottles; moderate, very coarse, prismatic structure that breaks to moderate, fine and medium, subangular blocky; very firm, compact and brittle; discontinuous clay films on most peds; coatings of gray silt and silty clay loam in nearly vertical seams that extend into lower horizons; strongly acid; gradual, wavy boundary.

Bx2—38 to 50 inches, mottled light brownish-gray (10YR 6/2), pale-brown (10YR 6/3), light-gray (10YR 7/1), and brown (7.5YR 4/4) silt loam; weak, very coarse, prismatic structure parting to weak, medium and fine, subangular blocky; firm, compact and brittle; few discontinuous clay films; gray silty material in seams and pores; few black and brown concretions; strongly acid; gradual, irregular boundary.

C—50 to 67 inches +, brown (7.5YR 4/4) silt loam; common, medium, distinct, gray (10YR 6/1), light-gray (10YR 7/1), and yellowish-brown (10YR 5/4) mottles; massive; friable; strongly acid.

The A horizon is 4 or 5 in value and 2 to 4 in chroma. The B2 horizon is 4 or 5 in value and 4 to 6 in chroma. In some places a few inches of the B2 horizon range to silty clay loam. The A'2 horizon is silt loam to silt. The Bx horizon ranges from 10YR to 5Y in hue, is 4 or 5 in value, and is 2 to 6 in chroma. It is evenly mottled in shades of gray and brown in many places. Texture of the Bx1 horizon ranges from silt loam to silty clay loam. The lower boundary of the Bx2 horizon is gradual or diffuse and is wavy or irregular. The C horizon has progressively less gray mottling with increasing depth. It is generally strongly acid but is neutral or slightly alkaline below a depth of 10 feet in some places. The loess ranges from 4 to more than 40 feet in thickness on uplands, and the alluvial material generally ranges from 4 to 9 feet in thickness on terraces. Depth to the fragipan ranges from 18 to 28 inches in the uneroded phases but is as little as 12 inches in some areas of the severely eroded phases.

Grenada soils are closely associated with Loring, Calloway, and Henry soils. Grenada soils have double clay maxima, whereas the Loring soils have a single clay maximum, which is above the fragipan. Grenada soils are better drained than the somewhat poorly drained Calloway soils and the poorly drained Henry soils.

Grenada silt loam, 0 to 2 percent slopes (GrA).—This soil occupies broad areas on the smooth uplands. It is also in small areas on terraces along creeks and rivers and on ridgetops in the dissected part of the survey area. This soil has a profile similar to the one described as representative for the series, but the surface layer is generally about 2 inches thicker and the fragipan is about 2 inches closer to the surface.

Included with this soil in mapping were small areas of Calloway and Grenada soils having slopes of slightly more than 2 percent. Also included, along stream terraces, were small areas of soils that are more than 15 percent sand in the upper 30 inches of the profile.

This soil is easy to cultivate. It has a moderately deep rooting zone, moderate natural fertility, and a low organic-matter content. It has moderate to high suitability for all the commonly grown crops except alfalfa. Ordinarily, alfalfa grows well for only 2 or 3 years. After that, its stands are likely to thin as a result of frost heaving when the seasonal water table is within 18 to 24 inches of the surface. The hazard of erosion is none to slight. The soil is suitable for continuous cultivation if management practices are used that maintain and build the fertility level and the organic-matter content and if insects and plant diseases are controlled.

Most of the acreage has been cleared and is used for cultivated crops, rotation pasture, and meadow (fig. 10). A small acreage is in woods. Most of the small wooded areas are grazed and are gradually being cleared. (Capability unit IIw-3; woodland group 3o1; pasture and hayland group 11)

Grenada silt loam, 2 to 6 percent slopes (GrB).—This is the dominant soil in the central uplands. It is also in small areas on terraces along creeks and rivers and small areas in the more dissected parts of the survey area. It has the profile described as representative of the series. Most slopes are 2 to 4 percent.

Included with this soil in mapping were small areas of nearly level Grenada soils, fairly large areas of eroded Grenada soils, and small areas of severely eroded Grenada soils. Also included were small areas of Calloway soils at the heads of natural drainageways, and small areas of alluvial soils along the natural drainageways. On stream terraces there are included small areas of Wheeling soils and of soils that

Figure 10.—A recently plowed field of Grenada silt loam, 0 to 2 percent slopes, in foreground. Pasture on Grenada silt loam, 2 to 6 percent slopes, in background.

are similar to Grenada soils but are more than 15 percent sand in the upper 30 inches of the profile.

This Grenada soil has a moderately deep rooting zone, moderate natural fertility, and a low organic-matter content. It is easily cultivated and has moderate to high suitability for all the commonly grown crops except alfalfa. Ordinarily, alfalfa grows well for only 2 or 3 years. After that, the stands are likely to become thin as a result of frost heaving when the seasonal water table is within 18 to 24 inches of the surface. The erosion hazard is moderate if the soil is used for cultivated crops. Management practices are needed to reduce soil loss and to maintain the fertility level and the organic-matter content.

Most of the acreage is cleared and used for cultivated crops, rotation pastures, and meadows. Large areas in McCracken County are used for urban development. (Capability unit IIe–4; woodland group 3o1; pasture and hayland group 11)

Grenada silt loam, 2 to 6 percent slopes, severely eroded (GrB3).—This soil is on side slopes on the uplands and in small areas on terraces along creeks and rivers. It has a profile that differs from the one described as representative for the series in that the plow layer is a mixture of the original surface layer and subsoil material and has a brighter color. Also, the fragipan is closer to the surface; it is at a depth of about 12 to 24 inches. Most of the acreage has slopes of 4 to 6 percent.

Included with this soil in mapping were small areas where gravelly or sandy layers are less than 48 inches below the surface. Also included were small areas of alluvial or colluvial soils along natural drainageways. In some areas where the fragipan is at a depth of more than 20 inches, the surface layer is thicker than normal because it has been covered by alluvial or colluvial deposits. Small areas having slopes of as much as 8 percent were also included.

This soil is shallow to the fragipan, which hinders root growth and water movement and creates a perched water table in wet periods. Natural fertility is low, and the organic-matter content is very low. The soil is easy to cultivate, but it needs to be worked within a narrow range of soil moisture to prevent clodding. Surface crusting causes poor germination of seeds and survival of seedlings, especially those that are planted in spring. The hazard of erosion is severe if the soil is used for cultivated crops. Intensive management practices are needed to control erosion and to build and maintain the fertility and organic-matter content.

Most of the acreage is used for cultivated crops, rotation pastures, and meadows. A small acreage is idle or has been allowed to grow back to trees, but in recent years many of the wooded areas are being recultivated. In McCracken County many areas of this soil are used for urban development. (Capability unit IIIe–14; woodland group 4o1; pasture and hayland group 9)

Grenada silt loam, 6 to 12 percent slopes, severely eroded (GrC3).—This soil is on side slopes in the upland parts of the survey area and in small areas along stream terraces. It has a profile that differs from the one described as representative for the series in that the plow layer is mostly material from the subsoil and the fragipan is closer to the surface. The depth to the fragipan ranges from 12 to 24 inches; the average depth is about 14 inches.

Included with this soil in mapping were small areas where gravelly or sandy layers are less than 48 inches below the surface. Severely eroded Loring soils having slopes of 6 to 12 percent were included in many places. Also included were small areas of Grenada or Loring soils that are less eroded than this soil, and soils that have slopes of slightly less than 6 percent or slightly more than 12 percent. Small areas of alluvial and colluvial soils were included along natural drainageways. In most places where the fragipan is at a depth of more than 20 inches, the surface layer has been covered by alluvial or colluvial deposits and is thicker than normal. Near Paducah, urban developments have altered the horizons in many areas.

This soil has a shallow root zone to the fragipan, which hinders root growth and water movement and creates a perched water table in wet periods. Natural fertility is low, and the organic-matter content is very low. The soil is easy to cultivate, but it needs to be worked within a narrow range of soil moisture to prevent clodding. Surface crusting causes poor germination of seeds and survival of seedlings, especially for spring-planted seeds. The hazard of erosion is very severe if the soil is used for cultivated crops. Intensive management practices are needed to control erosion and to build and maintain the fertility and organic-matter content. Conservation measures are needed to reduce soil loss when pastures and meadows are established.

Most of the acreage has been cleared and used for cultivated crops, but much of it is now idle or has been allowed to grow back to trees. Many areas in McCracken County are used for urban development. (Capability unit IVe–11; woodland group 4o1; pasture and hayland group 9)

Gullied Land

Gullied land (Gu) consists of areas that have been so cut by recent gullies that they are not arable. The soil material has been removed to a depth of 3 to more than 10 feet, except in small areas between the gullies. The soil material is medium acid to very strongly acid in the surface layer, subsoil, and substratum. Gullied land generally has slopes of about 12 to 20 percent and has been frequently cultivated. In some places, gullies have cut back into sloping or gently sloping ridgetops.

Reclaiming gullied land for crops or improved pasture is difficult and expensive, but in places it is feasible. Many areas have been almost completely stablized by trees that have restocked naturally. Some areas have been planted to pines. (Capability unit VIIe–3; woodland group not assigned; pasture and hayland group 10)

Henry Series

The Henry series consists of poorly drained soils that have a fragipan. These soils formed in thick deposits of loess or alluvium. They are mainly nearly level soils on uplands and stream terraces. In a few small areas that are incised by the heads of drainageways, the soils have slopes of as much as 5 percent.

In a representative profile the surface layer is about 8 inches of grayish-brown silt loam mottled with light brownish gray. The subsurface layer is gray or light-gray silt loam mottled with brown and is about 18 inches thick. Below this is a compact and brittle fragipan of gray silty clay loam and silt loam that is mottled with shades of brown and extends to a depth of 70 inches or more.

The Henry soils have moderate permeability above the fragipan and slow permeability in the pan. The fragipan hinders the downward movement of roots and water and causes a perched water table that is at the surface late in winter and early in spring. These soils are strongly acid or very strongly acid in the surface layer, except where they have been limed. They have low natural fertility and low organic-matter content. Crops that tolerate wetness respond well to lime and fertilizer, but potential growth is low for many of the commonly grown crops.

Representative profile of Henry silt loam, about 1½ miles south of Shawnee Steam Plant, 100 yards east of Metropolis Lake Road, and 100 yards south of Illinois Central Railroad, in McCracken County:

Ap—0 to 8 inches, grayish-brown (10YR 5/2) silt loam; common, medium, faint, light brownish-gray (10YR 6/2) mottles; very friable; few, soft and hard, iron-manganese accumulations; common roots; very strongly acid; abrupt, wavy boundary.

A21g—8 to 18 inches, gray (10YR 6/1) silt loam; many, medium, distinct, yellowish-brown (10YR 5/4) mottles; weak, medium, subangular blocky and weak, fine, granular structure; friable; few, soft, iron-manganese accumulations; few roots; very strongly acid; clear, wavy boundary.

A22x—18 to 26 inches, light-gray (10YR 6/1) silt loam; common, medium, distinct, grayish-brown (10YR 5/2) and brownish-yellow (10YR 6/6) mottles; weak, fine, subangular blocky and some weak, thin, platy structure in some parts of the horizon; compact and brittle in part of the horizon, friable when disturbed; 1 percent soft and hard iron-manganese accumulations; very strongly acid; clear, wavy boundary.

Bx1—26 to 48 inches, gray (10YR 6/1) silty clay loam; many, medium, prominent, yellowish-brown (10YR 5/6) and strong-brown (7.5YR 5/6) mottles; moderate, very coarse, prismatic structure parting to moderate, medium, subangular blocky; firm, compact and brittle; patchy clay films on most peds; very strongly acid; gradual, irregular boundary.

Bx2—48 to 70 inches +, gray (10YR 6/1) silt loam; many, medium, prominent, brown (7.5YR 4/4) mottles; moderate, very coarse, prismatic structure parting to weak, medium, subangular blocky; compact and brittle when undisturbed, friable when disturbed; 2 percent, by volume, soft and hard iron-manganese accumulations; strongly acid.

The loess on uplands ranges from 6 to 40 feet in thickness, and the alluvium on terraces ranges from 3 to 10 feet or more in thickness. Coastal Plain marine deposits, which are generally very gravelly, underlie the loess. They also underlie the alluvium, but in most places a clayey or moderately coarse textured deposit is above the gravel. Soft and hard, brown and black accumulations are in most horizons. The soil is strongly acid or very strongly acid to a depth of about 4 feet, except where it has been limed.

The Ap horizon ranges from 4 through 6 in value and is 2 or 3 in chroma. It contains common to many mottles in shades of gray and brown. The A21g and A22x horizons range from 10YR through 2.5Y in hue and from 4 to 6 in value and are 2 or less in chroma. They are mottled in shades of brown, yellow, and gray. In some places remnants of a B horizon are in the lower part of the A22x horizon. The A22x horizon in some places is friable and in others has the brittleness and compactness associated with a fragipan. The depth to the fragipan ranges from about 12 to 26 inches. The matrix of the Bx horizon is 10YR or 2.5Y in hue, 4 to 6 or more in value, and 2 or less in chroma. This horizon is heavy silt loam or silty clay loam.

Henry soils are closely associated with Calloway, Grenada, Waverly, and Okaw soils. They are not so well drained as the Calloway and Grenada soils. Their drainage compares with that of the Waverly and Okaw soils, but they have a fragipan that the Waverly and Okaw soils lack and do not have the clayey horizons in the lower part of the subsoil that are characteristic of the Okaw soils.

Henry silt loam (Hn).—This nearly level soil is on uplands and stream terraces. It has a concave or slightly concave surface.

Included with this soil in mapping on uplands were small areas of Calloway soils and small areas in which slopes are more than 2 percent. Included on terraces, mostly in the transition zone between Henry and Okaw soils, were areas of soils that have clayey material at a depth of about 2 feet. Also included were areas of soils that show a definite influence of sand or gravel from nearby Wheeling, Saffell, or Chavies soils. On terraces near Clanton Creek in the north-eastern part of Ballard County, small areas where the soil is so alkaline that plants cannot grow on it were included. Other small areas of included soils near Clanton Creek are alkaline about 2 feet below the surface, which does not noticeably affect plant growth.

In this soil the root zone ranges from shallow to moderately deep over the fragipan. The water table is perched above the fragipan and extends to the surface in wet periods. The soil is easy to work, but in many years cultivation is delayed by wetness.

Much of the acreage of this soil has been cleared and is used for cultivated crops, pasture, and meadow. Because of wetness, a considerable acreage of this soil has never been cleared and remains in forest. Improved technology in recent years has increased the usefulness of this soil for corn and soybeans. (Capability unit IVw-1; woodland group 1w2; pasture and hayland group 12)

Lindside Series

The Lindside series consists of moderately well drained soils that formed in stratified alluvium. These soils are mostly in swales near the rivers.

In a representative profile the surface layer is brown silty clay loam about 8 inches thick. The subsoil, to a depth of about 42 inches, is brown, firm silty clay loam that has grayish-brown and light brownish-gray mottles below a depth of about 18 inches. This is underlain by gray silty clay loam that is mottled with shades of brown and extends to a depth of 60 inches or more.

The Lindside soils have a deep root zone, high available moisture capacity, and moderate permeability. Natural fertility is moderate, and the organic-matter content is medium. A water table is within 18 to 24 inches of the surface in wet seasons. These soils are easy to work, but tillage is often delayed by floods in spring. The soils are mostly used for row crops, because flooding in many places destroys crops that grow in winter and spring. Flooding seldom damages crops that are planted and harvested between the middle of May and November.

The Lindside soils in Ballard and McCracken Counties are mapped only in a complex with Newark soils.

Representative profile of Lindside silty clay loam, in an area of Newark-Lindside silty clay loams, about two-thirds mile north-northwest of Grassy Lake, in the southwestern part of Ballard County:

Ap—0 to 8 inches, brown (10YR 4/3) silty clay loam; moderate, fine, granular structure; friable; slightly acid; clear, wavy boundary.

B21—8 to 18 inches, brown (10YR 4/3) silty clay loam; weak, medium, subangular blocky and weak, fine, granular structure; firm; slightly acid; clear, wavy boundary.

B22—18 to 22 inches, brown (10YR 4/3) silty clay loam; few, medium, distinct, grayish-brown (10YR 5/2) mottles; moderate, medium, subangular blocky structure; firm; slightly acid; clear, wavy boundary.

B23—22 to 42 inches, brown (10YR 4/3) silty clay loam; many, medium, distinct, light brownish-gray (10YR 6/2) mottles; moderate, medium, subangular blocky structure; firm; slightly acid; clear, wavy boundary.

C—42 to 60 inches +, gray (10YR 5/1) heavy silty clay loam; common, medium, distinct, brown (10YR 4/3) and strong-brown (7.5YR 5/6) mottles; massive; firm; neutral.

The stratified alluvial deposits are more than 20 feet thick. The soil is medium acid or slightly acid in the A and B horizons. Mica is visible throughout in most places. The Ap horizon is brown (10YR 4/3) or dark grayish brown (10YR 4/2). The matrix of the B2 horizon is 10YR or 7.5YR in hue, 4 or 5 in value, and 3 or 4 in chroma. This horizon has mottles in shades of brown and gray that range from few to many below a depth of about 18 inches. The structure of the B horizon is weak to moderate, granular and subangular blocky. The C horizon is dominantly 10YR in hue and 4 or 5 in value and ranges from 1 through 4 in chroma.

Lindside soils are near Nolin, Robinsonville, Newark, and Arkabutla soils. They are not so well drained as the Nolin and Robinsonville soils. They are better drained than the Newark and Arkabutla soils and are less acid throughout than the Arkabutla soils.

Loring Series

The Loring series consists of moderately well drained soils that have a fragipan. These soils formed in loess on ridgetops and side slopes. They are extensive in the southern and central parts of the two counties.

In a representative profile the surface layer is about 7 inches of dark-brown silt loam. The upper part of the subsoil, to a depth of about 34 inches, is brown, firm or friable silt loam that has brownish and gray mottles below a depth of about 24 inches. The lower part of the subsoil is a compact and brittle fragipan of mottled brown and gray silt loam that is about 12 inches thick. The underlying material, to a depth of 60 inches or more, is brown silt loam that has light-gray mottles.

The Loring soils have a moderately deep root zone, moderate permeability above the fragipan, and moderately slow permeability in the pan. The fragipan causes a seasonal water table above it in wet periods. The water table is high for fairly short periods. In unlimed areas these soils are strongly acid throughout. All the commonly grown crops respond well to lime and fertilizer.

Representative profile of Loring silt loam, 2 to 6 percent slopes, about one-fourth mile west of the junction of Krebs Station and Houser Roads, in McCracken County:

Ap—0 to 7 inches, dark-brown (10YR 4/3) silt loam; weak and moderate, fine, granular structure; many roots; strongly acid; clear, smooth boundary.

B1—7 to 12 inches, brown (7.5YR 4/4) silt loam; weak, fine, subangular blocky structure; friable; many roots; strongly acid; clear, smooth boundary.

B21t—12 to 24 inches, brown (7.5YR 4/4) heavy silt loam; moderate, medium, subangular blocky structure; firm; discontinuous clay films on most peds; several roots; strongly acid; clear, smooth boundary.

B22t—24 to 28 inches, brown (7.5YR 4/4) heavy silt loam; few, fine, distinct, light yellowish-brown (10YR 6/4) mottles; moderate, medium, subangular blocky structure; firm; discontinuous clay films; few roots; less than 1 percent, by volume, black stains; strongly acid; clear, wavy boundary.

B23—28 to 34 inches, brown (7.5YR 4/4) silt loam; common, medium, distinct, light yellowish-brown (10YR 6/4) and yellowish-brown (10YR 5/6) mottles; coatings and streaks of gray (10YR 6/1) silt; moderate, medium, subangular blocky structure; friable; slightly compact and brittle in parts of the horizon; few clay films; strongly acid; clear, wavy boundary.

Bx—34 to 46 inches, brown (7.5YR 4/4) silt loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; coatings and streaks of light-gray silt; moderate, very coarse, prismatic structure parting to weak, fine, subangular blocky; firm, compact and brittle; strongly acid; gradual, irregular boundary.

C—46 to 60 inches +, brown (7.5YR 4/4) silt loam; coatings and mottles of light-gray (10YR 7/1) silt; massive; friable; strongly acid.

The loess deposits range from 4 to more than 40 feet in thickness. Sand content throughout the solum is generally less than 10 percent. The A horizon is 4 or 5 in value and 2 to 4 in chroma. The B horizon above the fragipan is 7.5YR and 10YR in hue, 4 or 5 in value, and 4 to 6 in chroma. In many places the lower few inches of this horizon has pale-brown or gray mottles. The B2t horizon is heavy silt loam or silty clay loam. The soil has a single clay maximum, which is in the B21t horizon.

The matrix color of the fragipan is similar to that of the upper part of the B horizon, but the fragipan has common to many gray, brown, and yellowish mottles. The fragipan is generally about 26 to 36 inches below the surface in the less eroded phases and about 22 inches below the surface in the severely eroded phases. A polygonal network of thin bleached fracture planes is throughout the fragipan. Roots are concentrated along these cracks.

The C horizon is 10YR and 7.5YR in hue, 4 to 6 in value, and 3 to 6 in chroma. This horizon has few to many mottles in shades of gray. In some areas where the loess is more than 15 feet thick, the C horizon below a depth of about 10 feet ranges from slightly acid to mildly alkaline.

Loring soils are closely associated with Memphis and Grenada soils. They are not so well drained as the well drained Memphis soils. They do not have the double clay maxima that are characteristic of the Grenada soils.

Loring silt loam, 2 to 6 percent slopes (LoB).—This soil is on convex ridgetops. In areas that are greatly dissected by natural drainageways, it is on somewhat narrow ridgetops. In gently rolling areas, it is on the higher parts of broad ridges. Slopes are generally 2 to 4 percent. This soil has the profile described as representative of the series.

Included with this soil in mapping were areas of moderately eroded soils where the plow layer is a mixture of the original surface layer and the subsoil. Also included were small areas of severely eroded soils and Grenada and Memphis soils.

This Loring soil has high available moisture capacity, moderate natural fertility, and low organic-matter content. It is easy to work. The hazard of erosion is moderate where the soil is used for cultivated crops, and conservation practices are needed to reduce soil loss.

Most of the acreage has been cleared and is used for cultivated crops, rotation pasture, and meadow. Some areas, mostly on narrow ridgetops, are in forest or are idle. (Capability unit IIe–5; woodland group 3o1; pasture and hayland group 6)

Loring silt loam, 6 to 12 percent slopes (LoC).—This soil is on high, narrow ridgetops above strongly sloping or moderately steep soils on side slopes. A small part of the acreage is on the side slopes. This soil has a profile similar to the one described as representative of the series, but in many places the plow layer is a mixture of material from the original surface layer and the subsoil, and the fragipan is about 6 inches closer to the surface.

Included with this soil in mapping were small areas in which slopes are less than 6 percent. These areas are generally the center of the ridgetops but are too narrow to map separately. Also included were small areas where slopes are more than 12 percent and small areas of severely eroded soils. Small areas of Memphis soils were included in some places.

This Loring soil has moderate available moisture capacity, low natural fertility, and low organic-matter content. It is moderately suited to crops if management is good. The hazard of erosion is severe where the soil is used for cultivated crops, and intensive conservation practices are needed to reduce soil loss.

Most of the acreage is used for rotation pasture (fig. 11), meadow, and cultivated crops. A part of it is idle, and some areas have been allowed to grow back to trees or have never been cleared. (Capability unit IIIe–5; woodland group 3o1; pasture and hayland group 6)

Loring silt loam, 6 to 12 percent slopes, severely eroded (LoC3).—This soil is on side slopes generally near the heads of drainageways. It has a profile similar to the one described as representative of the series, but severe erosion has removed much of the original

***Figure 11.*—Pasture consisting of fescue, lespedeza, and Ladino clover on Loring silt loam, 6 to 12 percent slopes.**

surface layer, and the present plow layer is mostly yellowish-brown heavy silt loam subsoil material. Also, the fragipan is generally about 22 inches below the surface but in a few places is as close as 14 inches to the surface.

Included with this soil in mapping were areas of Memphis and Grenada soils. Also included were small areas of less severely eroded Loring soils and small areas of soils that have gravelly, sandy, or loamy Coastal Plain deposits less than 48 inches below the surface. Small areas where slopes are more than 12 percent also were included. Small areas of alluvial and colluvial soils along natural drainageways were also included.

This Loring soil has moderate available moisture capacity and very low natural fertility and organic-matter content. The hazard of erosion is very severe if the soil is used for cultivated crops, and intensive conservation measures are needed to reduce soil loss. This soil can be worked only within a narrow range of moisture content without clodding. Surface crusting causes poor germination of seeds and poor survival of seedlings.

Nearly all the acreage of this soil has been cleared and is used for cultivated crops. A large part is idle or has been allowed to grow back to trees, but in recent years some of these areas are being cleared and seeded to grasses and legumes for pasture and meadow. (Capability unit IVe–11; woodland group 4o1; pasture and hayland group 9)

Loring silt loam, 12 to 20 percent slopes (LoD).—This soil is on side slopes. It has a profile similar to the one described as representative of the series, but it is more eroded and in most places the plow layer is a mixture of material from the original surface layer and the subsoil. Also, the fragipan is about 6 inches closer to the surface.

Included with this soil in mapping were small areas of Memphis and Brandon soils and small areas where slopes are slightly less than 12 percent or more than 20 percent. Small areas of alluvial and colluvial soils along branches were also included.

This Loring soil has moderate available moisture capacity, low natural fertility, and low organic-matter content. The severe hazard of erosion precludes the use of this soil for cultivated crops. Conservation practices are needed to reduce soil loss while pasture and meadow are being established.

Much of the acreage has been cleared and is used for pasture and meadow and occasionally is cultivated. Part of it is idle or has been allowed to grow back to trees, and some has never been cleared. (Capability unit VIe–1; woodland group 3o1; pasture and hayland group 8)

Loring silt loam, 12 to 20 percent slopes, severely eroded (LoD3).—This soil is on side slopes. It has a profile similar to the one described as representative of the series, but severe erosion has removed much of the original surface layer, and the present plow layer is mostly yellowish-brown heavy silt loam subsoil material. Also, the fragipan is generally about 22 inches below the surface but in a few places is as close as 14 inches to the surface.

Included with this soil in mapping were small areas of Memphis and Brandon soils and small areas where slopes are slightly less than 12 percent or slightly more than 20 percent. Small areas of alluvial and colluvial soils along branches were also included.

This Loring soil has moderate available moisture capacity and very low natural fertility and organic-matter content. It can be worked only within a somewhat narrow range of moisture content without clodding. Surface crusting causes poor germination of seeds and poor survival of seedlings. Runoff is rapid, and the hazard of erosion is too severe to allow use of the soil for cultivated crops. Conservation practices are needed to reduce soil loss while pasture and meadow are being established.

Most of the acreage has been cleared. Part of it is used for pasture and meadow, and some areas are occasionally used for cultivated crops. Much of the acreage is idle or has been allowed to grow back to trees. (Capability unit VIe–5; woodland group 4o1; pasture and hayland group 9)

Memphis Series

The Memphis series consists of deep, well-drained soils that formed in loess. These soils are on ridgetops and on some side slopes, generally facing north and east, in the uplands.

In a representative profile the surface layer is brown silt loam about 7 inches thick. The upper 5 inches of the subsoil is strong-brown, friable silt loam. Between depths of about 12 and 47 inches, the subsoil is brown, firm or friable silty clay loam and heavy silt loam. The underlying material, to a depth of 60 inches or more, is strong-brown silt loam.

The Memphis soils have a deep root zone and moderate permeability. Natural fertility is high to moderate. These soils are strongly acid or very strongly acid throughout. All the commonly grown crops respond well to lime and fertilizer.

Representative profile of Memphis silt loam, 2 to 6 percent slopes, about 250 yards east of the Old Houser Road on the Lovl-Flor-Station Road, five-eighths mile south of the Blizzard Ponds Drainage Canal, in McCracken County:

Ap—0 to 7 inches, brown (10YR 4/3) silt loam; weak, fine, granular structure; very friable; many fine roots; strongly acid; clear, smooth boundary.

B1—7 to 12 inches, strong-brown (7.5YR 5/6) heavy silt loam; weak, fine, subangular blocky structure; friable; many roots; strongly acid; clear, smooth boundary.

B21t—12 to 24 inches, brown (7.5YR 4/4) silty clay loam; moderate, fine and medium, angular blocky structure; firm; clay films on most peds; few roots; strongly acid; clear, wavy boundary.

B22t—24 to 34 inches, brown (7.5YR 4/4) heavy silt loam; moderate, fine and medium, angular blocky structure; friable; black stains on less than 2 percent of peds, clay films on most peds; few black concretions; strongly acid; clear, smooth boundary.

B23t—34 to 47 inches, brown (7.5YR 4/4) heavy silt loam; moderate, medium, angular blocky structure; firm; discontinuous clay films; few small roots; few gray silt coatings on some vertical faces of peds; strongly acid; gradual, wavy boundary.

C—47 to 60 inches +, strong-brown (7.5YR 5/6) silt loam; massive to weak, fine, angular blocky structure; friable; many cracks filled with light-gray (10YR 7/1) silt; strongly acid.

The loess deposits range from 4 to more than 40 feet in thickness and are underlain by Coastal Plain deposits. Sand content throughout the solum is less than 10 percent. The Ap horizon is 2 to 4 in chroma, and the A1 horizon is 2 or 3. The B horizon is 7.5YR or 10YR in hue, 4 or 5 in value, and 4 to 6 in chroma. Clay films in the B2t horizon are 5YR in hue. A single clay maximum, in the B21t horizon, is at a depth of about 12 to 24 inches in the slightly eroded and moderately eroded phases. The B23t horizon in some places does not have coatings of gray silt. The C horizon is 7.5YR or 10YR in hue, 4 or 5 in value, and 4 to 6 in chroma. This horizon is slightly acid to mildly alkaline below a depth of 15 feet in some places where the soil formed in loess that is 15 to 40 feet thick.

Memphis soils are closely associated with Grenada, Loring, and Brandon soils. They do not have a fragipan, which is characteristic of the Grenada and Loring soils. They formed in loess more than 4 feet thick and do not have very gravelly horizons above a depth of 4 feet, which are characteristic of the Brandon soils.

Memphis silt loam, 2 to 6 percent slopes (MmB).—This soil is on the higher ridgetops. Some of the ridgetops are narrow above strongly sloping to steep side slopes, but other high ridgetops are broader in moderately dissected areas. This soil has the profile described as representative of the series.

Included with this soil in mapping were areas of moderately eroded soils, small areas of severely eroded soils, and small areas where urban development has altered or obscured the soil profile. Also included were small areas of Loring soils and some soils that have a slightly redder subsoil than this Memphis soil.

This soil has high available moisture capacity and low organic-matter content. It is well suited to crops if good management practices are used. The hazard of erosion is moderate if the soil is used for cultivated crops, and conservation practices are needed to reduce soil loss.

Most of the acreage has been cleared and is used for cultivated crops, rotation pasture, and meadow. In and near Paducah it is used for urban development. Some areas, mostly on narrow ridgetops, are forested. (Capability unit IIe–1; woodland group 2o1; pasture and hayland group 6)

Memphis silt loam, 6 to 12 percent slopes (MmC).—This soil is on high, narrow ridgetops above strongly sloping or moderately steep side slopes. A small acreage is on side slopes. The soil has a profile similar to the one described as representative of the series, but it is more eroded and in many places the present plow layer is a mixture of material from the original surface layer and the subsoil.

Included with this soil in mapping were small areas where slopes are less than 6 percent, generally the center of the narrow ridgetops that are too narrow to map separately. Also included were small areas where slopes are more than 12 percent and some small areas of severely eroded soils. Some mapped areas contain small areas of Loring or Brandon soils. In the area of Paducah, urban development has altered the profile of some of the included soils.

This Memphis soil has high available moisture capacity and low organic-matter content. It is moderately suited to crops. The hazard of erosion is severe if the soil is used for cultivated crops, and intensive conservation practices are needed to reduce soil loss.

Most of the acreage has been cleared and is used for rotation pasture, meadow, and cultivated crops. Near Paducah, some areas of this soil are used for urban development. Smaller parts of the acreage are forested or idle. (Capability unit IIIe–1; woodland group 2o1; pasture and hayland group 6)

Memphis silt loam, 12 to 20 percent slopes (MmD).—This soil is on side slopes in the parts of the survey area that are greatly dissected by natural drainageways. It has a profile similar to the one described as representative of the series, but it is more eroded and in many places the present plow layer is a mixture of material from the original surface layer and the subsoil.

Included with this soil in mapping were small areas of Loring and Brandon soils and small areas of soils that have sandy Coastal Plain deposits within 3 feet of the surface. Also included were small areas where slopes are more than 30 percent and small areas of alluvial and colluvial soils along the natural drainageways.

This Memphis soil has a deep root zone, high available moisture capacity, and low organic-matter content. Because it is strongly sloping, the hazard of erosion is too severe for cultivated crops. Erosion control practices are needed while pasture and meadow are being established. Under good management, which includes the use of fertilizer, lime, and mulching, this soil is suited to nearly all the pasture and meadow crops that are locally grown.

Much of the acreage has been cleared and is used for cultivated crops. Some has reverted to woodland or is idle. In recent years some areas have been cleared of trees and bushes and seeded to improved pasture. (Capability unit VIe–1; woodland group 2o1; pasture and hayland group 8)

Memphis silt loam, 20 to 30 percent slopes (MmE).—This soil is on side slopes. It has a profile similar to the one described as representative of the series, but in some places it is more eroded and the present plow layer is a mixture of material from the original surface layer and subsoil. Also, the subsoil is slightly thinner and not so well developed.

Included with this soil in mapping were small areas of Brandon soils and small areas of a soil that has sandy Coastal Plain deposits within 4 feet of the surface. Also included were small areas where slopes are less than 20 percent or steeper than 30 percent. Small areas of alluvial and colluvial soils along natural drainageways were also included.

This Memphis soil has a deep root zone, high available moisture capacity, and low organic-matter content. Because the soil is moderately steep, the hazard of erosion is too severe for cultivated crops, and erosion control practices are needed while pasture and meadow are being established. This soil is suited to most pasture plants, but slope limits the kind of machinery that can be used for harvesting meadow.

Much of the acreage is in woodland. Some areas have been cleared and are used for pasture. (Capability unit VIe–1; woodland group 3r1; pasture and hayland group 8)

Memphis silty clay loam, 6 to 12 percent slopes, severely eroded (MpC3).—This soil is on side slopes. Most of the acreage is in the parts of the survey area that are greatly dissected by natural drainageways. The soil has a profile similar to the one described as representative of the series, but erosion has removed most of the original surface layer and the present plow layer is mainly silty clay loam subsoil material.

Included with this soil in mapping were small areas of Loring soils and small areas where sandy or gravelly Coastal Plain deposits are within 3 feet of the surface. Also included were small areas of soils that have slopes of more than 12 percent. Small areas of alluvial and colluvial soils along natural drainageways were also included.

This Memphis soil has moderate natural fertility, very low organic-matter content, and poor suitability for crops. The very low organic-matter content and the higher content of clay in the surface layer cause surface crusting and poor seed germination and seedling survival at times, especially for spring-seeded crops. Runoff is rapid and the erosion hazard is very severe if this soil is used for cultivated crops, and very intensive erosion control practices and management are needed to reduce soil loss.

If a high level of management is used, which includes the use of fertilizer, lime, and mulching, this soil is suited to nearly all the pasture and meadow crops and to limited row cropping. (Capability unit IVe–9; woodland group 3o1; pasture and hayland group 9)

Memphis silty clay loam, 12 to 30 percent slopes, severely eroded (MpE3).—This soil is on side slopes in the parts of the survey area that are greatly dissected by natural drainageways. It has a profile similar to the one described as representative of the series, but it is more eroded and the present plow layer is mostly silty clay loam subsoil material.

Included with this soil in mapping were small areas of Loring and Brandon soils and small areas where sandy Coastal Plain deposits are within 3 feet of the surface. Small areas of soils that have slopes of more than 40 percent were also included, as were small areas of alluvial and colluvial soils along natural drainageways.

This Memphis soil has a deep root zone, high available moisture capacity, and very low organic-matter content. Because of the very low organic-matter content and the silty clay loam surface layer, the surface crusts at times and seed germination and seedling survival are poor, especially for spring-seeded crops. Runoff is very rapid, and the hazard of erosion is too severe for cultivated crops. Erosion control practices are needed while pasture and meadow are being established. Under good management, which includes the use of fertilizer, lime, and mulching, this soil is suited to most of the pasture and meadow crops that are commonly grown.

Most of the acreage has been cleared and is used for cultivated crops. Part of the acreage has been allowed to grow back to trees or is idle. (Capability unit VIe–5; woodland group 3r1; pasture and hayland group 9)

Molena Series

The Molena series consists of somewhat excessively drained soils, mainly on stream terraces of the Ohio River.

In a representative profile the surface layer is dark yellowish-brown loamy fine sand about 12 inches thick. The subsoil extends to a depth of about 40 inches. It is reddish-brown, very friable loamy fine sand in the upper part and brown and reddish-yellow, very friable loamy sand in the lower part. The underlying material, to a depth of 60 inches or more, is yellowish-brown and brownish-yellow loamy sand.

The Molena soils have low natural fertility and available moisture capacity. They are strongly acid in the surface layer unless they have been limed. Crops respond well to fertilizer and lime, but plant nutrients should be applied in small amounts to prevent leaching. These soils can be planted early in spring; early planted crops are likely to be successful because the available moisture is generally more plentiful at that time. Grasses and legumes for pasture and meadow are difficult to establish on the sandy surface layer. These soils are overflowed by only the highest floods of the Ohio River.

Representative profile of Molena loamy fine sand, 0 to 6 percent slopes, about 1⅛ miles southeast of Dam 53, three-fourths mile east-northeast of the south end of Shelby Lake, in Ballard County:

Ap—0 to 12 inches, dark yellowish-brown (10YR 4/4) loamy fine sand; weak, fine, granular structure; very friable; medium acid; clear, wavy boundary.

B21t—12 to 28 inches, reddish-brown (5YR 4/4) loamy fine sand; weak, moderate, subangular blocky structure; very friable; thin clay coatings on sand grains and few clay bridgings between sand grains; strongly acid; clear, wavy boundary.

B22t—28 to 40 inches, brown (7.5YR 4/4) and reddish-yellow (7.5YR 6/6) loamy sand; the brown sand makes up 70 percent of the horizon and is finer sand than the reddish-yellow sand; weak, medium, subangular blocky structure; very friable; thin clay coatings on sand grains and few clay bridgings between sand grains; strongly acid; clear, wavy boundary.

C—40 to 60 inches +, yellowish-brown (10YR 5/4) and brownish-yellow (10YR 6/6) loamy sand; single grained; loose; strongly acid.

The sandy sediments are generally more than 10 feet thick but range from 3 to 40 feet thick. Thin bands (lamallae) or small spherical pockets of slightly finer textured material occur in only a few places in the upper 5 feet of the soil. All horizons are strongly acid, except for surface layers that have been limed. The A horizon is commonly dark yellowish brown (10YR 4/4) or dark brown (10YR 4/3 or 7.5YR 4/4). In some places the Ap horizon has a value of 3 but is less than 6 inches thick. The B horizon ranges from 10YR to 5YR in hue, is 4 to 6 in value, and is 4 to 6 in chroma. It has weak subangular blocky and granular structure. The C horizon in most places ranges from 10YR to 7.5YR in hue, from 4 to 6 in value, and from 3 to 6 in chroma.

Molena soils are closely associated with Wheeling, Chavies, Grenada, Calloway, and Henry soils. They are sandier throughout than any of these soils and differ further in that they are excessively drained.

Molena loamy fine sand, 0 to 6 percent slopes (MsB).—This is a sandy soil. Included with it in mapping were small areas of Chavies and Wheeling soils.

The sandy texture causes this soil to be somewhat droughty. It is difficult to establish grasses and legumes for pasture and meadow. The soil is suited to truck crops and can be cultivated earlier in spring than finer textured soils. The hazard of erosion is moderate. A high level of management is needed to maintain fertility and the organic-matter content.

Most of the acreage has been cleared and is used for cultivated crops (fig. 12). Sand for commercial use is obtained from a few areas. (Capability unit IIIs–1; woodland group 3s1; pasture and hayland group 14)

Newark Series

The Newark series consists of nearly level, deep, somewhat poorly drained soils that formed in alluvium. These soils are mostly in swales near the rivers.

In a representative profile the surface layer is brown silty clay loam about 8 inches thick. The upper part of the subsoil, to a depth of about 15 inches, is brown, firm silty clay loam that has mottles of gray. The lower part of the subsoil and the underlying material, to a depth of about 60 inches or more, are gray, firm silty clay loam with brown mottles.

The Newark soils have a deep root zone, high available moisture capacity, and moderate permeability. Natural fertility is moderate, and the organic-matter content is medium. A water table is within 6 to 18 inches of the surface in wet periods. These soils are easy to work, but tillage is often delayed by the seasonal water table and floods in spring (fig. 13). Newark soils are mostly used for row crops because flooding often destroys crops that are growing in winter but seldom damages crops that are planted and harvested between June and November.

Newark soils in Ballard and McCracken Counties are mapped only in a complex with Lindside soils.

Representative profile of Newark silty clay loam, in an area of Newark-Lindside silty clay loams, about one-half mile north-northwest of Grassy Lake, in the southwestern part of Ballard County:

Ap—0 to 8 inches, brown (10YR 4/3) silty clay loam; moderate, medium, granular structure; friable; slightly acid; clear, wavy boundary.

B21—8 to 15 inches, brown (10YR 4/3) silty clay loam; common, medium, distinct, gray (10YR 6/1) mottles; weak, medium, subangular blocky and weak, fine, granular structure; firm, few concretions; neutral; clear, wavy boundary.

B22g—15 to 26 inches, light brownish-gray (10YR 6/2) silty clay loam; many, coarse, distinct, brown (10YR 4/3) mottles and many, medium, faint, gray (10YR 6/1) mottles; weak, medium, subangular blocky structure; firm; neutral; clear, wavy boundary.

B23g—26 to 42 inches, gray (5YR 5/1) silty clay loam; many, medium, distinct, brown (10YR 4/3) mottles; gray color is dominant on exterior of peds; weak, medium, subangular blocky structure; firm; neutral; clear, wavy boundary.

Cg—42 to 60 inches +, gray (10YR 5/1) heavy silty clay loam; common, medium, distinct, brown (10YR 4/3) and strong-brown (7.5YR 5/6) mottles; massive; firm; neutral.

The alluvial deposits are more than 20 feet thick. The soil ranges from medium acid to mildly alkaline throughout. Mica is visible throughout in most places. The A horizon ranges from 2 to 4 in chroma. The matrix of the B21 horizon has a value of 4 or 5 and a chroma of 2 to 4. Gray mottles are common to many. The matrix of the B22g and B23g horizons ranges from 10YR to 5Y in hue and from 4 to 6 in value and is 1 or 2 in chroma. Mottles in shades of brown are few to many. Colors that have a chroma of 2 or less make up more than 50 percent, by volume, of the B22g, B23g, and Cg horizons, and gray colors are more predominant in coatings than inside the peds. The B horizon has weak to moderate, granular and subangular blocky structure. The C horizon ranges from 7.5YR to 5Y in hue, from 4 to 7 in value, and from 1 to 6 in chroma. It is generally gray silty clay loam that has few to many brown mottles, but it has strata where an increased content of clay or sand causes the texture to be clayey or sandy.

Newark soils are on the same landscape as Nolin, Lindside, Robinsonville, Arkabutla, and Sharkey soils. They are not so well drained as the Nolin, Lindside, and Robinsonville soils, and they have more clay and less sand throughout than the Robinsonville soils. They have the same drainage as the Arkabutla soils but are less acid in the subsoil. They are better drained and have less clay throughout than the Sharkey soils.

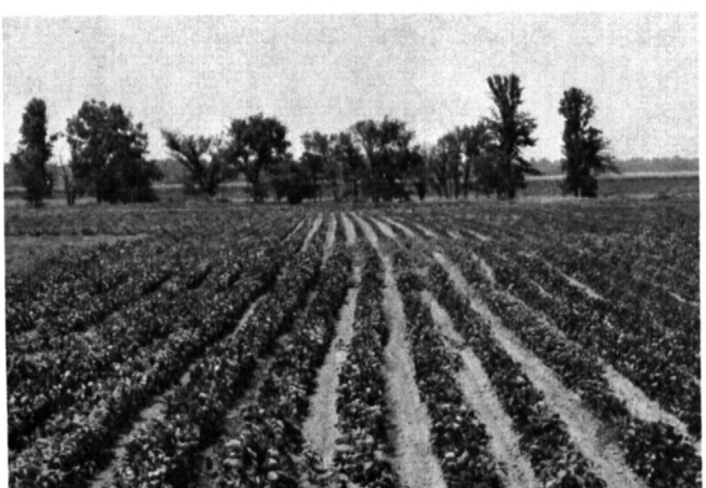

Figure 12.—**Soybeans growing on Molena loamy fine sand, 0 to 6 percent slopes.**

Newark-Lindside silty clay loams (Nd).—These nearly level soils are on flood plains of rivers.

These soils are mapped as a complex because their mixed pattern makes it impractical to map them separately. The mapping unit is generally 50 percent Newark soils and 35 percent Lindside soils, but in some areas Newark soils are dominant and in others Lindside soils are dominant. The Newark soils are generally at the lowest elevation in swales, and the Lindside soils are at a slightly higher elevation in the swales.

Newark and Lindside soils together make up about 85 percent of the total acreage. Included with them in mapping were small areas of Nolin, Arkabutla, Rosebloom, and Sharkey soils. Also included were small areas of soils that have thin sandy loam or clayey strata within a depth of 3 feet and areas of soils that have a surface layer of silt loam. Areas of Lindside soils that are neutral to mildly alkaline throughout were also included.

A seasonal water table is at a depth of about 6 to 18 inches in the Newark soils and 18 to 24 inches in the

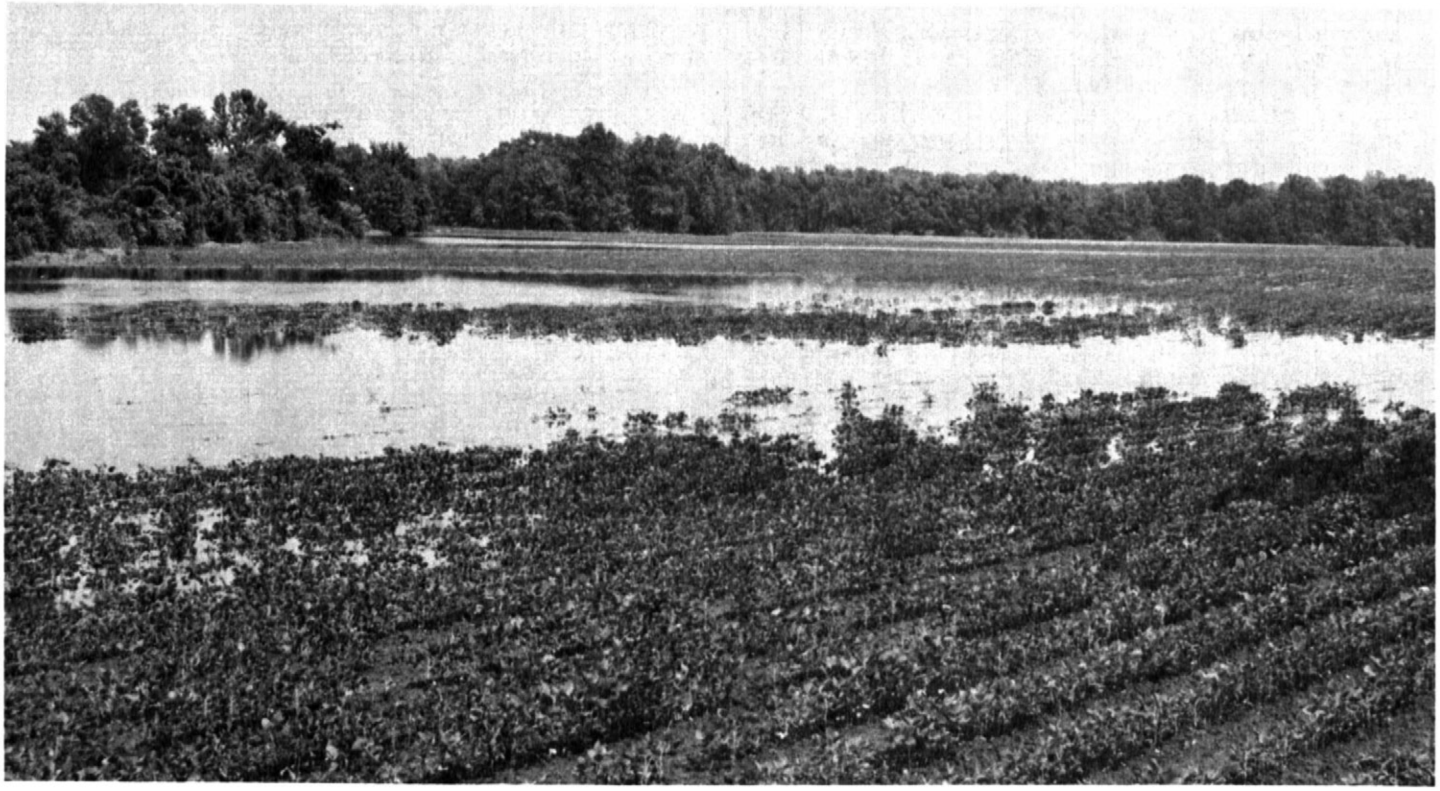

Figure 13.—**Flooding occasionally damages crops in the Newark soil.**

Linside soils. Artificial drainage in some areas lowers the water table so that crops can be planted earlier in spring. Additional drainage is impractical in many places because floodwater on the soils or a high water level in the river during the growing season nullifies additional drainage practices.

Most of the acreage has been cleared and is used for cultivated crops. Several large tracts in the western part of Ballard County that contain a large percentage of these soils were cleared in the late 1960's. A small acreage is still in forest. (Capability unit IIw-1; woodland group 1w1; pasture and hayland group 2)

Nolin Series

The Nolin series consists of well-drained soils on flood plains of rivers. These soils formed in alluvium.

In a representative profile the surface layer is dark-brown silty clay loam about 7 inches thick. The upper part of the subsoil, to a depth of about 35 inches, is dark yellowish-brown, firm silty clay loam. The lower part of the subsoil and the underlying material, to a depth of 108 inches or more, are brown and dark grayish-brown silty clay loam that is mottled with shades of gray and brown.

The Nolin soils are medium acid to neutral throughout. Roots easily penetrate the soil. In wet seasons the water table is below a depth of 24 inches in some places. Most areas are subject to flooding, but floods generally occur before the growing season and on some areas do not last long enough to damage winter grain crops.

Representative profile of Nolin silty clay loam, about 100 feet east of private road, 500 yards south of the Ohio River and Dam 52:

Ap—0 to 7 inches, dark-brown (10YR 3/3) silty clay loam, brown (10YR 4/3) when rubbed; weak, very fine and fine, granular structure; friable; few small roots; few small mica flakes; slightly acid; clear, smooth boundary.

B21—7 to 17 inches, dark yellowish-brown (10YR 4/4) silty clay loam; weak, fine and medium, subangular blocky structure; firm; few small roots; few small mica flakes; neutral; gradual, smooth boundary.

B22—17 to 35 inches, dark yellowish-brown (10YR 4/4) silty clay loam; weak, medium and coarse, subangular blocky structure; firm; dark grayish-brown (10YR 4/2) mud films on some peds and mud flows in many root channels; neutral; gradual, smooth boundary.

B23—35 to 45 inches, brown (10YR 4/3) light silty clay loam; many, medium, faint, olive-brown (2.5Y 4/4) mottles; weak, medium and coarse, subangular blocky structure; firm; dark grayish-brown (10YR 4/2) mud films on some peds and in some root channels; neutral; gradual, smooth boundary.

B24—45 to 90 inches, dark grayish-brown (2.5Y 4/2) heavy silty clay loam; common, fine, faint, dark yellowish-brown (10YR 3/4) mottles; weak, coarse, subangular blocky structure; firm; dark grayish-brown (2.5Y 4/2) mud films and flows in root channels and cracks; slightly acid; gradual, smooth boundary.

C—90 to 108 inches +, brown (10YR 4/3) silty clay loam; few, fine, faint, grayish-brown (2.5Y 5/2) mottles; massive; friable; common small mica flakes; slightly acid.

The alluvial deposits range from 4 to more than 40 feet in thickness. The soil ranges from medium acid to neutral throughout but is mainly slightly acid or neutral. The A and B horizons to a depth of 40 inches are silt loam or silty clay loam. The Ap horizon is 10YR in hue, 3 or 4 in value, and 2 or 3 in chroma. The B horizon has a hue of 10YR or 2.5Y and a chroma of 3 to 4. In many places both the A and B horizons have a darker appearance (value of 3) because the peds have dark coatings. The B horizon has weak to moderate, fine and medium, subangular blocky structure.

Nolin soils are closely associated with Dubbs, Dundee, Newark, Lindside, and Bruno soils. They are not so fine textured or so acid in the subsoil as Dubbs and Dundee soils. Also, they are better drained than Dundee soils. They are similar in texture to the Newark and Lindside soils, but they are better drained than those soils. They are finer textured throughout than the sandy Bruno soils.

Nolin silty clay loam (No).—This soil is mainly nearly level and is on flood plains. It has the profile described as representative of the series.

Included with this soil in mapping were areas of soils that contain more clay and are very strongly acid in the lower part of the subsoil. Small areas in which slopes are 2 to 20 percent were also included. In places these areas are as much as one-half mile long but are less than 75 feet wide. Also included were areas of soils near Paducah that are very strongly acid in the upper 10 inches.

This Nolin soil has a deep root zone, high available moisture capacity, high natural fertility, and medium organic-matter content. Tillage must be done only within a narrow range of moisture content to avoid clodding and crusting. Crops respond to fertilizer and small applications of lime. They do not respond so well to fertilizer as crops on soils that formed in loess or on soils that are on bottom lands and terraces and that have a surface layer of silt loam. This soil is well suited to crops. The hazard of erosion is none to slight.

Most of the acreage has been cleared and is used for cultivated crops (fig. 14). Large tracts have been cleared in recent years in both Ballard and McCracken Counties. (Capability unit IIs–2; woodland group 1o1; pasture and hayland group 1)

Nolin-Robinsonville silt loams (Nr).—These soils are mainly nearly level and are on flood plains of rivers.

Figure 14.—**Soybeans growing on Nolin silty clay loam.**

These soils are mapped as a complex because their mixed pattern makes it impractical to map them separately. The mapping unit is generally 60 percent Nolin soils and 25 percent Robinsonville soils, but in some areas the Nolin soils make up 50 to 80 percent of the acreage. The Nolin soils have a profile similar to the one described as representative of the Nolin series, but the surface layer and subsoil are silt loam. The Robinsonville soils have a surface layer of silt loam and a subsoil of fine sandy loam and sandy loam. The pattern of these soils is not entirely predictable, but generally the Robinsonville soils are within 200 to 300 yards of the river.

Nolin and Robinsonville soils together make up about 85 percent of the total acreage. Included soils make up a larger percentage of some mapped areas than the Robinsonville soils, but they are less extensive than the Nolin soils. Included with these soils in mapping were small areas where slopes are 4 to 20 percent. These areas are as much as one-half mile long but less than 75 feet wide. Also included were small areas of Lindside, Newark, and Bruno soils. Small areas of soils, mostly Robinsonville soils, that have a surface layer of fine sandy loam, loam, or sandy loam were also included. Also included were areas of a soil that is similar to the Nolin soils but has a higher percentage of sand in the subsoil.

These soils have a deep root zone, high natural fertility, and medium organic-matter content. Most of the acreage has a high available moisture capacity, but a small part of the Robinsonville soils is less well suited to crops, apparently because it is droughty. These soils are highly suitable for cultivated crops; they are easy to work and can be worked throughout a wide range of moisture content without clodding or crusting. The hazard of erosion is none to slight.

Most of the acreage has been cleared and is used for cultivated crops. Use for pasture and meadow crops is limited by the risk of flooding. (Capability unit I–1; woodland group 1o1; pasture and hayland group 1)

Okaw Series

The Okaw series consists of poorly drained to very poorly drained soils that formed in alluvium. These soils formed in loamy material and in the underlying clayey sediments on old stream terraces.

In a representative profile the surface layer is 13 inches of gray and light-gray silt loam that has dark-gray and light yellowish-brown mottles. The upper part of the subsoil, to a depth of 18 inches, is gray, friable silt loam that has light yellowish brown mottles. The lower part of the subsoil, between depths of 18 and 54 inches, is gray, firm or very firm silty clay that has yellowish-brown mottles. The underlying material is strong-brown silty clay that has gray mottles and extends to a depth of 62 inches or more.

The Okaw soils have a seasonal water table within 6 inches of the surface in winter and spring. Permeability is very slow because clay content is high in the subsoil. The available moisture capacity is high, but the clay holds much of the moisture in forms unavailable to plants. These soils are strongly acid or very strongly acid in the surface layer. They have low fertility and organic-matter content. Good response to lime and fertilizer is limited to crops that can tolerate wetness, and planting is often delayed by wetness.

Representative profile of Okaw silt loam, about three-eighths mile north of the Graves-McCracken County line, 225 feet west of the Said Road:

Ap1—0 to 3 inches, gray (10YR 5/1) silt loam; common, medium, faint, dark-gray (10YR 4/1) and light-gray (10YR 6/1) mottles; moderate, fine, granular structure; friable; less than 1 percent iron-manganese accumulations; strongly acid; clear, wavy boundary.

Ap2—3 to 8 inches, gray (10YR 5/1) silt loam; many, fine, faint, gray (10YR 6/1) mottles; moderate, fine, granular structure; friable; less than 2 percent iron-manganese accumulations; few worm casts; strongly acid; clear, wavy boundary.

A3g—8 to 13 inches, light-gray (5Y 7/2) silt loam; common, medium, distinct, light yellowish-brown (10YR 6/4) and dark grayish-brown (10YR 4/2) mottles; weak, medium, subangular blocky and weak, fine, granular structure; friable; less than 1 percent iron-manganese accumulations; very strongly acid; clear, irregular boundary.

B1g—13 to 18 inches, gray (10YR 6/1) heavy silt loam; common, medium, distinct, light yellowish-brown (10YR 6/4) mottles; weak, medium, subangular blocky structure; friable; less than 1 percent iron-manganese concretions; very strongly acid; abrupt, irregular boundary.

IIB2tg—18 to 40 inches, gray (5Y 6/1) silty clay to clay; common, medium, distinct, yellowish-brown (10YR 5/8) mottles; moderate, medium, angular blocky structure; very firm; thin clay films on most peds and in pores; very strongly acid; clear, wavy boundary.

IIB3tg—40 to 54 inches, gray (10YR 6/1) silty clay; common, coarse, distinct, yellowish-brown (10YR 5/8) mottles; weak, medium, angular blocky structure; firm; few patchy clay films; 3 percent iron-manganese accumulations in places; very strongly acid; gradual, wavy boundary.

IICg—54 to 62 inches +, strong-brown (7.5YR 5/6) silty clay; many, coarse, distinct, gray (10YR 6/1) mottles; massive; firm; 7 percent iron-manganese concretions in pockets; very strongly acid.

The gray loamy mantle ranges from 12 to 24 inches in thickness and averages about 18 inches thick. The underlying clayey alluvium extends to a depth of more than 6 feet. The solum ranges from 30 to about 55 inches in thickness. The Ap horizon ranges from 5 to 7 in value and from 1 to 3 in chroma. The A1 and A2 horizons have a value of 4 to 7 and a chroma of 1 or 2. The B1g horizon ranges from 10YR to 5Y in hue, is 5 or 6 in value, and is 0 to 2 in chroma. This horizon generally has some yellowish-brown to very pale brown mottles. It is heavy silt loam or silty clay loam. The IIB horizon has colors similar to those of the B1g horizon but is silty clay or clay that is firm or very firm. This horizon has weak, medium, prismatic structure in some places. The C horizon is dominantly gray in some places and has common to many brown mottles. It is generally very strongly acid but ranges to medium acid in some places below a depth of 3 feet.

Okaw soils are near Colp, Henry, and Alligator soils. They are not so well drained as the Colp soils. They are similar in drainage to the Henry soils but are more clayey in the lower part of the profile and do not have a fragipan. Okaw soils are not so clayey in the upper part of the profile as the Alligator soils.

Okaw silt loam (Oc).—This soil is nearly level. Included with it in mapping were small areas of Colp silt loam, larger areas of Henry silt loam, and small areas of a soil that is alkaline at a depth of 3 feet.

The most important limitations to use of this soil are wetness and the high content of clay in the lower part of the subsoil. The suitability for many of the commonly grown crops is poor. This soil is easy to work when dry, but cultivation is delayed by wetness in many years.

Some of the acreage of this soil has never been cleared of trees or has been allowed to grow back to trees after being cleared. Some areas are used for corn, soybeans, meadow, and pasture. A part of the city of Paducah is on this soil. In many of these areas, much of the wetness hazard is reduced by sewers, artificial fill, and drainage. (Capability unit IVw–2; woodland group 3w2; pasture and hayland group 12)

Robinsonville Series

The Robinsonville series consists of well-drained, nearly level soils that formed in loamy alluvium. These soils are on flood plains of rivers.

In a representative profile the surface layer is dark-brown silt loam about 17 inches thick. It is underlain by about 21 inches of dark yellowish-brown and brown, very friable fine sandy loam. The underlying material, to a depth of 60 inches or more, is dark yellowish-brown, light yellowish-brown, and brown sandy loam and loamy sand.

The Robinsonville soils have moderately rapid permeability. They do not have any internal qualities that limit their use. Most areas are subject to flooding, but floods generally occur before the growing season. Most of the acreage has been cleared and is used for cultivated crops.

The Robinsonville soils in Ballard and McCracken Counties are mapped only in a complex with Nolin soils.

Representative profile of Robinsonville silt loam, in an area of Nolin-Robinsonville silt loams, about one-half mile west of the Irvin Cobb Bridge, 1 mile east of Dam 52 and 500 feet south of the Ohio River:

Ap—0 to 8 inches, dark-brown (10YR 3/3) silt loam, brown (10YR 4/3) when crushed; moderate, fine, granular structure; very friable; mildly alkaline; clear, wavy boundary.

A1—8 to 17 inches, dark-brown (10YR 3/3) silt loam, brown (10YR 4/3) when crushed; weak, fine, granular structure; few bedding planes denoted by cleavage only; very friable; mildly alkaline; clear, wavy boundary.

C1—17 to 30 inches, dark yellowish-brown (10YR 3/4) fine sandy loam; massive; very friable; few very thin bedding planes of silt loam; mildly alkaline; clear, wavy boundary.

C2—30 to 38 inches, brown (10YR 4/3) fine sandy loam; bedding planes of light yellowish-brown (10YR 6/4) loamy sand as much as 1 inch thick; massive; very friable; neutral; clear, wavy boundary.

C3—38 to 50 inches, 55 percent dark yellowish-brown (10YR 4/4) sandy loam and 45 percent light yellowish-brown (10YR 6/4) loamy sand, mixed along thin bedding planes; massive; very friable; neutral; clear, wavy boundary.

C4—50 to 60 inches +, 85 percent brown (10YR 4/3) sandy loam and 15 percent thin bedding planes of light yellowish-brown (10YR 6/4) loamy sand; massive; very friable; mildly alkaline.

The soil ranges from slightly acid to moderately alkaline. Bedding planes are throughout the soil. The A horizon has a value of 4 or 5 and a chroma of 2 to 4. Dark coatings cause the A horizon to appear slightly darker (value of 3) in some places. The A1 horizon ranges from silt loam to fine sandy loam and loam. The C horizon has a value of 3 to 6 and a chroma of 3 or 4. Few to common mottles of gray are below a depth of 24 inches in some places. The C horizon has strata of silt loam, loam, fine sandy loam, or loamy fine sand.

Robinsonville soils are closely associated with Nolin and Bruno soils. They have a higher content of sand throughout than the Nolin soils. They are less sandy in the upper part than the Bruno soils.

Rosebloom Series

The Rosebloom series consists of poorly drained soils on flood plains of the lower reaches of the larger creeks.

In a representative profile the surface layer is dark-gray silt loam about 7 inches thick. The upper part of the subsoil, to a depth of about 52 inches, is light-gray, friable heavy silt loam. Between depths of 52 and 72 inches or more, the subsoil is gray, firm silty clay loam that has light brownish-gray and yellowish-brown mottles.

The Rosebloom soils have high available moisture capacity, slow permeability, and low natural fertility and organic-matter content. A seasonal water table is at the surface during winter and spring. The seasonal water table and flooding delay planting and limit the use of these soils in some years.

Representative profile of Rosebloom silt loam, about 1 mile east of High Point, 1⅛ miles south of the Ohio River:

Ap—0 to 7 inches, dark-gray (10YR 4/1) heavy silt loam; dark grayish-brown (10YR 4/2) when crushed; moderate, fine, granular structure; friable; neutral; gradual, wavy boundary.

B21g—7 to 52 inches, light-gray (10YR 7/1) heavy silt loam; weak, medium, subangular blocky structure; friable; 1 percent iron-manganese stains and accumulations; very strongly acid; diffuse, irregular boundary.

B22g—52 to 72 inches +, gray (10YR 6/1) heavy silty clay loam; many, coarse, distinct, light brownish-gray (10YR 6/2) mottles and common, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; firm; 1 percent, by volume, black iron-manganese accumulations and stains; strongly acid.

The Ap or A1 horizon is dark gray (10YR 4/1), dark grayish brown (10YR 4/2), or brown (10YR 5/3 or 4/3) and in many places contains few to many gray or light-gray mottles. This horizon is strongly acid or very strongly acid unless the soil has been limed. The B2g horizon is dominantly gray (10YR 5/1) to light gray (10YR 7/1) and contains few to many yellowish-brown, strong-brown, or yellowish-red mottles. This horizon is generally heavy silt loam or silty clay loam. It has granular to subangular blocky structure. The C horizon in some places contains some sandy and clayey strata.

Rosebloom soils are near Arkabutla, Newark, Waverly, Calloway, Grenada, Alligator, and Sharkey soils. They are not so well drained as the Arkabutla and Newark soils. They are similar in drainage and reaction to the Waverly soils, but they have more clay throughout. Rosebloom soils do not have a fragipan that is characteristic of the Calloway and Grenada soils. They are lighter textured throughout than the clayey Alligator and Sharkey soils.

Rosebloom silt loam (Ro).—This nearly level soil is on the lower flood plains of major streams. Included with it in mapping were small areas of Arkabutla, Waverly, Alligator, and Sharkey soils and small areas of soils that are similar to Swamp. Also included were areas where the subsoil is medium acid to neutral. Near the Molena soils in Ballard County, small areas were included where the surface layer and subsoil are sandy loam. A soil that has a surface layer of silty clay loam was also included.

This soil has slow permeability. It is easy to cultivate, but wetness delays cultivation in many years. It is subject to overflow, so its use for cultivated crops, meadow, and pasture is limited. Crops that have a medium or short growing season respond well to lime and fertilizer if adequate drainage is provided.

Much of the acreage of this soil is forested. Some areas have been cleared and are used for cultivated crops and pasture. (Capability unit IIIw-1; woodland group 1w2; pasture and hayland group 3)

Saffell Series

The Saffell series consists of well-drained soils that formed in gravelly Coastal Plain deposits. These soils are moderately steep and steep.

In a representative profile the surface layer is very dark grayish-brown gravelly fine sandy loam about 2 inches thick. The subsurface layer is brown gravelly fine sandy loam about 7 inches thick. The upper part of the subsoil, between depths of 9 and 16 inches, is yellowish-brown, friable gravelly fine sandy loam. Between depths of about 16 and 52 inches, the subsoil is yellowish-red and strong-brown, friable gravelly sandy clay loam. The underlying material is reddish-yellow very gravelly sandy loam that extends to a depth of 66 inches or more.

The Saffell soils have moderate to rapid permeability and are strongly acid or very strongly acid throughout. Natural fertility and organic-matter content are low.

Representative profile of Saffell gravelly fine sandy loam, in an area of Saffell and Flomaton soils, 20 to 60 percent slopes, about 40 yards south of old Blandville Cemetery, in Ballard County:

A1—0 to 2 inches, very dark grayish-brown (10YR 3/2) gravelly fine sandy loam; weak, fine, granular structure; very friable; many fine roots; about 30 percent, by volume, rounded gravel; strongly acid; clear, wavy boundary.

A2—2 to 9 inches, brown (10YR 5/3) gravelly fine sandy loam; weak, fine, granular structure; very friable; many fine roots; about 40 percent, by volume, rounded gravel; strongly acid; clear, wavy boundary.

B1—9 to 16 inches, yellowish-brown (10YR 5/4) gravelly fine sandy loam; weak, fine and medium, subangular blocky structure; friable; about 45 percent, by volume, rounded gravel; sand grains coated and bridged with clay; many fine roots; strongly acid; clear, wavy boundary.

B2t—16 to 30 inches, yellowish-red (5YR 5/6) gravelly sandy clay loam; weak, medium, subangular blocky structure; friable; about 50 percent, by volume, rounded gravel; thin patchy clay films on peds and gravel, sand grains coated and bridged with clay; strongly acid; clear, wavy boundary.

B3—30 to 52 inches, strong-brown (7.5YR 5/6) gravelly sandy clay loam; weak, medium subangular blocky structure; friable; about 40 percent, by volume, rounded gravel; thin patchy clay films in pores and on gravel, sand grains coated and bridged with clay; strongly acid; gradual, wavy boundary.

C—52 to 66 inches +, reddish-yellow (5YR 6/6) very gravelly sandy loam; massive; friable; about 60 percent, by volume, rounded gravel; strongly acid.

The solum ranges from 35 to 55 inches in thickness. Conglomerate rock of gravel cemented by ferruginous material and ferruginous sandstone are on the surface of the upland slopes and are discontinuous layers in the B and C horizons in some places.

The A1 horizon ranges from dark gray (10YR 4/1) to very dark grayish brown (10YR 3/2). The A2 horizon ranges from 4 to 6 in value and from 2 to 4 in chroma. The A1 and A2 horizons are 20 to 60 percent gravel, by volume.

The B1 horizon ranges from yellowish brown (10YR 5/6) to yellowish red (5YR 5/6). The fine-earth material of the B1 and B2t horizons is sandy loam or sandy clay loam, and the volume of gravel ranges from 35 to 70 percent. The B3 horizon ranges from yellowish brown (10YR 5/6) to yellowish red (5YR 5/6), and its fine-earth material ranges from clay loam to sandy loam. The content of gravel ranges from 20 to 70 percent, by volume. The B horizon has thin patchy clay films on some peds, but sand grains are well coated and bridged.

The C horizon ranges from yellowish brown (10YR 5/4) to yellowish red (5YR 5/6). The fine-earth material ranges from loamy sand to sandy clay loam, and the content of gravel ranges from 20 to 75 percent, by volume. The gravel throughout the profile is mostly rounded chert, but some is quartz and ferruginous sandstone.

Saffell soils are near Brandon, Memphis, and Flomaton soils on uplands and Wheeling, Henry, and Okaw soils on stream terraces. They have more gravel in the surface layer and subsoil than the Brandon, Memphis, Wheeling, Henry, and Okaw soils. They have a more strongly developed B horizon and have less sand in the lower part of the solum than the Flomaton soils.

Saffell gravelly loam, 0 to 12 percent slopes (SaC).—This soil is on long, low terrace ridges, at an elevation of about 355 feet above sea level, that are a few feet higher than the associated broad, flat terraces. It has a profile similar to the one described as representative of the series, but the subsoil has strata of loamy sand and is slightly less well developed and thinner. Also, the surface layer is less sand.

Included with this soil in mapping were small areas of Flomaton, Wheeling, and Chavies soils and soils that have less than 20 percent gravel below a depth of 20 inches. Also included were areas of soils that have a surface layer of silt loam, fine sandy loam, or loamy sand and have only a few pebbles. Other included soils have similar texture and are very gravelly. Also included were small areas where slopes are between 12 and 20 percent.

This Saffell soil has moderate to rapid permeability and low available moisture capacity, natural fertility, and organic-matter content. It is strongly acid or very strongly acid in the surface layer unless it has been limed. Suitability for most crops is very poor because the soil is droughty. This gravelly soil is difficult to work, and it dulls tillage implements. The hazard of erosion is severe if the soil is used for cultivated crops, and it is difficult to maintain a good stand of many of the commonly grown pasture and meadow plants.

Most of the acreage has been cleared. Since areas of this soil are on long, narrow ridges, they are used with the adjoining soils for row crops, pasture, and meadow or are left idle. This soil is sometimes left idle when adjoining soils are cultivated. (Capability unit IIIs–2; woodland group 4f1; pasture and hayland group 13)

Saffell and Flomaton soils, 20 to 60 percent slopes (SfE).—These soils are in deeply dissected areas. Their surface layer is 20 to 75 percent gravel, and the soil material ranges from silt loam to sand.

These soils are mapped as an undifferentiated unit because they are similar in use and suitability, and in some places it is impractical to map them separately because of their mixed pattern. They have the profile described as representative of their series. Most areas of this mapping unit contain both soils, but the proportion varies.

Saffell and Flomaton soils make up about 60 percent of the mapping unit, and other soils make up about 40 percent. The Saffell and Flomaton soils are mostly on the upper parts of slopes and make up about 80 percent of that acreage. Brandon and Memphis soils make up the remaining 20 percent. Soils that are underlain by sandy or loamy Coastal Plain deposits are on the lower parts of slopes in the eastern part of the survey area near Mayfield Creek, and soils that are underlain by clayey Coastal Plain deposits are on the lower slopes near Blandville. Also on the lower slopes are Saffell, Memphis, and Brandon soils and soils that formed in gravelly alluvium.

The soils in this mapping unit are very droughty, and their steep slopes cause rapid runoff. They are not suitable for cultivation and meadow, and they are poorly suited to pasture. It is difficult to establish and maintain pasture plants because of the steep slopes, gravelly surface layer, and droughtiness.

Very little of the acreage of this mapping unit has been cleared. Most of it is in hardwood trees of low quality. (Capability unit VIIe–2; woodland group 4f1; pasture and hayland group 13)

Sharkey Series

The Sharkey series consists of deep, poorly drained soils that formed in clayey slack water deposits. These are nearly level soils in low lying areas on river floodplains.

In a representative profile the surface layer is about 12 inches of dark-gray and grayish-brown silty clay that is mottled with gray and yellowish brown in the lower 7 inches. Between depths of 12 and 65 inches or more, the soil is gray, very firm silty clay that has mottles of strong brown, yellowish brown, and yellowish red.

The Sharkey soils have very slow permeability and moderate natural fertility. They range from medium acid to neutral. The soils are difficult to work because the surface layer is clayey, they are subject to wetness because of flooding, and they have very slow permeability. They are at a low elevation, and in some areas flooding delays cultivation until after the planting dates for corn and soybeans.

Representative profile of Sharkey silty clay, about one-half mile northwest of the western end of Crawford Lake, in McCracken County:

A11—0 to 5 inches, dark-gray (10YR 4/1) silty clay; moderate, fine, granular structure; firm; slightly acid; clear, wavy boundary.

A12—5 to 12 inches, grayish-brown (10YR 5/2) silty clay; many, medium, distinct, yellowish-brown (10YR 5/4) and gray (10YR 5/1) mottles; weak, medium, subangular blocky structure; very firm; neutral; gradual, wavy boundary.

B21g—12 to 34 inches, gray (N 6/0) silty clay; common, medium, distinct, strong-brown (7.5YR 5/6) mottles; weak, medium, prismatic structure parting to weak, coarse, subangular blocky; very firm; neutral; gradual, wavy boundary.

B22g—34 to 55 inches, gray (N 6/0) silty clay; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, fine, angular blocky structure; very firm; common organic stains; neutral; gradual, wavy boundary.

Cg—55 to 65 inches +, gray (N 6/0) silty clay; many, coarse, prominent, yellowish-red (5YR 5/6) mottles; massive to weak, fine, angular blocky structure; very firm; neutral.

The solum ranges from 36 to 60 inches in thickness. The soil has cracks in dry periods that are 5 to 20 millimeters wide and extend as thin cracks into the B horizon. The soil ranges from medium acid to neutral throughout. The A horizon has a value of 3 to 5 and a chroma of 1 or 2. The B horizon has a neutral hue in some places, and in others it ranges from 10YR to 2.5Y in hue, is 4 to 6 in value, and is less than 2 in chroma, except for common yellowish-brown mottles. The B horizon is silty clay or clay. It has weak, medium, prismatic and weak, coarse to fine, subangular blocky structure. The C horizon has about the same color and texture as the B horizon.

Sharkey soils in Ballard and McCracken Counties contain slightly less clay in the B horizon than the defined range for the series, but this difference does not alter the usefulness and behavior of the soils.

Sharkey soils are closely associated with Newark, Rosebloom, and Alligator soils. They are not so well drained as the Newark soils and have more clay throughout than those soils. They have more clay throughout and are less acid in the subsoil than the Rosebloom soils. They are similar in texture and drainage to the Alligator soils but are less acid throughout.

Sharkey silty clay (Sh).—This fine-textured, nearly level soil is on river flood plains. Included with it in mapping were small areas of Rosebloom, Arkabutla, and Newark soils. Also included were some areas of Sharkey soils that have a layer of dark grayish-brown or brown heavy silt loam or silty clay loam overwash that is 3 to 10 inches thick and areas of Sharkey soils that have a surface layer of clay.

This soil is suited to corn and soybeans if good management and conservation practices, including artificial drainage, are used. The soil is often flooded, and surface runoff is slow unless adequate drainage is provided. The available moisture capacity is high, and the organic-matter content is medium. The root zone is deep. Flooding and a seasonal high water table at the surface prevent many areas from being cultivated in wet years.

Much of the acreage of this soil is in forest. Some cleared areas are idle in many years because of flooding and wetness. Some areas are used for soybeans and corn year after year. (Capability unit IIIw–5; woodland group 1w2; pasture and hayland group 4)

Swamp

Swamp (Sw) consists of nearly level soils in low-lying areas that are under water most of the year. In many areas the trees have been killed by ponded water. In others all but cypress and gum trees show damage from ponded water (fig. 15). Because of the standing water, the soils were not identified. In some areas the soil is exposed during dry periods late in summer, and it is gray or white heavy silt loam or silty clay loam from the surface to a depth of more than 42 inches. In other areas it is gray or bluish-gray silty clay or clay throughout.

Swamp is not suited to any farm crops unless it is drained, but it is important to some forms of wildlife, especially waterfowl. (Capability unit VIIw–1; woodland group not assigned; pasture and hayland group not assigned)

Vicksburg Series

The Vicksburg series consists of well-drained, nearly level soils on flood plains of branches and creeks. These soils formed in sediments washed mainly from loess.

In a representative profile the surface layer is brown silt loam about 8 inches thick. To a depth of about 48 inches, the underlying material is brown and dark-brown, very friable silt loam. Between depths of 48 and 60 inches or more, it is brown loam that has pale-brown mottles.

The Vicksburg soils have high available moisture capacity, high natural fertility, and low organic-matter content. They are strongly acid throughout. These soils have moderate permeability. In some areas the water table is below a depth of about 2 feet in wet seasons. The soils are easy to till. All the commonly grown crops respond well to lime and fertilizer and are very well suited.

Representative profile of Vicksburg silt loam, about 25 yards east of Womble Road and 100 yards north of Sugar Creek, in the southwestern part of McCracken County:

Ap—0 to 8 inches, brown (10YR 5/3) silt loam; weak, fine, granular structure; very friable; common fine roots; strongly acid; clear, wavy boundary.

C1—8 to 14 inches, brown (10YR 4/3) silt loam; massive or very weak subangular blocky structure; bedding planes denoted by cleavage; very friable; common fine roots; strongly acid; clear, wavy boundary.

C2—14 to 29 inches, dark-brown (10YR 4/3) silt loam; very weak subangular blocky structure and massive; bedding planes denoted by cleavage; very friable; strongly acid; gradual, wavy boundary.

C3—29 to 48 inches, brown (10YR 4/3) silt loam; very weak subangular blocky structure and massive; bedding planes denoted by cleavage; very friable; strongly acid; clear, wavy boundary.

C4—48 to 60 inches +, brown (10YR 4/3) loam; common, medium, distinct, pale-brown (10YR 6/3) mottles; massive; very thin bedding planes; very friable; strongly acid.

The alluvium ranges from 3 to 15 feet or more in thickness. Near the small branches where it is thin, the alluvium is underlain by loess in some places. Along the larger branches and creeks, Coastal Plain deposits underlie the alluvium. Loamy, sandy, or clayey strata are below a depth of 3½ feet in some places. The Ap horizon is 4 or 5 in value and 2 to 4 in chroma. The C horizon is mainly 10 YR in hue but ranges to 7.5YR. It is 4 or 5 in value and 3 to 6 in chroma. The C horizon is mottled in shades of brown and

Figure 15.—**In this area of Swamp, all the trees except the cypress trees have died because of the ponded water.**

gray below a depth of 2 feet in some places, but in others it does not have any gray mottles above a depth of 4 feet. In most places the structure is granular to a depth of 3 feet or more, but weakly developed blocky structure is not uncommon in the C horizon. Bedding planes are generally visible only by soil cleavage, but some have slightly different color and texture.

Vicksburg soils are near Collins, Falaya, Waverly, and Cascilla soils. They have similar texture but are better drained than the Collins, Falaya, and Waverly soils. They are similar in drainage and profile development to the Cascilla soils but have less clay in the subsoil.

Vicksburg silt loam (Vb).—This nearly level soil is on bottom lands, mostly on somewhat narrow flood plains beginning about one-fourth mile below the heads of branches and extending for 1 or 2 miles along the streams.

Included with this soil in mapping were small areas of Collins, Cascilla, and Falaya soils and small areas of a soil that has more sand in the subsoil than this Vicksburg soil. Also included were small areas where slopes are 2 to 6 percent. Some included soils have a weakly developed soil profile denoted by brighter color and a slight increase in clay in the subsoil. Also included were areas of soils that have compacted layers at a depth of 30 inches or more.

This soil is very well suited to cultivated crops, and crops respond well to lime and fertilizer. Some areas are subject to overflow, but the floods are of short duration and the hazard of erosion is slight. Such deep-rooted crops as alfalfa are benefited on some areas of this soil by drainage that quickly lowers the water table.

Most of the acreage has been cleared and is used for cultivated crops (fig. 16). Some areas are used for rotation pasture and meadow, and a small acreage is in

Figure 16.—**A plowed area of Vicksburg silt loam in foreground. Falaya and Waverly soils in the background.**

forest. (Capability unit I–1; woodland group 1o1; pasture and hayland group 1)

Waverly Series

The Waverly series consists of poorly drained soils on flood plains of the larger creeks. These soils formed in sediments washed mainly from loess.

In a representative profile the surface layer is about 7 inches of grayish-brown silt loam mottled with light gray. The subsoil is gray or light-gray, friable silt loam that is mottled with shades of gray and brown and extends to a depth of 70 inches or more.

The Waverly soils have high available moisture capacity, moderate permeability, and low natural fertility and organic-matter content. They are strongly acid or very strongly acid throughout, except where they have been limed. A seasonal water table is at a depth of 0 to 6 inches. It generally delays cultivation in spring and limits the crops that are suitable. Some of the commonly grown crops respond well to lime and fertilizer on these soils, but adequate drainage is needed for some crops.

Representative profile of Waverly silt loam, about 1¼ miles south of New Hope Church, one-fourth mile north of Mayfield Creek, one-half mile east of the Illinois Central Railroad, in the southwestern part of McCracken County:

Ap—0 to 7 inches, grayish-brown (10YR 5/2) silt loam; many, fine, distinct, light-gray (10YR 7/1) mottles; weak, fine, granular structure; very friable; common roots; few concretions; mildly alkaline; clear, smooth boundary.

B21g—7 to 11 inches, gray (10YR 6/1) silt loam; many, medium, distinct, brown (10YR 4/3) mottles; weak, medium, subangular blocky structure that breaks into weak, fine, granular; friable; common dark yellowish-brown coatings; few concretions; medium acid; gradual, wavy boundary.

B22g—11 to 34 inches, light-gray (10YR 7/1) silt loam; common, medium, distinct, light yellowish-brown (10YR 6/4) mottles; weak, fine, subangular blocky structure that breaks into weak, fine, granular; friable; 3 percent, by volume, brown concretions and stains; strongly acid; clear, wavy boundary.

B23g—34 to 49 inches, light-gray (10YR 7/1) silt loam; common, medium, distinct, pale-brown (10YR 6/3), brown (10YR 5/3), light yellowish-brown (2.5Y 6/4), and light olive-brown (2.5Y 5/4) mottles; weak, fine, granular structure; friable; strongly acid; gradual, wavy boundary.

B24g—49 to 70 inches +, mottled light-gray (10YR 7/1), yellowish-brown (10YR 5/6), and light olive-brown (2.5Y 5/4) silt loam; weak, fine, granular structure; friable; common brown concretions; strongly acid.

The alluvium ranges from about 5 to more than 15 feet in thickness. The A horizon ranges from 4 to 6 in value and from 1 to 3 in chroma. The Bg horizon ranges from 10YR to 5Y in hue and from 5 to 7 in value and is 1 or 2 in chroma. It has few to common mottles in shades of brown. In some places below a depth of 3 feet is a Cg horizon that generally is similar to the B horizon in color and texture but is massive and in some places has sandy, clayey, or gravelly strata.

Waverly soils are near Falaya, Collins, Vicksburg, Calloway, Grenada, and Rosebloom soils. They are similar in texture throughout to the Falaya, Collins, and Vicksburg soils but are not so well drained. They do not have as much clay in the subsoil and are not so well drained as the Calloway and Grenada soils, and they do not have a fragipan. They have the same drainage as the Rosebloom soils but have less clay throughout.

Waverly silt loam (Wa).—This nearly level soil is on bottom lands, mostly on flood plains of the larger creeks. Included with it in mapping were small areas of Falaya, Rosebloom, and Arkabutla soils and small areas of a soil that is loam in parts of the subsoil. Small areas that are almost as wet as Swamp were included in places.

A seasonal water table that is within 6 inches of the surface generally delays planting. Drainage is needed to lower the water table and to remove overflow quickly. Some areas are not suited to cultivated crops until adequate drainage is provided.

Part of the acreage of this soil has been cleared and is used for row crops (fig. 17). Some areas are used for rotation pasture and meadow, and some large tracts are in forest. (Capability unit IIIw-1; woodland group 1w2; pasture and hayland group 3)

Wheeling Series

The Wheeling series consists of deep, well-drained, nearly level to sloping soils on stream terraces of the major creeks and rivers. These soils formed in mixed alluvium that is dominantly loamy.

In a representative profile the surface layer is dark grayish-brown silt loam about 8 inches thick. The next layer is dark grayish-brown, friable silt loam that has mottles of yellowish brown and is about 5 inches thick. The subsoil is strong brown and extends to a depth of about 46 inches. It is friable silty clay loam in the upper part, friable clay loam in the middle, and very friable sandy loam in the lower part. The underlying material, to a depth of 70 inches or more, is brown sandy loam.

The Wheeling soils have a deep root zone, moderate permeability, and high available moisture capacity. They are strongly acid throughout. Crops respond well to lime and fertilizer. These soils occupy high positions on the flood plain and are not subject to annual flooding.

Representative profile of Wheeling silt loam, 0 to 2 percent slopes, about 2¼ miles north of Rossington, 2½ miles west-northwest of Shawnee Steam Plant, one-half mile south of the Ohio River:

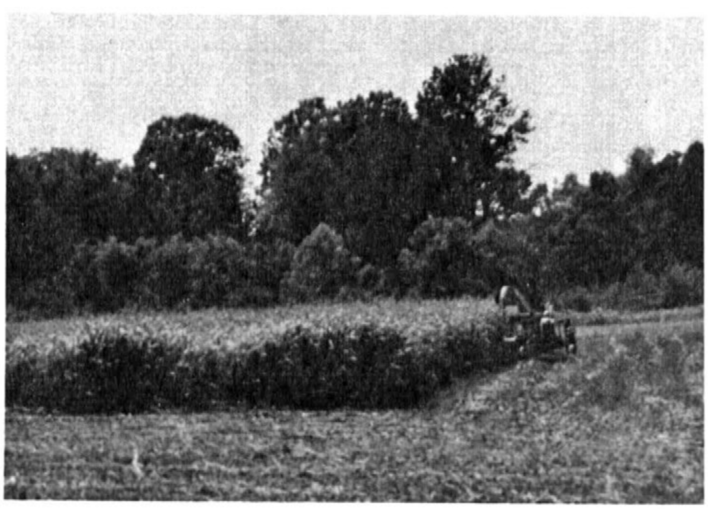

Figure 17.—**Harvesting sudan grass for silage. The soil is Waverly silt loam.**

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, fine, granular structure; friable; strongly acid; clear, wavy boundary.

AB—8 to 13 inches, dark grayish-brown (10YR 4/2) heavy silt loam; medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky and weak, fine, granular structure; friable; less than 1 percent iron-manganese concretions; strongly acid; clear, wavy boundary.

B21t—13 to 28 inches, strong-brown (7.5YR 5/6) silty clay loam; moderate, medium, subangular blocky structure; friable; thin discontinuous clay films on most peds; 2 percent iron-manganese accumulations; strongly acid; clear, wavy boundary.

B22t—28 to 36 inches, strong-brown (7.5YR 5/6) clay loam; weak, fine, subangular blocky structure; friable; thin discontinuous clay films on peds; less than 1 percent iron-manganese accumulations; strongly acid; clear, wavy boundary.

B3—36 to 46 inches, strong-brown (7.5YR 5/6) sandy loam; common, medium, distinct, brown (10YR 4/3) mottles; weak, medium, subangular blocky structure; very friable; strongly acid; clear, wavy boundary.

C—46 to 70 inches +, brown (7.5YR 4/4) sandy loam; massive; very friable; visible mica flakes; strongly acid.

The solum generally ranges from about 30 to 60 inches in thickness; the shallower depth is generally restricted to eroded sites. At lower depths, generally below a depth of 3 to 6 feet, the soil is underlain by noncalcareous, stratified, sandy, gravelly, loamy, and clayey material that extends to a depth of more than 40 feet in places. Shiny mica and quartz particles are visible without magnification in most places. The A horizon has a value of 4 or 5 and a chroma of 2 to 4. The B2t horizon is 10YR or 7.5YR in hue and ranges from 4 to 6 in value and chroma. In most places it is silty clay loam, but it ranges to clay loam and loam. Thin clay films are visible in some pores and are discontinuous on peds. The C horizon is stratified in some places. It ranges from loamy sand to silty clay but generally is sandy loam.

The Wheeling soils are near Grenada, Calloway, Henry, Dubbs, and Chavies soils. They do not have a fragipan and are better drained than the Grenada, Calloway, and Henry soils. Also, they have more sand in the subsoil than those soils. They have more sand and less clay in the upper part of the profile than the Dubbs soils. They have less sand and more clay in the upper part of the profile than the Chavies soils.

Wheeling silt loam, 0 to 2 percent slopes (WhA).—This soil is on the highest parts of stream terraces and is generally in long, somewhat narrow areas that parallel the present drainage pattern. It has the profile described as representative of the series.

Included with this soil in mapping were small areas of a soil that has slopes of 2 to 4 percent. A soil included in mapped areas near Island Creek southeast of Paducah has as much as 10 percent gravel in the surface layer and as much as 70 percent gravel at a depth of about 2 feet. The gravel is mostly ½ to 1 inch in diameter. Some included soils have a surface layer, subsoil, or both of sandy loam or loam. Also included were small areas of a soil that has a surface layer, subsoil, or both of silty clay loam. Some mapped areas include soils that have gray mottles at a depth of 33 inches or more.

This Wheeling soil has moderate natural fertility, low organic-matter content, and a high suitability for cultivated crops. It is easy to work, and crops respond well to lime and fertilizer. The soil is subject to flooding during the highest floods but is seldom flooded during the growing season.

Most of the acreage has been cleared and was used for farming in the past. Although a considerable part is now being used for row crops, some areas are in pasture or are idle. Most of the acreage of this soil in and around Paducah is used for urban development. (Capability unit I–5; woodland group 2o1; pasture and hayland group 6)

Wheeling silt loam, 2 to 6 percent slopes (WhB).—This soil is on stream terraces, generally on the larger flood plains in the survey area and on the highest parts of the terraces. The areas are generally elongated and parallel the present drainage pattern.

Included with this soil in mapping were small areas of soils that have more gravel, sand, or clay in the subsoil than this Wheeling soil. Also included were areas of moderately eroded soils where the present surface layer is a mixture of material from the original surface layer and the subsoil and is generally 4 to 6 inches thick. The plow layer in these eroded areas contains slightly more clay and less organic matter than the plow layer of uneroded soils. A soil that has a surface layer of loam was also included.

This Wheeling soil has moderate natural fertility, low organic-matter content, and a high suitability for cultivated crops. It is easy to work, and crops respond well to lime and fertilizer. The hazard of erosion is moderate, and erosion control practices are needed if the soil is used for cultivated crops. This soil is subject to occasional flooding but is seldom flooded during the growing season.

Much of the acreage of this soil is used for cultivated crops (fig. 18), meadow, or rotation pasture. The acreage near Paducah is used for urban purposes. (Capability unit IIe–1; woodland group 2o1; pasture and hayland group 6)

Wheeling silt loam, 6 to 12 percent slopes (WhC).—This soil is on terraces of the larger flood plains in the survey area. It is generally on the edge of the terrace and occurs as long, somewhat narrow strips. On the Ohio River flood plain it frequently separates the first bottoms of recent alluvium from the older, higher terraces. This soil has a profile similar to the one described as representative of the series, but the present surface layer is generally 2 to 4 inches thinner and in places is a mixture of material from the original surface layer and the subsoil.

Figure 18.—**Ornamental plants grown commercially on Wheeling silt loam, 2 to 6 percent slopes.**

Included with this soil in mapping were small areas of severely eroded Wheeling soils and some areas where slopes are as much as 15 percent. Also included were small areas of Brandon, Chavies, and Dubbs soils and a soil that has a surface layer of loam.

This Wheeling soil has moderate natural fertility and low organic-matter content. Its suitability for crops is moderate. The soil is easy to cultivate, but it should be worked within only a limited range of moisture content to prevent clodding.

Most of the acreage has been cleared and is used for row crops or seeded to meadow. It is suited to row crops, but the severe hazard of erosion limits the percentage of time that row crops should be included in the cropping system. A few wooded areas, generally close to the Ohio River, have not been cleared because they are subject to overflow. (Capability unit IIIe–1; woodland group 2o1; pasture and hayland group 6)

Use and Management of the Soils

This section is designed to help land users understand how soils behave and how they can be used. It includes discussions of the use and management of soils for crops and pasture, woodland, wildlife, and engineering.

Use of Soils for Crops and Pasture [2]

This section is a guide to the suitability and management of the soils for crops and pasture. Specific management is not suggested for each soil. Suggestions for the use of each soil are in the section "Descriptions of the Soils."

This section has four main parts. In the first, some general principles of soil management are described. In the second part, the capability grouping is explained. In the third, the pasture and hayland groups are described. And in the fourth, estimates of yields for suitable crops are shown for each of the soils under high and medium levels of management.

General principles of soil management

Some principles of management are general enough to apply to all of the soils that are suited to farm crops and pasture throughout the survey area, although the individual soils or groups of soils require different kinds of management. These general principles of management are described in the paragraphs that follow.

Most of the soils in the survey area need lime or fertilizer or both. The amounts needed depend on the

[2] ROSCOE ISAACS, assistant State resource conservationist, Soil Conservation Service, helped prepare this section.

natural content of lime and plant nutrients, as determined by laboratory analyses of soil samples; on the needs of the crop; and on the level of yield desired. Only general suggestions for applications of lime and fertilizer are given in this publication.

Most of the soils of Ballard and McCracken Counties were never high in content of organic matter, and it is not economically feasible to build up the content to a high level. It is important, however, to return organic matter by adding farm manure, leaving plant residue on the surface, and growing sod crops, cover crops, and green-manure crops.

Tillage tends to break down soil structure, and it should be kept to the minimum necessary to prepare a seedbed and control weeds. Maintaining the organic-matter content of the plow layer also helps to protect the structure.

On wet soils, such as Waverly silt loam, yields of cultivated crops can be increased by open drainage ditches or tile drains. Tile drains are expensive to install, but they generally provide better drainage than open ditches. Soils that have a fragipan are difficult to drain; they can generally be drained better by open ditches than by tile. Open ditches are more effective if the ditches intercept the water as it moves horizontally on top of the fragipan. Suitable outlets are needed for drainage by either tile or open ditches.

All of the gently sloping and steeper soils that are cultivated are subject to erosion. Most runoff and erosion occurs while a row crop is growing or soon after one has been harvested. On erodible soils, such as Loring silt loam, 2 to 6 percent slopes, a cropping system that controls runoff and erosion is needed in combination with other erosion control practices. As used here, cropping system refers to the sequence of crops grown in combination with management practices that include minimum tillage, mulch planting, use of crop residue, growing of cover crops and green-manure crops, and use of lime and fertilizer. Other erosion control practices are contour cultivation, terracing, contour strip-cropping, diversion of runoff, and use of grassed waterways. The effectiveness of a particular combination of these practices differs from one soil to another, but different combinations can be equally effective on the same soil. The local representative of the Soil Conservation Service can assist land users in planning an effective combination of practices.

Pasture is effective in controlling erosion on all but a few of the erodible soils. A good pasture management program is needed on some soils to provide enough ground cover to keep the soil from eroding. This level of pasture management should provide for fertilization, control of grazing, selection of pasture mixtures, and other practices that are adequate to maintain good ground cover and forage for grazing. Grazing is controlled by rotating the livestock from one pasture to another and providing rest periods for the pasture after each grazing period to allow for regrowth of the plants. On some soils it is important to use pasture mixtures that require the least amount of renovation to maintain good ground cover and forage for grazing.

Capability grouping

Some readers, particularly those who farm on a large scale, may find it practical to use and manage alike some of the different kinds of soil on their farm. These readers can make good use of the capability classification system. This grouping shows, in a general way, the suitability of soils for most kinds of farming.

The grouping is based on limitations of soils when they are used for field crops, the risk of damage when they are farmed, and the way the soils respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops that require special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of the soils for forest trees or for engineering.

In the capability system, all kinds of soil are grouped at three levels: the class, the subclass, and the unit. The eight classes in the capability system and the subclasses and units in Ballard and McCracken Counties are described in the list that follows. The capability unit for each mapping unit is given at the end of the mapping unit description in the section "Descriptions of the Soils" and in the "Guide to Mapping Units."

Class I. Soils that have few limitations that restrict their use. (No subclasses.)

Unit I–1.—Deep, nearly level, well-drained silt loams; on flood plains; permeability is moderate and moderately rapid.

Unit I–5.—Deep, nearly level, well-drained soils that have a silt loam plow layer and a loamy subsoil; on stream terraces; permeability is moderately rapid.

Unit I–6.—Deep, nearly level, well-drained fine sandy loams; on stream terraces; permeability is moderately rapid.

Class II. Soils that have some limitations that reduce the choice of plants or require moderate conservation practices.

Subclass IIe.—Soils that are subject to moderate erosion if they are not protected.

Unit IIe–1.—Deep, gently sloping, well-drained soils that have a silt loam plow layer and a moderately fine textured subsoil; on uplands and stream terraces; permeability is moderate.

Unit IIe–4.—Gently sloping, moderately well drained silt loams that have a compact fragipan; fragipan hinders root growth and water movement and causes a perched water table 18 to 28 inches below the surface in wet periods; on uplands and stream terraces.

Unit IIe-5.—Gently sloping, moderately well drained silt loams that have a compact fragipan; fragipan causes a perched water table 26 to 36 inches below the surface in wet periods; on uplands.

Subclass IIw.—Soils that have moderate limitations caused by excess water.

Unit IIw-1.—Deep, nearly level soils that have a water table 6 to 24 inches below the surface in wet periods; on bottom lands; permeability is moderate.

Unit IIw-3.—Nearly level, moderately well drained silt loams that have a fragipan 16 to 26 inches below the surface; on uplands or stream terraces.

Unit IIw-6.—Deep, nearly level, somewhat poorly drained soils that have a silty clay loam plow layer and a slowly permeable, clayey subsoil; on stream terraces.

Subclass IIs.—Soils that have moderate limitations because the texture of the plow layer makes them difficult to cultivate.

Unit IIs-2.—Deep, nearly level, well-drained soils that have a silty clay loam plow layer and subsoil; on flood plains.

Unit IIs-3.—Deep, nearly level, well-drained soils that have a silty clay loam plow layer and a slowly permeable, clayey subsoil; on stream terraces.

Class III. Soils that have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Subclass IIIe.—Gently sloping or sloping soils that are subject to severe erosion if they are not protected.

Unit IIIe-1.—Deep, sloping, well-drained soils that have a silt loam plow layer and a moderately fine textured subsoil; permeability is moderate.

Unit IIIe-5.—Sloping, moderately well drained silt loams that have a fragipan 26 to 36 inches below the surface.

Unit IIIe-14.—Severely eroded, gently sloping silt loams that have a slowly permeble, compact fragipan 12 to 24 inches below the surface.

Subclass IIIw.—Soils that have severe limitations caused by excess water.

Unit IIIw-1.—Deep, nearly level, poorly drained silt loams; on flood plains; permeability is moderate or slow.

Unit IIIw-2.—Deep, nearly level, somewhat poorly drained soils that are silt loam in the plow layer and upper part of the subsoil and clayey in the lower part of the subsoil; on stream terraces; permeability is slow.

Unit IIIw-3.—Nearly level, somewhat poorly drained silt loams that have a compact fragipan; fragipan hinders root growth and water movement and causes a perched water table 6 to 18 inches below the surface in wet periods; on uplands or terraces.

Unit IIIw-5.—Deep, nearly level, poorly drained, clayey soils; on flood plains; permeability is very slow.

Unit IIIw-7.—Gently sloping, somewhat poorly drained silt loams that have a compact fragipan; fragipan hinders root growth and water movement and causes a perched water table 6 to 18 inches below the surface in wet periods.

Subclass IIIs.—Soils that have severe limitations caused by sandy or gravelly texture.

Unit IIIs-1.—Deep, nearly level or gently sloping, excessively drained or somewhat excessively drained, sandy soils; on flood plains or stream terraces; permeability is rapid.

Unit IIIs-2.—Deep, nearly level to sloping, well-drained, gravelly soils; on stream terraces; permeability is moderate to rapid.

Class IV. Soils that have very severe limitations that restrict the choice of plants, require careful management, or both.

Subclass IVe.—Sloping or gently sloping soils that are subject to very severe erosion if they are not protected.

Unit IVe-6.—Deep, gently sloping or sloping, somewhat poorly drained soils that have a silt loam plow layer and a slowly permeable, clayey subsoil.

Unit IVe-9.—Severely eroded, deep, sloping, well-drained soils that have a silty clay loam plow layer and subsoil; on uplands; permeability is moderate.

Unit IVe-11.—Severely eroded, sloping, moderately well drained silt loams that have a fragipan 12 to 28 inches below the surface; on uplands and stream terraces.

Subclass IVw.—Soils that have very severe limitations caused by excess water.

Unit IVw-1.—Nearly level, poorly drained silt loams that have a compact fragipan; fragipan hinders root growth and water movement and causes a perched water table 0 to 6 inches below the surface in wet periods; on uplands or stream terraces.

Unit IVw-2.—Nearly level, poorly drained soils that have a silt loam plow layer and a clayey subsoil; a seasonal water table is 0 to 6 inches below the surface in wet seasons; permeability is slow.

Class V. Soils that are subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife food and cover. (None in Ballard and McCracken Counties.)

Class VI. Soils that have severe limitations that make them generally unsuited to cultivation without major reclamation and limit their use largely to pasture, woodland, or wildlife food and cover.

Subclass VIe.—Strongly sloping or moderately steep soils that are subject to very severe erosion unless cover is maintained.

Unit VIe–1.—Deep, strongly sloping or moderately steep, well drained or moderately well drained silt loams; on uplands.

Unit VIe–2.—Strongly sloping, well-drained soils that have a silt loam surface layer and a silty clay loam subsoil that is underlain by very gravelly material at a depth of 20 to 48 inches; on uplands.

Unit VIe–5.—Severely eroded, strongly sloping or moderately steep, well drained to moderately well drained soils; on uplands.

Class VII. Soils that have severe limitations that make them unsuited to cultivation and restrict their use largely to grazing, woodland, or wildlife food and cover.

Subclass VIIe.—Strongly sloping to steep soils that are subject to very severe erosion unless cover is maintained.

Unit VIIe–1.—Moderately steep to steep, well-drained soils that have a silt loam surface layer.

Unit VIIe–2.—Steep or moderately steep, droughty soils that have a gravelly or very gravelly surface layer.

Unit VIIe–3.—Severely eroded, strongly sloping or moderately steep silty clay loams that are underlain by gravelly material at a depth of 2 to 3 feet.

Subclass VIIw.—Soils that have very severe limitations caused by excess water.

Unit VIIw–1.—Swamp.

Class VIII. Soils and landforms that have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife food and cover, water supply, or esthetic purpoes. (None in Ballard and McCracken Counties.)

Pasture and hayland groups

This section lists and describes the pasture and hayland groups in Ballard and McCracken Counties. The grouping of soils is based on the suitability of the soils for similar pasture and hay plants. The grouping takes into consideration the productivity of the soil for suitable plants and the ability of the plants to survive and produce forage for pasture and hay. The pasture and hayland group number is given at the end of the description of each mapping unit and in the "Guide to Mapping Units."

Group 1.—Deep, nearly level, well-drained silt loams or silty clay loams on first bottoms. These soils have very high productivity potential. Some suitable plants are alfalfa, tall fescue, annual lespedeza, Ladino clover, orchardgrass, and timothy.

Group 2.—Deep, nearly level, somewhat poorly drained or moderately well drained silt loams or silty clay loams on first bottoms. These soils have high productivity potential. Some suitable plants are tall fescue, annual lespedeza, Ladino clover, orchardgrass, red clover, and timothy.

Group 3.—Deep, nearly level, poorly drained silt loams on first bottoms. These soils have moderate to high productivity potential. Some suitable plants are tall fescue, annual lespedeza, and Ladino clover.

Group 4.—Deep, nearly level, poorly drained silty clays on first bottoms. These soils have moderate to high productivity potential. Some suitable plants are tall fescue, annual lespedeza, and Ladino clover.

Group 5.—Deep, nearly level, well-drained to somewhat poorly drained silty clay loams on stream terraces. These soils have moderate to high productivity potential. Some suitable plants are tall fescue, annual lespedeza, sericea lespedeza, orchardgrass, and bermudagrass.

Group 6.—Deep, well-drained soils that have a silt loam or fine sandy loam surface layer and a loamy subsoil. These soils are on uplands and terraces and have slopes of 0 to 12 percent. Productivity potential is high. Some suitable plants are alfalfa, tall fescue, bermudagrass, annual lespedeza, Ladino clover, sericea lespedeza, orchardgrass, and red clover.

Group 7.—Deep, strongly sloping to steep, well-drained soils that have a surface layer of silt loam, a subsoil of silty clay loam, and very gravelly material below a depth of 20 to 48 inches in most places. These soils are on uplands. Productivity potential is moderate. Some suitable plants are tall fescue, bermudagrass, annual lespedeza, and sericea lespedeza.

Group 8.—Deep, well drained or moderately well drained soils that have a surface layer of silt loam and a loamy subsoil. These soils are on uplands and terraces and have slopes of more than 12 percent. Productivity potential is moderate. Some suitable plants are tall fescue, bermudagrass, annual lespedeza, and sericea lespedeza.

Group 9.—Severely eroded, gently sloping to moderately steep soils that have a loamy subsoil. These soils are on uplands and terraces. They have low to moderate productivity potential. Some suitable plants are tall fescue, bermudagrass, annual lespedeza, and sericea lespedeza.

Group 10.—Severely eroded, strongly sloping or moderately steep soils that have a loamy subsoil and very gravelly material at a depth of 1½ feet or more. These soils are on uplands. Productivity potential is low. Some suitable plants are tall fescue, bermudagrass, annual lespedeza, and sericea lespedeza.

Group 11.—Moderately well drained soils that have a silt loam fragipan. These soils are on uplands and stream terraces and have slopes of 0 to 12 percent. Productivity potential is moderate to high. Some suitable plants are alfalfa, bermudagrass, tall fescue, Ladino clover, orchardgass, red clover, and timothy. Alfalfa stands usually last 2 to 3 years, and alfalfa and Ladino clover generally do not survive under a low level of management.

Group 12.—Poorly drained or somewhat poorly drained, nearly level to sloping soils that have a fragipan or clayey strata below a depth of 15 to 25 inches. These soils are on uplands and terraces. Productivity potential is moderate. Some suitable plants are tall fescue, annual lespedeza, Ladino clover, redtop, and timothy.

Group 13.—Gravelly and very gravelly soils on uplands and terraces. These soils have low productivity potential. Some suitable plants are tall fescue, annual lespedeza, and sericea lespedeza.

Group 14.—Deep, nearly level to gently sloping, sandy soils on first bottoms and stream terraces. These soils have low to moderate productivity potential. Some suitable plants are tall fescue, bermudagrass, and sericea lespedeza.

Estimated yields

The estimated yields for the most common crops grown in the survey area under two levels of management are shown in table 2. Yields for a medium level of management are shown in columns A and those for a high level of management in columns B. Tobacco is grown only under a high level of management.

Yields shown are the average yields that can be expected over several years. Yields for 1 year may be adversely affected by extremes of weather, insects, disease, or some other disaster or may be extremely high because of a combination of good factors.

Comparison of yields in columns A to yields in columns B represents the differences that can be expected by improving management.

A high level of management includes (1) use of adapted recommended varieties; (2) use of correct seeding rates, inoculation of legumes, correct planting dates, and efficient harvesting methods; (3) control of weeds, insects, and plant disease; (4) application of fertilizer equal to or above the current recommendations of the University of Kentucky Agricultural Experiment Station or equal to or above the need shown by properly interpreted soil tests; (5) application of adequate lime; (6) drainage of naturally wet soils; (7) use of cropping systems that maintain soil structure and organic-matter content; (8) use of applicable conservation practices, such as minimum tillage, contour tillage, terracing, contour stripcropping, and grassed waterways; (9) use of cover crops, crop residue, or both to increase the supply of organic matter and control erosion; (10) use of all the applicable pasture management practices; and (11) use of other practices that may be suggested by representatives of the Soil Conservation Service and the Agricultural Extension Service in the two counties.

The high level of management is not considered the maximum but is one that many farmers find practical and one that will result in the highest sustained production that is economically feasible.

The medium level of management is the management generally considered as the minimum that will keep the soil from deteriorating and produce sufficient crops for some profit. Failure to adequately apply one or more of the listed items for high level of management can cause the production level to drop and not return a profit or result in some permanent damage to the soil, or both. Inadequate drainage or only partial application of erosion control practices are examples of deficiencies in the medium level of management.

Use of Soils for Woodland [3]

Originally the land in Ballard and McCracken Counties was covered by hardwood forests. When white men first viewed the region, large areas in the level and gently sloping uplands did not have trees. These areas were known as the "Barrens" and were probably caused by fires started by the Indians to provide more grazing for buffalo (*9*). Fires became less frequent with the departure of the Indians, and forests increased to such a degree that much of the land had to be cleared of timber before it could be plowed by settlers (*8*). Early settlers progressively cleared and farmed the land. By 1958 there were 42,681 acres of forest in Ballard County and 45,164 acres in McCracken County, according to the Kentucky Soil and Water Conservation Needs Inventory. By 1967 this inventory shows the forested area had decreased to 36,793 acres in Ballard County and to 37,600 acres in McCracken County.

Most of the forest acreage in Ballard and McCracken Counties is on farms and other private tracts, but in both counties some wooded areas are on land owned by the State and used mainly for wildlife refuge and management. In McCracken County, about 15,130 acres are Federal noncropland. Small tracts of this land are in forest.

Hardwoods are dominant on virtually all of the forested land. About half of the forest is in the oak-hickory and central mixed hardwood types. Bottom-land species occur frequently in the two counties, and this woodland is in the elm-ash-cottonwood and oak-gum-cypress types. Indiscriminate logging, forest fires, and overgrazing have reduced the proportion of desirable tree species.

A large pulpwood mill, which utilizes hardwood as well as pine, began operation in Ballard County in 1970. This additional market should utilize more of the low-grade hardwoods and encourage landowners to manage their woodland. Before this pulpwood mill began operation, the main market for timber was local sawmills or plants that use high-quality white oak and hickory for cooperage and handle stock for axes and garden tools.

Most soils in these two counties have a potential for producing faster growing stands of better quality than now exist. To utilize this potential, better management of woodland is necessary to improve the stocking of desirable species. Such management should also relate tree growth to soil characteristics, such as available moisture capacity, depth of the root zone, aeration, thickness of the surface layer, texture, drainage, and depth to the fragipan.

Woodland groups

Soils influence the growth and management of trees. The soils in Ballard and McCracken Counties have been grouped according to soil productivity for the principal tree species and the degree and kind of limitation of the soils for woodland use. Table 3 describes the woodland groups in the survey area and shows their potential for producing wood crops, factors that affect management, and suitable tree species. The woodland group of each soil in the two counties is listed at the end of the mapping unit description and in the "Guide to Mapping Units."

[3] CHARLES A. FOSTER, staff forester, Soil Conservation Service, assisted in preparing this section.

TABLE 2.—*Estimated average yields*

[Yields in columns A are those to be expected under a medium level of management; those in columns B, under a high level of management. Dashes indicate that the soil is considered unsuitable for the crop or the crop is not commonly grown on it]

Soil	Corn		Soybeans		Wheat		Tobacco [1]	Hay						Pasture (tall grasses and legumes)	
								Alfalfa		Red clover and grass (2nd year)		Annual lespedeza			
	A	B	A	B	A	B	B	A	B	A	B	A	B	A	B
	Bu	*Bu*	*Bu*	*Bu*	*Bu*	*Bu*	*Lb*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Cow-acre-days* [2]	*Cow-acre-days* [2]
Alligator silty clay	40	70	20	30	---	---	---	---	---	---	---	1.0	2.0	150	170
Alluvial land, steep	---	---	---	---	---	---	---	---	---	---	---	---	---	105	180
Arkabutla silt loam	75	90	25	40	---	---	---	---	---	---	---	1.5	2.5	180	230
Brandon silt loam, 10 to 20 percent slopes	---	---	---	---	---	---	---	---	---	---	---	---	---	150	210
Brandon silt loam, 20 to 30 percent slopes	---	---	---	---	---	---	---	---	---	---	---	---	---	140	200
Brandon silty clay loam, 10 to 30 percent slopes, severely eroded	---	---	---	---	---	---	---	---	---	---	---	---	---	120	165
Brandon and Memphis silt loams, 30 to 60 percent slopes	---	---	---	---	---	---	---	---	---	---	---	---	---	120	165
Bruno loamy fine sand	40	55	20	30	---	---	---	---	---	---	---	1.0	1.5	100	125
Calloway silt loam, 0 to 2 percent slopes	70	90	25	35	20	35	2,000	---	---	2.5	3.0	1.5	2.0	160	220
Calloway silt loam, 2 to 6 percent slopes	60	80	20	30	20	30	1,900	---	---	2.0	2.5	1.5	2.0	160	220
Cascilla silt loam	75	90	30	40	---	---	---	---	---	---	---	2.0	2.5	175	250
Chavies fine sandy loam, 0 to 4 percent slopes	70	90	25	40	35	50	2,000	3.5	5.0	1.5	2.5	2.0	2.5	175	250
Colp silt loam, 0 to 2 percent slopes	50	70	25	35	20	30	1,800	---	---	1.5	2.5	1.5	2.0	150	220
Colp silt loam, 2 to 12 percent slopes	40	55	15	25	15	25	---	---	---	1.0	2.0	1.0	1.5	120	180
Dubbs silty clay loam, clayey subsoil variant	40	60	15	25	40	50	---	---	---	---	---	1.0	1.5	150	180
Dundee silty clay loam, clayey subsoil variant	50	70	20	30	35	45	---	---	---	1.5	2.0	1.5	2.0	150	170
Falaya-Collins silt loams	80	100	25	40	25	40	2,000	---	---	2.5	3.0	1.5	2.5	175	235
Grenada silt loam, 0 to 2 percent slopes	80	100	25	40	30	40	2,400	2.5	3.5	2.5	3.0	2.0	2.5	170	240
Grenada silt loam, 2 to 6 percent slopes	80	100	25	40	30	45	2,400	3.0	4.0	2.5	3.0	2.0	2.5	170	240
Grenada silt loam, 2 to 6 percent slopes, severely eroded	60	80	20	30	20	30	---	2.0	3.0	1.5	2.0	1.5	2.0	150	180
Grenada silt loam, 6 to 12 percent slopes, severely eroded	40	60	15	25	15	25	---	---	---	1.0	2.0	1.0	1.5	130	170
Gullied land	---	---	---	---	---	---	---	---	---	---	---	---	---	90	---
Henry silt loam	50	80	20	35	---	---	---	---	---	1.5	2.5	1.5	2.0	160	220
Loring silt loam, 2 to 6 percent slopes	85	105	30	40	30	45	2,400	3.0	4.5	3.0	3.5	2.0	2.5	175	250
Loring silt loam, 6 to 12 percent slopes	75	90	25	30	25	35	1,800	2.5	4.0	2.5	3.0	1.5	2.0	160	210
Loring silt loam, 6 to 12 percent slopes, severely eroded	50	70	15	25	20	30	---	2.0	3.0	1.5	2.0	1.0	1.5	140	180
Loring silt loam, 12 to 20 percent slopes	---	---	---	---	---	---	---	2.5	3.5	1.5	2.0	1.5	2.0	150	185
Loring silt loam, 12 to 20 percent slopes, severely eroded	---	---	---	---	---	---	---	---	---	---	---	---	---	120	160
Memphis silt loam, 2 to 6 percent slopes	85	110	30	40	30	50	2,500	4.0	5.0	3.0	3.5	2.0	2.5	185	250
Memphis silt loam, 6 to 12 percent slopes	80	95	25	35	30	45	2,400	4.0	5.0	2.5	3.0	1.5	2.0	170	230
Memphis silt loam, 12 to 20 percent slopes	---	---	---	---	---	---	---	3.0	4.0	2.0	2.5	1.0	1.5	160	210
Memphis silt loam, 20 to 30 percent slopes	---	---	---	---	---	---	---	---	---	---	---	---	---	150	180
Memphis silty clay loam, 6 to 12 percent slopes, severely eroded	55	75	15	25	20	30	---	2.5	3.5	1.5	2.5	1.5	2.0	150	190
Memphis silty clay loam, 12 to 30 percent slopes, severely eroded	---	---	---	---	---	---	---	---	---	---	---	---	---	130	170

See footnotes at end of table.

TABLE 2.—*Estimated average yields*—Continued

Soil	Corn		Soybeans		Wheat		Tobacco [1]	Hay						Pasture (tall grasses and legumes)	
								Alfalfa		Red clover and grass (2nd year)		Annual lespedeza			
	A	B	A	B	A	B	B	A	B	A	B	A	B	A	B
	Bu	*Bu*	*Bu*	*Bu*	*Bu*	*Bu*	*Lb*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Cow-acre-days* [2]	*Cow-acre-days* [2]
Molena loamy fine sand, 0 to 6 percent slopes	50	70	20	30	25	35	1,700	2.5	3.5	1.0	1.5	1.0	1.5	120	150
Newark-Lindside silty clay loams	85	95	25	35	----	----	----	----	----	----	----	2.0	2.5	165	210
Nolin silty clay loam	85	95	25	35	35	45	2,300	4.0	5.0	2.5	3.0	2.0	2.5	185	250
Nolin-Robinsonville silt loams	85	105	30	40	----	----	2,500	----	----	----	----	2.0	2.5	185	250
Okaw silt loam	50	80	20	35	----	----	----	----	----	1.5	2.5	1.5	2.0	160	220
Rosebloom silt loam	60	85	20	40	----	----	----	----	----	2.0	2.5	1.5	2.0	150	180
Saffell gravelly loam, 0 to 12 percent slopes	40	55	15	25	20	30	1,800	2.5	3.5	1.5	2.0	1.0	1.5	120	170
Saffell and Flomaton soils, 20 to 60 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	100	130
Sharkey silty clay	50	80	25	35	----	----	----	----	----	----	----	----	----	150	170
Swamp	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Vicksburg silt loam	95	120	35	45	35	45	2,500	3.5	5.0	3.0	3.5	2.0	2.5	190	270
Waverly silt loam	60	85	25	40	----	----	----	----	----	2.0	2.5	1.5	2.0	150	180
Wheeling silt loam, 0 to 2 percent slopes	85	110	30	40	35	45	2,500	4.0	5.0	2.5	3.0	2.0	2.5	185	250
Wheeling silt loam, 2 to 6 percent slopes	85	110	30	40	35	45	2,500	4.0	5.0	2.5	3.0	2.0	2.5	185	250
Wheeling silt loam, 6 to 12 percent slopes	75	90	25	35	35	40	2,000	3.5	4.5	2.0	3.0	1.5	2.0	170	220

[1] Burley and dark tobacco are both grown, and the yields are approximately the same on most soils. On the somewhat poorly drained Calloway, Colp, and Falaya soils, the yields shown are for dark tobacco. Burley tobacco is poorly suited to these soils.

[2] Cow-acre-days is a term used to express the carrying capacity of pasture. It is the number of animal units carried per acre multiplied by the number of days the pasture is grazed during a single grazing season without injury to the sod. An acre of pasture that provides 30 days of grazing for two cows has a carrying capacity of 60 cow-acre-days.

In the woodland classification system, soils are grouped at three levels: the class, which is indicative of soil productivity; the subclass, which denotes the dominant kind of limitation; and the group, which reflects preferred tree species and kind of woodland management needed.

Woodland classes, the broadest groups, are designated by the Arabic numerals 1 to 6. The numerals indicate progressively less productivity for woodland products from the tree species that are adapted to a specific kind of soil. Class 1 produces the highest yields and class 6, the lowest. Classes 1 to 4 are in Ballard and McCracken Counties.

Woodland subclasses are subdivisions within a class. They are designated by adding a small letter, *x, w, t, d, c, s, f, r,* or *o,* to the class numeral; for example, *3w.* These subclasses are based on soil properties that cause limitations in management and are defined as follows:

Subclass x (*stoniness or rockiness*).—Soils that have restrictions or limitations for woodland use or management caused by stones or rocks.

Subclass w (*excessive wetness*).—Soils in which excess water, either seasonal or year long, causes significant limitations for woodland use and management. These soils have restricted drainage, a fluctuating to permanently high water table, or a hazard of overflow that adversely affects either development or management of the stand.

Subclass t (*toxic substances*).—Soils that have, within the root zone, excessive alkalinity, acidity, sodium salts, or other toxic substances that limit or impede the development and functioning of root systems of desirable tree species.

Subclass d (*restricted rooting depth*).—Soils that have restrictions or limitations for woodland use or management caused by a restricted root depth.

Subclass c (*clayey soils*).—Soils that have restrictions or limitations for woodland use or management caused by the kind and amount of clay in the profile.

Subclass s (*sandy soils*).—Soils that have restrictions or limitations for woodland use or management caused by the amount of coarse-textured material in the profile.

Subclass f (*fragmental or skeletal soils*).—Soils that have restrictions or limitations for woodland use or management caused by the amount of fragments between 2 millimeters and stone size in the profile.

Subclass r (*relief or slope*).—Soils that have restrictions or limitations for woodland use or management caused solely by steepness of slope.

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TABLE 3.—*Woodland*

[Gullied land (Gu) and Swamp (Sw) were not classified in a woodland

Woodland groups and map symbols	Potential productivity			Hazards and limitations	
	Kind of trees	Site index	Average annual growth [1]	Erosion hazard	Equipment limitation
1o1: Well-drained, nearly level soils on bottom lands; very high productivity potential. Cc, No, Nr, Vb.	Yellow-poplar Sweetgum Cottonwood Lowland oaks	95+ 95+ 95+ 95+	500+ 500+ 570+ 450+	Slight	Slight
1w1: Moderately well drained to somewhat poorly drained, nearly level to gently sloping soils; very high productivity potential. Ay, CaA, CaB, Du, Fc, Nd.	Sweetgum Lowland oaks Yellow-poplar	95+ 95+ 95+	500+ 450+ 500+	Slight	Moderate
1w2: Poorly drained, nearly level soils; very high productivity potential. Ag, Hn, Ro, Sh, Wa.	Lowland oaks	95+	450+	Slight	Severe
2o1: Well-drained, nearly level to strongly sloping soils on uplands and terraces; high productivity potential. ChA, Db, MmB, MmC, MmD, WhA, WhB, WhC.	Upland oaks Yellow-poplar Lowland oaks	75–85 85–95 85–95	240–350 380–500 350–450	Slight to moderate	Slight to moderate
3o1: Well drained, sloping to strongly sloping soils and moderately well drained, nearly level to strongly sloping soils that have a fragipan; moderate productivity potential. BdD, GrA, GrB, LoB, LoC, LoD, MpC3.	Upland oaks Loblolly pine	65–75 75–85	160–240 570–740	Slight	Slight
3r1: Well-drained, strongly sloping to steep soils and a steep land type; moderate productivity potential. Av, BdE, BsF, MmE, MpE3.	Upland oaks Loblolly pine	65–75 75–85	160–240 570–740	Moderate to severe	Moderate to severe
3s1: Nearly level to gently sloping, droughty, sandy soils; moderate productivity potential. Bu, MsB.	Loblolly pine	75–85	570–740	Slight	Slight to moderate
3w2: Poorly drained to somewhat poorly drained, nearly level to sloping soils; moderate productivity potential. CpA, CpC, Oc.	Lowland oaks Sweetgum	75–85 75–85	240–350 280–390	Slight	Severe
4o1: Moderately well drained, gently sloping to strongly sloping, severely eroded soils that have a fragipan; low productivity potential. GrB3, GrC3, LoC3, LoD3.	Upland oaks Loblolly pine	55–65 65–75	90–160 440–570	Slight	Slight
4r1: Well-drained, sloping to moderately steep, severely eroded soils; low productivity potential. BrD3.	Upland oaks Loblolly pine	55–65 65–75	90–160 440–570	Slight to moderate	Moderate
4f1: Well-drained and excessively drained, nearly level to steep, droughty soils; low productivity potential. SaC, SfE.	Upland oaks	55–65	90–160	Moderate	Moderate to severe

[1] Growth is in board feet per acre per year by the International one-quarter inch rule.

interpretations by groups

group because they are variable and require onsite examination]

Hazards and limitations—Continued			Kinds of trees	
Seedling mortality	Plant competition for—		Preferred in existing stands	Suitable for planting
	Conifers	Hardwoods		
Slight	Severe	Moderate	Cottonwood, yellow-poplar, black walnut, sweetgum, tupelo, hackberry, hickory, white oak, cherrybark oak.	Ash, cottonwood, cherrybark oak, sweetgum, sycamore, yellow-poplar, black walnut, loblolly pine, white pine, black locust.
Slight	Severe	Severe	White ash, cherrybark oak, white oak, sweetgum, sycamore, tupelo, yellow-poplar, hackberry, cottonwood.	White ash, cherrybark oak, red oak, sweetgum, yellow-poplar, loblolly pine, cottonwood.
Severe	Severe	Severe	Post oak, southern red oak, sweetgum, pin oak, hickory.	Sweetgum, pin oak, loblolly pine, willow oak, sycamore.
Slight	Severe	Moderate	Cherrybark oak, Shumard oak, southern red oak, white oak, sweetgum, black walnut, yellow-poplar.	Cherrybark oak, Shumard oak, white oak, loblolly pine, shortleaf pine, white pine, sweetgum, black walnut, yellow-poplar, black locust.
Slight	Moderate	Slight	Black oak, yellow-poplar, white oak, post oak, hickory, black walnut, southern red oak.	Loblolly pine, shortleaf pine, Virginia pine, yellow-poplar, white ash, red oak, white oak, white pine, black locust.
Slight	Moderate	Slight	Yellow-poplar, white oak, black oak, scarlet oak, post oak, white ash.	Loblolly pine, white pine, shortleaf pine, white oak.
Moderate	Moderate	Slight	Sweetgum, cottonwood, red oak, white oak, hickory.	Sweetgum, cottonwood, loblolly pine.
Severe	Severe	Severe	Pin oak, sweetgum, black oak, southern red oak, post oak, hickory, red maple.	Pin oak, sweetgum, sycamore, loblolly pine.
Slight	Slight	Slight	Black oak, white oak, scarlet oak, post oak, hickory.	Loblolly pine, shortleaf pine, Virginia pine.
Moderate	Slight	Slight	White oak, black oak, scarlet oak, hickory, southern red oak.	Loblolly pine, shortleaf pine, Virginia pine.
Moderate to severe	Slight	Slight	White oak, black oak, post oak, southern red oak, hickory, scarlet oak.	Loblolly pine, shortleaf pine, Virginia pine.

Subclass o (slight or no limitations).—Soils that have no significant restrictions or limitations for woodland use or management.

The subclasses designated by *w, s, f, r,* and *o* are in this survey area.

Woodland groups are divisions within the subclasses. The factors considered in placing each soil in a woodland group include (1) potential productivity for several kinds of trees, (2) species to favor in managing existing woodland, (3) species preferred for planting, and (4) critical soil-related hazards and limitations to be considered in woodland management with respect to erosion, use of equipment, plant competition, and seedling mortality.

Woodland groups are generally designated by adding an Arabic numberal to the class and subclass symbols; for example, 3w2. Thus, in one symbol the first Arabic numeral designates the class or productivity potential, the small letter indicates the subclass or kind of limitation, and the second Arabic numeral, assigned on a Statewide basis, specifically identifies the woodland group within the subclass. Not all of the groups in the State are in this survey area.

The potential productivity within each group is expressed as site index, or the expected height in feet that a tree species will attain on a specified soil or group of soils at a specified age—50 years for most species. These site index ratings are expressed as a range in height.

For fast-growing trees, such as yellow-poplar, pin oak, sweetgum, and cottonwood, class 1 soils have a site index of more than 95; class 2 soils, between 85 and 95; class 3 soils, between 75 and 85; class 4 soils, between 65 and 75; class 5 soils, between 55 and 65; and class 6 soils, less than 55.

For trees that have a moderate growth rate, such as oak, Virginia pine, and shortleaf pine, class 1 soils have a site index of more than 85; class 2 soils, between 75 and 85; class 3 soils, between 65 and 75; class 4 soils, between 55 and 65; class 5 soils, between 45 and 55; and class 6 soils, less than 45.

For slow-growing trees, such as redcedar, class 1 soils have a site index of more than 65; class 2 soils, between 55 and 65; class 3 soils, between 45 and 55; class 4 soils, between 35 and 45; and class 5 soils, less than 35.

On some soils higher productivity has been measured on north and east slopes than on south and west slopes. Generally, differences in aspect are taken into account for soils that have slopes of 20 percent or more. Aspect is the compass direction in which a slope faces. The south and west aspects are generally delineated as the azimuth range from 135 degrees to 315 degrees. North and east aspects are the remainder of the azimuth circle.

Many trees in this county and in adjacent areas were measured and the soils were described at each site to determine the site indexes for wood crops. As nearly as possible, the studies were confined to well-stocked, naturally occurring, even-aged, essentially unmanaged stands that had not been adversely affected by fire, insects, or disease and had not been damaged by overgrazing.

The average height and age measurements for most species were converted to site index by using site index curves in published research (*3, 4, 5, 7, 17, 21*). Unpublished field studies of 271 plots by the Tennessee Valley Authority were used to determine the site indexes for eastern redcedar.

Site index can be converted to a columetric prediction of growth and yield, which can be shown in such wood measurements as board feet per acre.

Predictions of average yearly growth per acre are given in board feet, according to the International ¼-inch rule, and are based on published data (*16, 17, 21, 22, 23*) and on evaluations made by the Soil Conservation Service. Estimates were made for oak and yellow-poplar up to 60 years old and for other species up to 50 years old.

Erosion hazard is the degree of soil erosion that can occur following cutting operations and where the soil is exposed along roads, skid trails, fire lanes, and landing areas. It is assumed that the woodland is well managed and is protected from fire and grazing. Soil characteristics or properties considered in rating erosion hazard include slope, rate of infiltration, permeability of the subsoil, water storage capacity, and resistance to detachment of soil particles by rainfall and runoff. The ratings used indicate the intensity of erosion control measures needed to reduce erosion. A rating of *slight* indicates that no special measures are needed. *Moderate* indicates that some attention needs to be given to the prevention of soil erosion. *Severe* indicates that intensive erosion control measures are needed. Erosion can be kept to a minimum by taking care in locating, constructing, and maintaining roads, trails, fire lanes, and landings.

The equipment limitation is influenced by relief and soil characteristics, such as slope, drainage, soil texture, and stoniness and rockiness, that restrict the use of conventional wheel or track-type equipment for harvesting and planting wood crops, constructing roads, and controlling fire and unwanted vegetation. Relief or differences in soils may necessitate using different kinds of equipment and methods of operation or varying the season when equipment is used. Generally, the limitation is *slight* if the slope is 20 percent or less, soil wetness is not a problem, and farm machinery can be operated efficiently without construction and maintenance of permanent roads and truck trails. The rating is *moderate* if the slope is 20 to 30 percent, if the use of ordinary farm machinery is limited, if track-type equipment is necessary for efficient harvesting, or if soil wetness prevents the use of logging vehicles for 2 to 6 months. The rating is *severe* if the slope is more than 30 percent, if track-type equipment is not adequate for harvesting and power vehicles and other special equipment are needed, or if wetness prevents the use of vehicles for 6 months or more.

Seeding mortality is the expected mortality of naturally occurring or planted tree seedlings and is influenced by such soil characteristics as drainage, root zone, surface texture, and aspect. Plant competition is not considered in these ratings. The rating is *slight* if expected mortality is 0 to 25 percent, *moderate* if it is

26 to 50 percent, and *severe* if it is more than 50 percent. If the rating is moderate or severe, replanting is likely to be needed to insure a fully stocked stand, and special preparation of the seedbed and special planting techniques are often necessary.

Plant competition is the invasion of unwanted trees, vines, shrubs, and other plants on a site when openings are made in the canopy. This competition hinders the establishment and normal development of desirable seedlings, whether they occur naturally or are planted. Soil characteristics that influence plant competition are drainage, productivity, and acidity. Tree growth characteristics also influence plant competition. Plant competition is *slight* if unwanted plants do not prevent adequate natural regeneration, interfere with early growth, or restrict the normal development of planted stock. Competition is *moderate* if unwanted plants delay establishment and hinder the growth of either planted stock or naturally regenerated seedlings or if they retard the development of a fully stocked stand. Competition is *severe* if unwanted plants prevent adequate restocking, either by natural regeneration or by planting, without intensive site preparation or special maintenance practices.

Use of Soils for Wildlife

The welfare of wildife depends largely on the amount and distribution of food, shelter, and water. If any of these elements is missing, inadequate, or inaccessible, wildlife is absent or scarce. The kinds of wildlife that live in a given area and the number of each kind are closely related to land use, to the resulting kinds and patterns of vegetation, and to the supply and distribution of water. These, in turn, are generally related to the kind of soil.

Habitat for wildlife generally can be created or improved by planting suitable vegetation, by properly managing the existing plant cover (fig. 19), by encouraging the natural establishment of desirable plants, or by using a combination of these measures (*1*).

Table 4 rates the soils of Ballard and McCracken Counties according to their suitability for seven elements of wildlife habitat and for three classes, or groups, of wildlife. The suitability ratings can be used as an aid in—

1. Planning the general use of parks, refuges, nature-study areas, and other recreation developments for wildlife.
2. Selecting the better soils for creating, improving, or maintaining specific kinds of wildlife habitat elements.
3. Determining the relative intensity of management needed for individual habitat elements.
4. Eliminating sites that would be difficult or not feasible to manage for specific kinds of wildlife.

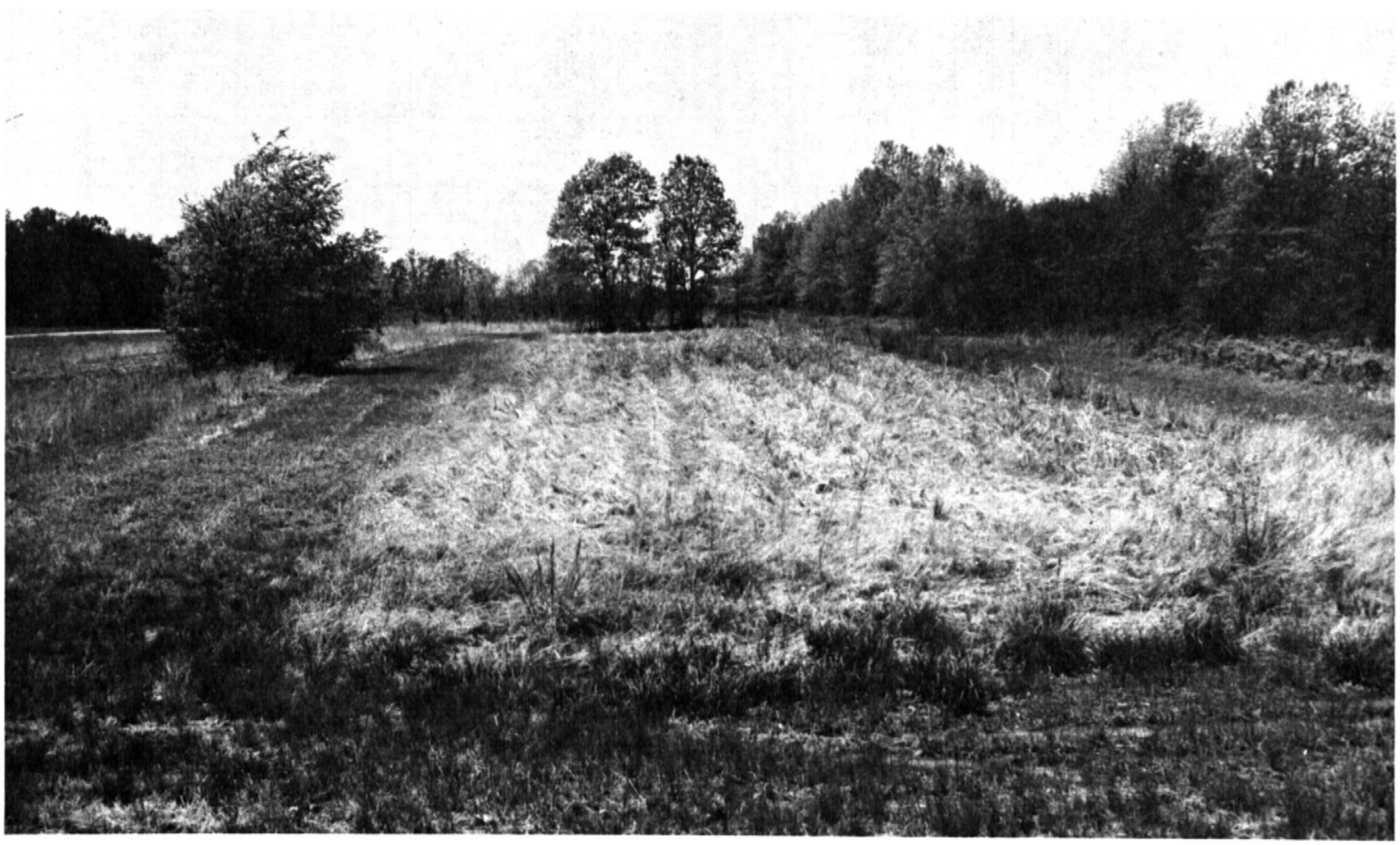

Figure 19.—Part of the Kentucky wildlife area in McCracken County. Here, some areas are mowed, some are not mowed, and some are planted to grain crops for wildlife.

TABLE 4.—*Rating of soils for elements of*

Soil series and map symbols	Wildlife habitat elements			
	Grain and seed crops	Domestic grasses and legumes	Wild herbaceous plants	Hardwood plants
Alligator: Ag	Poor	Fair	Fair	Fair
Arkabutla: Ay	Fair	Fair	Good	Good
Brandon:				
BdD	Fair	Good	Good	Good
BdE, BrD3	Poor	Fair	Good	Good
BsF	Very poor	Poor	Fair	Fair
For Memphis part, see Memphis series.				
Bruno: Bu	Poor	Poor	Fair	Poor
Calloway:				
CaA	Fair	Good	Good	Good
CaB	Fair	Good	Good	Good
Cascilla: Cc	Good	Fair	Good	Good
Chavies: ChA	Good	Good	Good	Good
Collins	Good	Good	Good	Good
Mapped only in a complex with Falaya soils.				
Colp:				
CpA	Fair	Good	Good	Good
CpC	Fair	Good	Good	Good
Dubbs: Db	Good	Good	Good	Good
Dundee: Du	Fair	Good	Good	Good
Falaya: Fc	Fair	Good	Good	Good
For Collins part, see Collins series.				
Flomaton	Very poor	Poor	Fair	Poor
Mapped only in an undifferentiated group with Saffell soils.				
Grenada:				
GrA, GrB	Fair	Good	Good	Good
GrB3, GrC3	Poor	Poor	Fair	Fair
Henry: Hn	Poor	Fair	Fair	Fair
Lindside	Good	Good	Good	Good
Mapped only in a complex with Newark soils.				
Loring: LoB, LoC, LoC3, LoD, LoD3	Fair	Good	Good	Good
Memphis:				
MmB	Good	Good	Good	Good
MmC, MmD, MpC3	Fair	Good	Good	Good
MmE, MpE3	Poor	Fair	Good	Good
Memphis part of BsF	Very poor	Poor	Good	Good
Molena: MsB	Poor	Poor	Fair	Poor
Newark: Nd	Fair	Fair	Good	Good
For Lindside part, see the Lindside series.				
Nolin: No, Nr	Good	Good	Good	Good
For the Robinsonville part, see the Robinsonville series.				
Okaw: Oc	Poor	Fair	Fair	Fair
Robinsonville	Good	Good	Good	Good
Mapped only in a complex with Nolin soils.				
Rosebloom: Ro	Poor	Fair	Fair	Fair
Saffell:				
SaC	Poor	Poor	Fair	Poor
SfE	Very poor	Poor	Fair	Poor
For Flomaton part, see the Flomaton series.				
Sharkey: Sh	Poor	Fair	Fair	Fair
Vicksburg: Vb	Good	Good	Good	Good
Waverly: Wa	Poor	Fair	Fair	Fair
Wheeling:				
WhA, WhB	Good	Good	Good	Good
WhC	Fair	Good	Good	Good

wildlife habitat and kinds of wildlife

Wildlife habitat elements—Continued			Kinds of wildlife		
Coniferous plants	Wetland plants	Shallow water areas	Openland	Woodland	Wetland
Fair	Poor	Good	Fair	Fair	Fair.
Good	Good	Fair	Fair	Good	Fair.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Fair	Good	Very poor.
Fair	Very poor	Very poor	Poor	Fair	Very poor.
Poor	Very poor	Very poor	Poor	Poor	Very poor.
Good	Fair	Fair	Good	Good	Fair.
Good	Fair	Poor	Good	Good	Poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Poor	Poor	Good	Good	Poor.
Good	Fair	Fair	Good	Good	Fair.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Fair	Fair	Good	Good	Fair.
Good	Fair	Fair	Good	Good	Fair.
Poor	Very poor	Very poor	Poor	Poor	Very poor.
Good	Poor	Poor	Good	Good	Very poor.
Fair	Poor	Very poor	Poor	Fair	Very poor.
Fair	Good	Good	Fair	Fair	Good.
Good	Poor	Poor	Good	Good	Poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Fair	Good	Very poor.
Good	Very poor	Very poor	Poor	Good	Very poor.
Poor	Very poor	Very poor	Poor	Poor	Very poor.
Good	Good	Fair	Fair	Good	Fair.
Good	Poor	Very poor	Good	Good	Very poor.
Fair	Good	Good	Fair	Fair	Good.
Good	Poor	Very poor	Good	Good	Very poor.
Fair	Good	Fair	Fair	Fair	Fair.
Poor	Very poor	Very poor	Poor	Poor	Very poor.
Poor	Very poor	Very poor	Poor	Poor	Very poor.
Fair	Poor	Good	Fair	Fair	Fair.
Good	Poor	Very poor	Good	Good	Very poor.
Fair	Good	Fair	Fair	Fair	Fair.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Poor	Very poor	Good	Good	Very poor.

5. Determining areas that are suitable for acquisition for use by wildlife.

The ratings used in table 4 are *good, fair, poor,* and *very poor.* On soils rated *good,* habitat generally is easily created, improved, or maintained. Few or no soil limitations affect habitat management, and satisfactory results are insured.

On soils rated *fair,* habitat generally can be created, improved, or maintained, but the soils have moderate limitations that affect the creation, improvement, or maintenance of the habitat. A moderate intensity of management and fairly frequent attention may be required to insure satisfactory results.

On soils rated *poor,* habitat generally can be created, improved, or maintained, but soil limitations are rather severe. Habitat management may be difficult and expensive and may require intensive effort. Satisfactory results are questionable.

On soils rated *very poor,* habitat is impractical to create, improve, or maintain because soil limitations are very severe. Unsatisfactory results are probable.

Not considered in the ratings are present land use, the location of a soil in relation to other soils. and the mobility of wildlife. The land types Alluvial land, steep, Gullied land, and Swamp are not listed in the table because they have highly variable properties and onsite examination must be made to determine suitability.

Each soil is rated in table 4 according to its suitability for various kinds of plants and other elements that make up wildlife habitat. The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops.—These crops include such seed-producing annuals as corn, sorghum, wheat, oats, millet, buckwheat, soybeans, sunflowers, and other plants commonly grown for grain or for seed. The major soil properties that affect this habitat element are depth of root zone, available moisture capacity, natural drainage, slope, surface stoniness, hazard of flooding, and texture of the surface layer.

Domestic grasses and legumes.—These are domestic perennial grasses and herbaceous legumes that are established by planting and that furnish wildlife cover and food. Among the plants are fescue, timothy, redtop, orchardgrass, reed canarygrass, bluegrass, bromegrass, clover, trefoil, and alfalfa. The major soil properties that affect this habitat element are depth of root zone, available moisture capacity, natural drainage, slope, surface stoniness, hazard of flooding, and texture of the surface layer.

Wild herbaceous plants.—In this group are native or introduced perennial grasses and weeds that generally are established naturally. They include bluestem, quackgrass, panicgrass, goldenrod, wild carrot, nightshade, and dandelion. These plants provide food and cover mainly for wildlife on the uplands. The major soil properties that affect this habitat element are depth of root zone, available moisture capacity, natural drainage, surface stoniness, hazard of flooding or ponding, and texture of the surface layer.

Hardwood plants.—These are nonconiferous trees, shrubs, and woody vines that produce nuts or other fruits, buds, catkins, twigs, or foliage that wildlife eat. They are generally established naturally but can be planted. Among the native plants are oak, beech, cherry, maple, poplar, dogwood, persimmon, sumac, sassafras, hazelnut, black walnut, hickory, sweetgum, blueberry, virburnum, grape, and briers. The major soil properties that affect this habitat element are depth of root zone, available moisture capacity, and natural drainage.

Also in this group are several varieties of fruiting shrubs that are raised commercially for planting. Autumn-olive, Amur honeysuckle, Tatarian honeysuckle, crabapple, multiflora rose, highbush cranberry, and silky cornel dogwood are some of the shrubs that generally are available and can be planted on soils that are rated *good.* Hardwoods that are not available commercially can commonly be transplanted successfully.

Coniferous plants.—This element consists of cone-bearing evergreen trees and shrubs that are used by wildlife mainly as cover, although they also provide browse and seeds or fruitlike cones. Among them are hemlock, Virginia pine, loblolly pine, shortleaf pine, pond pine, Scotch pine, and redcedar. Generally, the plants are established naturally in areas where the cover of weeds and sod is thin, but they can also be planted. The major soil properties that affect this habitat element are depth of root zone, available moisture capacity, and natural drainage.

Wetland plants.—Making up this group are wild herbaceous annual and perennial plants that grow on moist to wet sites. Submerged or floating aquatics are not included. These plants produce food and cover that is extensively used, mainly by wetland wildlife. They include smartweed, wild millet, rushes, sedges, reeds wildrice cutgrass, cordgrass, saltgrass, and cattails. The major soil properties that affect this habitat element are natural drainage, surface stoniness, slope, and texture of the surface layer.

Shallow water areas.—These are impoundments or excavations that provide areas of shallow water, generally not more than 5 feet deep, near food and cover for wetland wildlife. Examples of such developments are shallow dugouts, level ditches, blasted potholes, and devices that keep the water 6 to 24 inches deep in marshes. The major soil properties that affect this habitat element are depth to bedrock, natural drainage, slopes, permeability, and surface stoniness.

Table 4 rates the soils according to their suitability for three kinds of wildlife—openland, woodland, and wetland. These kinds of wildlife are described in the paragraphs that follow.

Openland wildlife.—Examples of openland wildlife are quail, meadowlark, field sparrow, dove, cottontail rabbit, red fox, and woodchuck. These birds and mammals normally make their home in areas of cropland, pasture, meadow, and lawns and in areas that are overgrown with grasses, herbs, and shrubs.

Woodland wildlife.—Among the birds and mammals that prefer woodland are ruffed grouse, woodcock, thrushes, vireos, woodpeckers, scarlet tanager, gray and red squirrels, gray fox, white-tailed deer, raccoon, and wild turkey. They obtain food and cover in stands of hardwoods, coniferous trees, shrubs, or a mixture of these plants.

Wetland wildlife.—Ducks, geese, herons, shore birds, mink, beaver, and muskrat are familiar examples of birds and mammals that normally make their home in such wet areas as ponds, marshes, and swamps.

Each rating for kinds of wildlife in table 4 is based on the ratings listed for the habitat elements in the first part of the table. For openland wildlife the rating is based on the ratings shown for grain and seed crops, grasses and legumes, wild herbaceous plants, and hardwood plants. The rating for woodland wildlife is based on the ratings listed for grasses and legumes, wild herbaceous plants, and hardwood plants. For wetland wildlife the rating is based on the ratings shown for wetland plants and shallow water areas.

Engineering Uses of the Soils [4]

This section is useful to planning commissions, town and city managers, land developers, engineers, contractors, farmers, and others who need information about soils used as structural material or as foundation on which structures are built.

Properties of soils highly important in engineering include permeability, strength, compaction characteristics, soil drainage condition, shrink-swell potential, grain size, plasticity, and soil reaction. Also important are depth to the water table, depth to bedrock, and soil slope. These properties, in various degrees and combinations, affect construction and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

Information in this section of the soil survey can be helpful in—

1. Selecting potential residential, industrial, commercial. and recreation areas.
2. Evaluating alternate routes for roads, highways, pipelines, and underground cables.
3. Seeking sources of gravel, sand, or clay.
4. Planning farm drainage systems, irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil.
5. Correlating performance of structures already built with properties of the kinds of soil on which they are built, for the purpose of predicting performance of structures on the same or similar kinds of soil in other locations.
6. Predicting the trafficability of soils for cross-country movement of vehicles and construction equipment.
7. Developing preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in tables 5 and 6, which show several estimated soil properties significant in engineering and interpretations for various engineering uses. This information, along with the soil map and other parts of this publication, can be used to make other interpretations and other useful maps.

The information in this section does not eliminate the need for further investigation of engineering properties of soils at construction sites, especially when heavy loads are involved or when excavations to depths greater than those shown in the tables, generally depths greater than 6 feet, are required. Also, inspection of sites, especially small ones, is needed because many mapped areas of a soil mapping unit contain small areas of other kinds of soils that have strongly contrasting properties and different suitabilities or limitations for soil engineering.

Loess affects the engineering properties of most of the soils in Ballard and McCracken Counties. On the upland soils, such as Memphis and Grenada soils, it is the uppermost part of the soil. The thickness of the loess varies with the soil series and is stated in the soil series description. The soils on first bottoms and terraces of branches and creeks, such as Vicksburg and Calloway soils, are dominantly silty in the upper part because the alluvium in which they formed washed down from the loess-covered uplands.

Engineering properties vary with the soil-forming factors that affected the development of different horizons, but most engineering properties of the horizons that formed in loess or silty alluvium have a narrow range. In soil horizons that formed in Coastal Plain deposits of sandy, gravelly, or clayey alluvium, such as the lower horizons in Brandon and Okaw soils, most engineering properties vary greatly.

Because loess is predominantly a silty material deposited by wind, moisture content causes a pronounced adjustment in particle-to-particle adhesive strength. When the content of moisture is below 10 percent, loess can support large loads and can stand on very steep, nearly vertical slopes. When wet, loess loses strength, settles rapidly (*11*), and large chunks frequently shear and fall from the nearly vertical roadbanks. It is highly erodible, and unless it is adequately protected, gullies form during wet periods.

For the soils that formed in thin loess, such as Brandon and Colp soils, the depth to and the kind of underlying layers are given in the section "Descriptions of the Soils." In many places soils that formed in thick loess, such as Memphis and Falaya soils, are underlain at a depth of more than 5 feet on the uplands, or 4 feet on the first bottoms and terraces, by Coastal Plain deposits or fairly recent alluvial deposits that have a gravelly, sandy, or clayey texture. Deep construction below the loess or loesslike material extends into the underlying deposits that have variable engineering properties. In Ballard and McCracken Counties, there are many places where gravelly material is mined from pits that extend into Coastal Plain deposits; there also are a few places where sand or clay materials are mined from similar pits.

Some of the terms used in this soil survey have a special meaning to soil scientists that are not known to all engineers. The Glossary defines many of those terms commonly used in soil science.

Engineering classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified sys-

[4] JULIAN M. COX, engineer, Soil Conservation Service, helped prepare this section.

TABLE 5.—*Estimated soil properties*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. Because these symbol > means more than;

Soil series and map symbols	Depth to seasonal high water table	Depth from surface (typical profile)	USDA texture	Classification		Percentage passing sieve [1]—	
				Unified	AASHO	No. 4 (4.7 mm)	No. 10 (2.0 mm)
	Feet	*Inches*					
Alligator: Ag	[2] 0–½	0–8	Silty clay	CL or CH	A–7	100	100
		8–60	Clay	CH	A–7	100	100
Alluvial land: Av. Too variable to estimate.							
Arkabutla: Ay	[2] ½–1½	0–36	Heavy silt loam	ML or CL	A–6	100	100
		36–60	Silty clay loam	ML or CL	A–6 or A–7	100	100
*Brandon: BdD, BdE, BrD3, BsF. For Memphis part of BsF, see Memphis series.	>6	0–12	Silt loam	ML or ML–CL	A–4	100	100
		12–32	Silty clay loam	ML or CL	A–4 or A–6	100	95–100
		32–75	Very gravelly sandy loam.	GM or GC, SM, and SC	A–2, A–4, or A–6	40–70	35–60
Bruno: Bu	[2] >4	0–6	Loamy fine sand	SM	A–4	100	100
		6–9	Fine sandy loam	SM or ML	A–4	100	100
		9–46	Loamy sand and fine sandy loam.	SM	A–2 or A–4	100	100
		46–66	Loamy fine sand and loam.	SM or ML	A–4	100	100
Calloway: CaA, CaB	½–1½	0–26	Silt loam	ML or ML–CL	A–4	100	100
		26–50	Silty clay loam (fragipan).	CL or ML	A–6 or A–4	100	100
		50–70	Silt loam	ML or ML–CL	A–4 or A–6	100	100
Cascilla: Cc	[2] >3	0–65	Heavy silt loam	ML or CL	A–6	100	100
Chavies: ChA	<4	0–44	Fine sandy loam	SM or SM–SC	A–4	100	100
		44–72	Sandy loam	SM	A–2 or A–4	100	100
Collins. Mapped only with Falaya soils.	[2] 1½–2	0–75	Silt loam	ML or ML–CL	A–4	100	100
Colp: CpA, CpC	½–1½	0–12	Silt loam	ML or ML–CL	A–4	100	100
		12–18	Heavy silt loam	CL	A–6	100	100
		18–65	Silty clay	CH	A–7	100	100
Dubbs, clayey subsoil variant: Db.	>4	0–13	Silty clay loam	CL or ML	A–7 or A–6	100	100
		13–38	Silty clay	MH, CL, or CH	A–7	100	100
		38–52	Clay loam	CL or ML	A–6 or A–7	100	100
		52–65	Sandy loam	SM	A–2–4 or A–4	100	100
		65–85	Sand	SM	A–2–4 or A–3	100	100
Dundee, clayey subsoil variant: Du.	½–1½	0–25	Silty clay loam	ML or CL	A–7 or A–6	100	100
		25–52	Silty clay	CL, MH, or CH	A–7	100	100
		52–65	Silty clay loam	ML or CL	A–7 or A–6	100	100
		65–81	Silty clay	CL, MH, or CH	A–7	100	100
*Falaya: Fc. For Collins part, see Collins series.	[2] ½–1½	0–54	Silty loam	ML or ML–CL	A–4	100	100
Flomaton. Mapped only with Saffell soils.	>5	0–11	Gravelly loam	GM or SM	A–4 or A–2	40–65	35–65
		11–80	Very gravelly sand	GW or GM	A–1	20–35	15–30

significant in engineering

soils may have different properties and limitations, it is necessary to refer to other series as indicated in the first column of this table. The the symbol < means less than]

Percentage passing sieve [1]—Continued		Liquid limit	Plasticity index	Permeability	Available moisture capacity	Reaction	Shrink-swell potential	Corrosivity	
No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
				Inches per hour	*Inches per inch of soil*	*pH*			
95–100	90–100	41–55	20–30	0.06–0.20	0.18–0.20	4.5–5.0	Moderate to high.	High	Moderate to high.
100	95–100	71–85	30–50	<0.06	0.14–0.18	4.5–5.0	High	High	High.
95–100	95–100	30–40	12–18	0.6–2.0	0.19–0.21	4.5–6.0	Low	High	High to moderate.
95–100	95–100	36–45	12–20	0.6–2.0	0.19–0.21	4.5–5.5	Moderate to low.	High	High.
95–100	90–100	20–30	2–6	0.6–2.0	0.18–0.23	4.5–5.5	Low	Low	Moderate.
95–100	85–100	35–40	5–12	0.6–2.0	0.19–0.21	4.5–5.5	Low	Moderate	High.
35–55	25–45	25–30	[3] NP–10	2.0–6.0	0.07–0.13	4.5–5.5	Low	Low	Moderate to high.
65–80	35–50	NP	NP	6.0–20	0.06–0.08	5.6–7.8	Low	Low	Moderate.
70–85	40–55	10–20	2–4	6.0–20	0.12–0.16	5.6–7.8	Low	Low	Moderate.
50–85	15–50	NP	NP	6.0–20	0.06–0.10	5.6–7.8	Low	Low	Moderate.
65–80	40–60	NP	NP	6.0–20	0.06–0.08	5.6–7.8	Low	Low	Moderate.
95–100	90–100	25–35	2–8	0.6–2.0	0.18–0.23	4.5–5.5	Low	Moderate to high.	Moderate to high.
95–100	80–100	35–40	10–20	<0.20	0.10–0.12	4.5–5.5	Low	High	High.
95–100	80–100	25–40	5–15	0.6–2.0	0.10–0.12	5.1–6.0	Low	High	High.
90–100	70–90	30–40	12–18	0.6–2.0	0.19–0.21	4.5–5.5	Low	Low	High.
70–85	40–50	16–25	2–6	2.0–6.0	0.12–0.16	4.5–6.0	Low	Low	Moderate to high.
60–70	30–40	16–25	2–6	2.0–6.0	0.10–0.14	4.5–6.0	Low	Low	Moderate to high.
95–100	90–100	25–30	5–8	0.6–2.0	0.20–0.23	4.5–6.0	Low	Low	High.
95–100	80–95	20–30	4–8	0.6–2.0	0.18–0.23	4.5–5.5	Low	High	High.
95–100	80–95	25–33	11–15	0.6–2.0	0.18–0.23	4.5–5.5	Low	High	High.
95–100	85–95	50–60	35–40	<0.20	0.14–0.17	4.5–7.8	High	High	High.
95–100	85–100	34–45	11–18	0.2–0.6	0.19–0.21	4.5–6.5	Moderate	Moderate	Moderate.
95–100	90–100	41–56	12–30	0.06–0.2	0.15–0.18	4.5–5.5	High	High	High.
90–100	70–80	30–45	11–15	0.2–0.6	0.16–0.18	4.5–5.5	Moderate	High	High.
60–75	30–40	NP	NP	2.0–6.0	0.10–0.14	4.5–5.5	Low	High	High.
65–80	5–35	NP	NP	2.0–6.0	0.02–0.04	4.5–5.5	Low	High	High.
95–100	85–100	34–45	11–18	0.2–0.6	0.19–0.21	4.5–7.3	Moderate	Moderate	Moderate.
95–100	90–100	41–56	15–30	0.06–0.2	0.15–0.18	4.5–5.5	High	High	High.
95–100	85–100	30–45	15–25	0.2–0.6	0.19–0.21	4.5–5.5	Moderate	High	High.
95–100	90–100	41–55	15–30	0.06–0.2	0.15–0.18	4.5–5.5	High	High	High.
95–100	90–100	25–35	5–8	0.6–2.0	0.20–0.23	4.5–6.5	Low	High	High.
30–55	25–50	20–30	2–6	>6.0	0.08–0.10	4.5–5.5	Low	Low	High.
10–25	0–15	NP	NP	>6.0	0.01–0.05	4.5–5.5	Low	Low	High.

TABLE 5.—*Estimated soil properties*

Soil series and map symbols	Depth to seasonal high water table	Depth from surface (typical profile)	USDA texture	Classification		Percentage passing sieve [1]—	
				Unified	AASHO	No. 4 (4.7 mm)	No. 10 (2.0 mm)
	Feet	*Inches*					
Grenada: GrA, GrB, GrB3, GrC3.	1½–2	0–7	Silt loam	ML or ML–CL	A–4	100	100
		7–25	Heavy silt loam	ML or CL	A–4 or A–6	100	100
		25–50	Silt loam (fragipan)	ML or CL	A–4 or A–6	100	100
		50–67	Silt loam	ML or CL	A–4 or A–6	100	100
Gullied land: Gu. Too variable to estimate.							
Henry: Hn	0–½	0–8	Silt loam	ML	A–4	100	100
		8–18	Silt loam	ML or ML–CL	A–4	100	100
		18–26	Silt loam (fragipan)	ML or ML–CL	A–4	100	100
		26–48	Silty clay loam (fragipan).	CL or ML	A–4 or A–6	100	100
		48–70	Silt loam (fragipan)	ML or CL	A–4 or A–6	100	100
Lindside. Mapped only with Newark soils.	[2] 1½–2	0–60	Silty clay loam	ML or CL	A–6 or A–4	100	100
Loring: LoB, LoC, LoC3, LoD, LoD3.	2–3	0–12	Silt loam	ML or CL	A–4	100	100
		12–34	Heavy silt loam	ML or CL	A–4 or A–6	100	100
		34–46	Silt loam (fragipan)	ML or CL	A–4 or A–6	100	100
		46–60	Silt loam	ML or CL	A–4 or A–6	100	100
Memphis: MmB, MmC, MmD, MmE, MpC3, MpE3.	>4	0–12	Silt loam	ML or ML–CL	A–4	100	100
		12–24	Silty clay loam	CL	A–7 or A–6	100	100
		24–60	Heavy silt loam	ML or ML–CL	A–4	100	100
Molena: MsB	>4	0–28	Loamy fine sand	SM or ML	A–4	100	100
		28–60	Loamy sand	SM or SM–SP	A–3 or A–4	100	100
*Newark: Nd. For Lindside part, see Lindside series.	[2] ½–1½	0–60	Silty clay loam	ML or CL	A–6 or A–4	100	100
*Nolin: No, Nr. For Robinsonville part of Nr, see Robinsonville series.	[2] >3	0–108	Silty clay loam	ML or CL	A–6	100	100
Okaw: Oc	0–½	0–13	Silt loam	ML or CL	A–4	100	100
		13–18	Heavy silt loam	ML or CL	A–6 or A–4	100	100
		18–62	Silty clay to clay	CH or CL	A–7	100	100
Robinsonville. Mapped only with Nolin soils.	[2] >3	0–17	Silt loam	ML or CL	A–4	100	95–100
		17–38	Fine sandy loam	SM or ML	A–4	100	95–100
		38–60	Sandy loam	SM	A–2 or A–4	100	95–100
Rosebloom: Ro	[2] 0–½	0–52	Heavy silt loam	CL or ML–CL	A–4 or A–6	100	100
		52–72	Heavy silty clay loam.	CL	A–6	100	100
*Saffell: SaC, SfE. For Flomaton part of SfE, see Flomaton series.	>5	0–16	Gravelly fine sandy loam.	SM	A–4 or A–2	70–80	65–75
		16–52	Gravelly sandy clay loam.	SC	A–2 or A–4	65–90	60–85
		52–66	Very gravelly sandy loam.	GM or GW	A–1 or A–2	25–45	20–40
Sharkey: Sh	[2] 0–½	0–65	Silty clay	CH, MH, or CL	A–7	100	100
Swamp: Sw. Too variable to estimate.							

significant in engineering—Continued

Percentage passing sieve [1]—Continued		Liquid limit	Plasticity index	Permeability	Available moisture capacity	Reaction	Shrink-swell potential	Corrosivity	
No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
				Inches per hour	*Inches per inch of soil*	*pH*			
95–100	85–100	20–30	1–5	0.6–2.0	0.18–0.23	4.5–5.5	Low	Low	Moderate.
90–100	85–100	25–40	5–15	0.6–2.0	0.18–0.23	4.5–5.5	Low	Moderate	High.
90–100	85–100	25–40	5–20	<0.20	0.10–0.12	4.5–5.5	Low	Moderate	High.
90–100	70–96	20–30	5–20	0.2–0.6	0.10–0.12	4.5–5.5	Low	Moderate	High.
95–100	85–100	20–25	1–5	0.6–2.0	0.18–0.23	4.5–5.5	Low	Moderate	High.
95–100	85–100	20–30	2–6	0.6–2.0	0.19–0.21	4.5–5.5	Low	Moderate	High.
95–100	85–100	20–30	2–6	<0.2	0.10–0.12	4.5–5.5	Low	Moderate	High.
95–100	85–100	25–35	5–15	<0.2	0.10–0.12	4.5–5.5	Low	High	High.
95–100	85–100	25–35	5–15	<0.2	0.10–0.12	4.5–6.0	Low	High	High to low.
95–100	90–100	30–40	5–15	0.6–2.0	0.19–0.21	6.1–6.5	Moderate	Moderate	Moderate.
95–100	90–100	20–30	1–5	0.6–2.0	0.18–0.23	4.5–5.5	Low	Low	Moderate.
95–100	90–100	25–40	5–15	0.6–2.0	0.19–0.21	4.5–5.5	Low	Moderate	High.
95–100	90–100	20–30	5–15	0.2–0.6	0.10–0.14	4.5–5.5	Low	Moderate	High.
95–100	90–100	20–30	5–20	0.2–0.6	0.10–0.14	4.5–5.5	Low	Moderate	High.
100	90–100	25–30	4–8	0.6–2.0	0.18–0.23	4.5–5.5	Low	Low	Moderate.
100	90–100	35–47	20–30	0.6–2.0	0.16–0.19	4.5–5.5	Low	Moderate	High.
100	90–100	30–40	6–10	0.6–2.0	0.18–0.23	4.5–5.5	Low	Low	Moderate.
85–95	40–60	NP	NP	6.0–20	0.06–0.08	5.1–6.0	Low	Low	High.
50–70	5–15	NP	NP	6.0–20	0.04–0.06	5.1–6.0	Low	Low	High.
95–100	90–100	30–40	5–15	0.6–2.0	0.19–0.21	5.6–7.8	Moderate	Moderate	Low.
95–100	90–100	30–40	11–20	0.6–2.0	0.19–0.21	5.6–7.3	Moderate	Moderate	Moderate to low.
95–100	80–95	20–30	5–10	0.6–2.0	0.18–0.23	4.5–5.5	Low	High	High.
95–100	80–95	25–35	5–15	0.2–0.6	0.16–0.19	4.5–5.0	Moderate	High	High.
95–100	80–95	41–60	20–30	<0.06	0.14–0.17	4.5–6.0	High	High	High.
90–100	85–100	20–35	4–8	0.6–2.0	0.18–0.23	6.1–8.4	Low	Low	Low.
85–95	35–55	NP	NP	2.0–6.0	0.15–0.20	6.1–8.4	Low	Low	Low.
85–95	30–50	NP	NP	2.0–6.0	0.08–0.10	6.1–8.4	Low	Low	Low.
85–100	85–95	20–35	5–15	0.60–2.0	0.18–0.23	4.5–7.3	Low	High	Moderate to high.
85–100	85–95	30–40	15–25	0.06–0.2	0.16–0.19	5.1–5.5	Moderate	High	Moderate to high.
60–70	30–50	20–30	0–5	2.0–6.0	0.08–0.11	4.5–5.5	Low	Low	High.
50–80	30–50	20–30	5–10	0.6–6.0	0.05–0.08	4.5–5.5	Low	Low	High.
20–40	10–25	NP	NP	>6.0	0.03–0.08	4.5–5.5	Low	Low	High.
100	95–100	41–70	20–38	<0.06	0.18–0.20	5.6–7.3	High	High	Low.

TABLE 5.—*Estimated soil properties*

Soil series and map symbols	Depth to seasonal high water table	Depth from surface (typical profile)	USDA texture	Classification		Percentage passing sieve [1]—	
				Unified	AASHO	No. 4 (4.7 mm)	No. 10 (2.0 mm)
	Feet	*Inches*					
Vicksburg: Vb	[2] >3	0–48	Silt loam	ML	A–4	100	100
		48–60	Loam	ML	A–4	100	100
Waverly: Wa	[2] 0–½	0–70	Silt loam	ML or CL	A–4	100	100
Wheeling: WhA, WhB, WhC	>4	0–13	Silt loam	ML or CL	A–4	100	95–100
		13–28	Silty clay loam	CL	A–4 or A–6	100	95–100
		28–36	Clay loam	ML or CL	A–4 or A–6	100	95–100
		36–70	Sandy loam	SM or ML	A–2 or A–4	100	95–100

[1] Coarse fraction greater than 3 inches not shown. Only the Flomaton, Saffell, and the lower horizons of Brandon soils have fragments coarser than 3 inches and these fragments generally make up less than 3 percent of the volume.

tem (*20, 27*), used by the Soil Conservation Service, Department of Defense, and other agencies, and the AASHO system, adopted by the American Association of State Highway Officials (*2, 20*).

In the Unified system soils are classified according to particle-size distribution, plasticity, liquid limit, and organic-matter content. Soils are grouped in 15 classes. There are eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes are designated by symbols for both classes; for example, ML-CL.

The AASHO system is used to classify soils according to those properties that affect use in highway construction and maintenance. In this system a soil is placed in one of seven basic groups ranging from A–1 to A–7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A–1 are gravelly soils of high bearing strength, or the best soils for subgrade (foundation). At the other extreme, in group A–7, are clay soils that have low strength when wet and that are the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A–1, A–2, and A–7 groups are divided as follows: A–1–a, A–2–b, A–2–4, A–2–5, A–2–6, A–2–7; and A–7–5 and A–7–6. As additional refinement, the engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 for the best material to 20 or more for the poorest. The estimated classification, without group index numbers, is given in table 5 for all soils mapped in the survey area.

Soil properties significant in engineering

Several estimated soil properties significant in engineering are shown in table 5. These estimates are made for typical soil profiles, by layers sufficiently different to have different significance for soil engineering. The estimates are based on field observations made in the course of mapping, on test data for these and similar soils, and on experience with the same kinds of soil in other counties. Most soils in this survey area are deep enough over bedrock so that it does not affect their use (*10, 15*). Following are explanations of some of the columns in table 5.

Depth to seasonal high water table is the distance from the surface of the soil to the highest level that ground water reaches in the soil in most years.

Soil texture is described in table 5 in the standard terms used by the Department of Agriculture. These terms take into account the relative percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the soil contains gravel or other particles coarser than sand, an appropriate modifier is added, as for example, "gravelly loamy sand." "Sand," "silt," "clay," and some of the other terms used in USDA textural classification are defined in the Glossary at the back of this survey.

Liquid limit and plasticity index indicate the effect of water on the strength and consistence of soil material. As the moisture content of a clayey soil is increased from a dry state, the material changes from a semisolid to a plastic state. If the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material changes from the semisolid to the plastic state; and the liquid limit, from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which the soil material is plastic.

Permeability is that quality of a soil that enables it to transmit water or air. It is estimated on the basis *significant in engineering*—Continued

Percentage passing sieve [1]—Continued		Liquid limit	Plasticity index	Permeability	Available moisture capacity	Reaction	Shrink-swell potential	Corrosivity	
No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
				Inches per hour	*Inches per inch of soil*				
95-100	85-100	30-35	5-7	0.6-2.0	0.18-0.23	4.5-5.0	Low	Low to moderate.	Moderate to high.
85-95	60-75	30-35	5-7	0.6-2.0	0.15-0.20	4.5-5.0	Low	Low to moderate.	Moderate to high.
95-100	85-100	20-35	5-10	0.6-2.0	0.18-0.23	4.5-7.8	Low	High	Moderate to high.
95-100	75-90	20-30	5-10	0.6-2.0	0.18-0.23	5.1-5.5	Low	Low	Moderate.
95-100	80-95	25-35	10-20	0.6-2.0	0.18-0.23	5.1-5.5	Low	Low	High.
90-100	70-80	20-30	5-15	0.6-2.0		5.1-5.5	Low	Low	High.
85-95	30-65	NP	NP	2.0-6.0	0.10-0.14	5.1-5.5	Low	Low	High.

[2] Subject to flooding.
[3] NP means nonplastic.

of those soil characteristics observed in the field, particularly structure and texture. The estimates in table 5 do not take into account lateral seepage or such transient soil features as plowpans and surface crusts.

Available moisture capacity is the ability of soils to hold water for use by most plants. It is commonly defined as the difference between the amount of water in the soil at field capacity and the amount at the wilting point of most crop plants.

Reaction is the degree of acidity or alkalinity of a soil, expressed in pH values. The pH value and terms used to describe soil reaction are explained in the Glossary.

Shrink-swell potential is the relative change in volume to be expected of soil material with changes in moisture content, that is, the extent to which the soil shrinks as it dries out and swells when it gets wet. Extent of shrinking and swelling is influenced by the amount and kind of clay in the soil. Shrinking and swelling of soils cause much damage to building foundations, roads, and other structures. A *high* shrink-swell potential indicates a hazard to maintenance of structures built in, on, or with material that has this rating.

Corrosivity, as used in table 5, pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. Rate of corrosion of uncoated steel is related to such soil properties as drainage, texture, total acidity, and electrical conductivity of the soil material. Ratings of soils for corrosivity for concrete are based mainly on soil texture and acidity. Installations that interest soil boundaries or soil horizons are more susceptible to corrosion than installations entirely in one kind of soil or in one soil horizon. A corrosivity rating of *low* means that there is a low probability of soil-induced corrosion damage. A rating of *high* means that there is a high probability of damage and that protective measures for steel and more resistant concrete should be used to avoid or minimize damage.

Interpretations of engineering properties of the soils

The estimated interpretations in table 6 are based on the engineering properties of soils shown in table 5, on test data for soils in this survey area and nearby or adjoining areas, and on the experience of engineers and soil scientists with the soils of Ballard and McCracken Counties. In table 6, ratings are used to summarize limitation or suitability of the soils for all listed purposes other than for ponds and reservoirs, embankments, drainage of cropland and pasture, irrigation, and terraces and diversions. For these particular uses, table 6 lists those soil features not to be overlooked in planning, installation, and maintenance.

Soil limitations are indicated by the ratings *slight, moderate,* and *severe. Slight* means that soil properties are generally favorable for the rated use, or, in other words, limitations are minor and easily overcome. *Moderate* means that some soil properties are unfavorable but can be overcome or modified by special planning and design. *Severe* means that soil properties are so unfavorable and so difficult to correct or overcome as to require major soil reclamation, special design, or intensive maintenance.

Soil suitability is rated by the terms *good, fair,* and *poor,* which have meanings approximately parallel to the terms slight, moderate, and severe.

Following are explanations of the columns in table 6.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into natural soil. The soil material from a depth of 18 to 72 inches is evaluated. The soil properties considered are those that affect both the construction and operation of the system and the absorption of effluent. Permeability, depth to the water table or to rock, and susceptibility to flooding are properties that affect absorption. Slope affects difficulty of layout and construction and also the risk of soil erosion, lat-

TABLE 6.—*Interpretations of*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil.

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings without basement	Sanitary landfill [1]	Local roads and streets
Alligator: Ag	Severe: very slow permeability; seasonal high water table; flooding.	Severe: seasonal high water table; flooding.	Severe: poorly drained; flooding; poor workability; seasonal high water table.	Severe: poorly drained; seasonal high water table; flooding; poor workability.	Severe: poorly drained; flooding; poor workability.	Severe: poorly drained; flooding; high shrink-swell potential.
Alluvial land: Av. Too variable to rate.						
Arkabutla: Ay	Severe: seasonal high water table; flooding.	Severe: seasonal high water table; flooding.	Severe: seasonal high water table; flooding.	Severe: seasonal high water table; flooding.	Severe: flooding; seasonal high water table.	Severe: flooding.
*Brandon: BdD, BdE, BrD3, BsF. For Memphis part of BsF, see MpE3 in the Memphis series.	Severe: slope.	Severe: slope.	Severe: slope; very gravelly below a depth of 3 feet.	Severe: slope.	Severe: moderately rapid permeability below a depth of 3 feet; slope.[2]	Severe: slope.
Bruno: Bu	Severe: flooding.[2]	Severe: flooding; rapid permeability.[2]	Severe: flooding; sloughing.	Severe: flooding.	Severe: rapid permeability; flooding.[2]	Severe: flooding.
Calloway:[3] CaA, CaB	Severe: seasonal high water table; slow permeability.	Severe: seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained; piping hazard.
Cascilla: Cc	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding; seasonal high water table.	Severe: flooding.
Chavies:[5] ChA	Slight [2]	Severe: moderately rapid permeability.[2]	Slight	Slight	Severe: moderately rapid permeability; seasonal high water table.[2]	Slight
Collins. Mapped only with Falaya soils.	Severe: flooding; seasonal high water table.	Severe: seasonal high water table; flooding.	Severe: seasonal high water table; flooding.	Severe: flooding; seasonal high water table.	Severe: flooding; seasonal high water table.	Severe: flooding.
Colp:[3] CpA, CpC	Severe: seasonal high water table; slow permeability.	Slight	Severe: somewhat poorly drained.	Severe: seasonal high water table; high shrink-swell potential.	Severe: poor workability.	Moderate: high shrink-swell potential below a depth of 18 inches.

See footnotes at end of table.

engineering properties of the soils

Because soils may have different properties and limitations, it is necessary to refer to other series as indicated in the first column]

Suitability as source of—			Soil features affecting—				
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments and dikes	Drainage of cropland and pasture	Irrigation	Terraces and diversions
Poor: poorly drained; poor workability; high shrink-swell potential.	Unsuited	Poor: poor workability; poorly drained.	Limited to dug ponds; nearly level.	Fair to poor slope stability and compaction characteristics.	Flooding; seasonal high water table; slow permeability.	Slow intake rate; frequent flooding.	Nearly level; poor workability; flooding.
Fair: somewhat poorly drained; fair stability.	Unsuited	Good to fair	Moderate permeability.	Fair stability	Flooding; seasonal high water table.	Flooding; seasonal high water table.	Nearly level; flooding.
Fair: slope; fair stability.	Fair for gravel below a depth of 2 to 4 feet.	Poor: slope	Moderately rapid permeability in substratum; slope.	Fair stability	Well drained	Slope	Slope of more than 8 percent.
Good	Fair for sand; unsuited for gravel.	Poor: sandy texture.	Rapid permeability.	Seepage; piping hazard; difficult to vegetate.	Excessively drained; flooding.	Very low available moisture capacity; rapid intake rate; flooding.	Nearly level; flooding.
Fair: somewhat poorly drained; fair stability.	Poor: no sand or gravel above a depth of 4 feet.[4]	Good	Seasonal high water table.	Piping hazard; fair stability.	Slow permeability; seasonal high water table.	Slow permeability; seasonal high water table.	Seepage; terraces generally not needed.
Fair: fair stability.	Unsuited	Good	Moderate permeability.	Fair stability	Well drained; flooding.	Subject to flooding.	Nearly level; flooding.
Good	Fair for sand; unsuited for gravel.	Good	Moderately rapid permeability.	Piping hazard	Well drained	Moderately rapid permeability.	Nearly level.
Fair: fair stability.	Unsuited	Good	Pervious substrata.	Poor stability; piping hazard.	Features generally favorable.	Flooding	Nearly level; flooding.
Poor: high shrink-swell potential below a depth of 18 inches.	Unsuited	Fair: as much as 18 inches of good material.	Features generally favorable.	Fair stability; high shrink-swell potential below a depth of 18 inches.	Suitable outlets are limited; slow permeability.	Slow permeability.	Seepage; short slopes.

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TABLE 6.—*Interpretations of*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings without basement	Sanitary landfill [1]	Local roads and streets
Dubbs, clayey subsoil variant:[3] Db	Severe: slow permeability.	Moderate: fair workability; permeable substratum.	Moderate: seasonal high water table; poor workability.	Moderate: moderate to high shrink-swell potential.	Severe: seasonal high water table.	Moderate: fair workability; moderate to high shrink-swell potential.
Dundee, clayey subsoil variant:[3] Du	Severe: slow permeability; seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table; poor workability.	Severe: seasonal high water table; high shrink-swell potential.	Severe: seasonal high water table.	Severe: high-shrink-swell potential.
*Falaya: Fc For the Collins part, see Collins series.	Severe: seasonal high water table; flooding.	Severe: seasonal high water table; flooding.	Severe: seasonal high water table; flooding.	Severe: seasonal high water table; flooding.	Severe: seasonal high water table; flooding.	Moderate: somewhat poorly drained.
Flomaton Mapped only with Saffell soils.	Severe: slope.	Severe: rapid permeability; slope.	Severe: very gravelly; slope.	Severe: slope.	Severe: very gravelly; slope.[1]	Severe: slope.
Grenada:[3] GrA, GrB, GrB3, GrC3	Severe: seasonal high water table; slow permeability.	Severe: seasonal high water table; slope in some places.	Severe: seasonal high water table.	Moderate: seasonal high water table.	Moderate: moderately well drained; seasonal high water table.	Moderate: fair stability.
Gullied land: Gu. Severe limitations for most uses.						
Henry:[3] Hn	Severe: seasonal high water table; slow permeability.	Severe: seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table.	Severe: poorly drained.
Lindside Mapped only with Newark soils.	Severe: flooding; seasonal high water table.	Severe: seasonal high water table; flooding.	Severe: seasonal high water table; flooding.	Severe: flooding; seasonal high water table.	Severe: flooding; seasonal high water table.	Severe: flooding.
Loring: LoB, LoC, LoC3, LoD, LoD3	Severe: seasonal high water table; slope in some areas; moderately slow permeability.	Moderate to severe: slope in some areas.	Moderate to severe: seasonal high water table; slope in some areas.	Moderate to severe: seasonal high water table; slope in some areas.	Moderate: fair stability; slope in some areas.	Moderate to severe: fair stability; slope in some areas.
Memphis: MmB	Slight	Moderate: moderate permeability.	Slight	Moderate: fair stability.	Moderate: fair workability; fair trafficability.	Moderate: fair stability.

See footnotes at end of table.

engineering properties of the soils—Continued

Suitability as source of—			Soil features affecting—				
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments and dikes	Drainage of cropland and pasture	Irrigation	Terraces and diversions
Fair: fair workability; moderate to high shrink-swell potential.	Poor: limited amount of sand in some areas below a depth of about 52 inches.	Fair: Fair workability.	Seepage; sand at a depth of about 4 feet.	Medium shrink-swell potential.	Well drained	Slow permeability.	Nearly level.
Fair: fair workability; high shrink-swell potential.	Unsuited	Fair: fair workability.	Seasonal high water table.	Poor workability.	Slow permeability.	Seasonal high water table; slow permeability.	Nearly level.
Fair: somewhat poorly drained.	Unsuited	Good	Pervious substrata.	Poor stability; piping hazard.	Features generally favorable.	Flooding; seasonal high water table.	Nearly level; flooding.
Poor: slope.	Fair for gravel; poor for sand.	Poor: high gravel content; slope.	Very pervious material.	Fair stability; seepage.	Excessively drained.	Very low available moisture capacity.	Difficult to vegetate.
Fair: fair stability.	Fair: no sand or gravel above a depth of 4 feet.[4]	Good to fair where not severely eroded.	Features generally favorable.	Fair stability	Slow permeability.	Slow permeability.	Features generally favorable.
Poor: poorly drained.	Unsuited	Poor: poorly drained.	Seasonal high water table.	Piping hazard	Slow permeability; suitable outlets are limited.	Slow permeability; seasonal high water table.	Nearly level; seasonal high water table.
Fair: fair stability.	Unsuited	Fair: fair workability.	Moderate permeability.	Fair stability	Features generally favorable.	Flooding	Nearly level; flooding.
Fair: fair stability; slope in some areas.	Fair: no sand or gravel above a depth of 4 feet.	Fair to poor: slope in some areas.	Gravelly or sandy substratum at a depth of 4 to 25 feet.	Fair stability; piping hazard.	Moderately well drained; slope; moderately slow permeability.	Slope in some areas.	Slope in some areas.
Fair: fair stability.	Fair: no sand or gravel above a depth of 4 feet.[4]	Fair: about 12 inches of good material.	Pervious substratum at a depth of 4 to 25 feet.	Fair stability; piping hazard.	Well drained	Features generally favorable.	Features generally favorable.

TABLE 6.—*Interpretations of*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings without basement	Sanitary landfill [1]	Local roads and streets
MmC, MmD, MmE, MpC3, MpE3	Moderate to severe: slope.	Severe: slope.	Moderate to severe: slope.	Moderate to severe: slope.	Moderate to severe: slope.	Moderate to severe: fair stability; slope.
Molena:[3] MsB	Slight [2]	Severe: rapid permeability.	Severe: sandy; sloughing.	Slight	Severe: rapid permeability.[2]	Slight
*Newark: Nd. For Lindside part, see Lindside series.	Severe: seasonal high water table; flooding.	Severe: flooding; seasonal high water table.	Severe: seasonal high water table; flooding.	Severe: seasonal high water table; flooding.	Severe: flooding; seasonal high water table.	Severe: flooding.
*Nolin: No, Nr. For Robinsonville part of Nr, see Robinsonville series.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
Okaw:[3] Oc	Severe: seasonal high water table; very slow permeability.	Slight	Severe: seasonal high water table; poor workability.	Severe: seasonal high water table; high shrink-swell potential.	Severe: seasonal high water table; poor workability.	Severe: poorly drained; poor workability; high shrink-swell potential.
Robinsonville. Mapped only with Nolin soils.	Severe: flooding.	Severe: flooding; moderately rapid permeability.	Severe: flooding.	Severe: flooding.	Severe: flooding; moderately rapid permeability.[2]	Severe: flooding.
Rosebloom: Ro	Severe: seasonal high water table; flooding; slow permeability.	Severe: seasonal high water table; flooding.	Severe: seasonal high water table; flooding.	Severe: seasonal high water table; flooding.	Severe: seasonal high water table; flooding.	Severe: seasonal high water table; flooding.
*Saffell:						
SaC	Slight [2]	Severe: rapid permeability.[2]	Severe: very gravelly.	Slight	Severe: rapid permeability.[2]	Slight
SfE. For Flomaton part, see Flomaton series.	Severe: slope.[2]	Severe: slope; rapid permeability.[2]	Severe: slope; very gravelly.	Severe: slope.	Severe: very gravelly; slope.[2]	Severe: slope.
Sharkey: Sh	Severe: seasonal high water table; very slow permeability.	Severe: seasonal high water table; flooding.	Severe: poorly drained; seasonal high water table; flooding; poor workability.	Severe: seasonal high water table; poorly drained; high shrink-swell potential.	Severe: poorly drained; flooding; poor workability.	Severe: poorly drained; flooding; high shrink-swell potential.

See footnotes at end of table.

engineering properties of the soils—Continued

Suitability as source of—			Soil features affecting—				
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments and dikes	Drainage of cropland and pasture	Irrigation	Terraces and diversions
Fair: fair stability; slope.	Fair: no sand or gravel above a depth of 4 feet.	Fair to poor: about 12 inches of good material; slope in some areas.	Pervious substratum at a depth of 4 to 25 feet; slope.	Fair stability; piping hazard.	Well drained	Slope; erodibility.	Slope in some areas.
Slight	Good for sand; unsuited for gravel.	Poor: sandy texture.	Rapid permeability.	Seepage; difficult to vegetate; piping hazard.	Somewhat excessively drained.	Low available moisture capacity; rapid intake rate.	Nearly level.
Fair: fair stability; somewhat poorly drained.	Unsuited	Fair: silty clay loam texture.	Moderate permeability.	Fair stability	Seasonal high water table; flooding.	Flooding; seasonal high water table.	Nearly level; flooding.
Fair: fair stability.	Unsuited	Fair: silty clay loam texture.	Moderate permeability.	Moderate shrink-swell potential; fair stability.	Well drained; flooding.	Features generally favorable.	Nearly level; flooding.
Poor: poor workability; high shrink-swell potential.	Unsuited	Poor: poorly drained; clayey subsoil below a depth of about 18 inches.	Limited to excavated ponds; nearly level.	Poor workability; high shrink-swell potential.	Seasonal high water table; very slow permeability.	Seasonal high water table; very slow permeability.	Nearly level.
Good to fair: fair stability.	Fair for sand; unsuited for gravel.	Good	Moderately rapid permeability.	Fair stability; piping hazard.	Well drained; flooding.	Moderately rapid permeability.	Nearly level; flooding.
Poor: poor workability; poorly drained.	Unsuited	Poor: poorly drained.	Limited to excavated ponds; nearly level.	Poor workability.	Seasonal high water table; slow permeability; flooding.	Slow permeability; seasonal high water table.	Nearly level; seasonal high water table.
Good	Good for gravel; poor for sand.	Poor: high content of gravel.	Very pervious gravelly material.	Fair stability	Well drained	Low available moisture capacity; rapid permeability.	Difficult to vegetate.
Poor: slope	Good for gravel; some areas on lower slopes have sand.	Poor: high content of gravel; slope.	Very pervious material; slope.	Fair stability; seepage.	Well drained	Low available moisture capacity; rapid permeability.	Difficult to vegetate.
Poor: poorly drained; poor workability; high shrink-swell potential.	Unsuited	Poor: clayey texture; poorly drained.	Limited to dug ponds; nearly level.	Slope; fair stability; poor workability; high shrink-swell potential.	Very slow permeability; flooding; seasonal high water table.	Seasonal high water table; slow permeability.	Poor workability; nearly level; flooding.

TABLE 6.—*Interpretations of*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings without basement	Sanitary landfill [1]	Local roads and streets
Swamp: Sw. Severe limitations for most uses.						
Vicksburg: Vb	Severe: some areas are subject to flooding.	Severe: flooding; moderate permeability.	Moderate: seasonal high water table; some areas are subject to flooding.	Moderate: some areas are subject to flooding.	Severe: seasonal high water table; some areas are subject to flooding.	Moderate: some areas are subject to flooding.
Waverly: Wa	Severe: seasonal high water table; flooding.	Severe: seasonal high water table; flooding.	Severe: poorly drained; seasonal high water table; flooding.	Severe: poorly drained; flooding; seasonal high water table.	Severe: poorly drained; flooding.	Severe: poorly drained; flooding.
Wheeling: WhA, WhB, WhC	Slight to moderate: slope.[2]	Moderate to severe: slope; highly permeable substratum.[2]	Slight	Moderate: slope.	Moderate: moderate workability; rapid permeability in substratum.[2]	Moderate: slope.

[1] Onsite studies of the underlying strata, water table, and hazards of pollution and drainage into ground water need to be made for landfills deeper than 5 or 6 feet.
[2] Pollution may be a hazard because of rapid permeability in the substratum.
[3] Flood hazard not rated, but some areas of these soils are on stream terraces and are subject to occasional flooding.

eral seepage, and downslope flow of effluent. Large rocks or boulders increase construction costs.

Sewage lagoons are shallow ponds constructed to hold sewage within a depth of 2 to 5 feet long enough for bacteria to decompose the solids. A lagoon has a nearly level floor and sides, or embankments, of compacted soil material. The assumption is made that the embankment is compacted to medium density and the pond is protected from flooding. Soil properties that affect the pond floor and the embankment are considered. Those that affect the pond floor are permeability, organic matter, and slope, and if the floor needs to be leveled, depth to bedrock becomes important. The soil properties that affect the embankment are the engineering properties of the embankment material, as interpreted from the Unified Soil Classification System, and the amount of stones, if any, that influence the ease of excavation and compaction of the embankment material.

Shallow excavations are those that require digging or trenching to a depth of less than 6 feet, such as excavations for pipelines, sewer lines, phone and power transmission lines, basements, open ditches, and cemeteries. Desirable soil properties are good workability, moderate resistance to sloughing, gentle slopes, absence of rock outcrops or big stones, and freedom from flooding or a high water table.

Dwellings, as rated in table 6, are no more than three stories high and are supported by foundation footings placed in undisturbed soil. The rating of a soil for dwellings is related to its capacity to support load and resist settlement under load and to its ease of excavation. Soil properties that affect capacity to support load are wetness, susceptibility to flooding, density, plasticity, texture, and shrink-swell potential. Those that affect excavation are wetness, slope, depth to bedrock, and content of stones and rocks.

Sanitary landfill is a method of disposing of refuse in dug trenches. The waste is spread in thin layers, compacted, and covered with soil throughout the disposal period. Landfill areas are subject to heavy vehicular traffic. Some soil properties that affect suitability for landfill are ease of excavation, hazard of polluting ground water, and trafficability. The best soils have moderately slow permeability, withstand heavy traffic, and are friable and easy to excavate. Unless otherwise stated the ratings in table 6 apply only to a depth of about 6 feet, and therefore limitation ratings of *slight* or *moderate* may not be valid if trenches are to be much deeper than that. For some soils, reliable predictions can be made to a depth of 10 to 15 feet; nevertheless every site should be investigated before it is selected.

Local roads and streets, as rated in table 6, have an all-weather surface expected to carry automobile traffic all year. They have a subgrade of underlying soil

engineering properties of the soils—Continued

Suitability as source of—			Soil features affecting—				
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments and dikes	Drainage of cropland and pasture	Irrigation	Terraces and diversions
Fair: fair stability.	Unsuited	Good	Hazard of seepage; moderate permeability in substratum in places.	Piping hazard; poor stability.	Well drained; flooding.	Some areas are subject to flooding.	Nearly level; flooding.
Poor: poor stability; poorly drained.	Unsuited	Poor: poorly drained.	Rapid permeability in substratum in some places.	Piping hazard; poor suitaability.	Seasonal high water table; flooding.	Flooding; seasonal high water table.	Nearly level; seasonal high water table flooding.
Fair: fair stability.	Unsuited for gravel; fair for sand below a depth of 4 feet.	Fair: about 13 inches of good material.	Hazard of seepage; rapid permeability in substratum.	Piping hazard; difficult to vegetate.	Well drained	Moderate permeability.	Slope.

[4] Coastal plain materials, which are mostly gravelly, are overlain by 5 to 30 feet of loess on uplands at an elevation of more than 400 feet. Small areas of soils on stream terraces and on uplands at an elevation of less than 400 feet have some gravelly or sandy material.

[5] Flood hazard not rated, but these soils are on stream terraces and some areas are subject to occasional flooding.

material; a base consisting of gravel, crushed rock, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. These roads are graded to shed water and have ordinary provisions for drainage. They are built mainly from soil at hand, and most cuts and fills are less than 6 feet deep.

Soil properties that most affect design and construction of roads and streets are load-supporting capacity and stability of the subgrade and the workability and quantity of cut and fill material available. The AASHO and Unified classifications of the soil material and the shrink-swell potential indicate traffic-supporting capacity. Wetness and flooding affect stability of the material. Slope, depth to hard rock, content of stones and rocks, and wetness affect ease of excavation and amount of cut and fill needed to reach an even grade.

Road fill is soil material used in embankments for roads. The suitability ratings reflect (1) the predicted performance of the soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage and (2) the relative ease of excavating the material at borrow areas.

Sand and gravel are used in great quantities in many kinds of construction. The ratings in table 6 provide guidance about where to look for probable sources. A soil rated as a *good* or *fair* source of sand or gravel generally has a layer at least 3 feet thick, the top of which is within a depth of 6 feet. The ratings do not take into account thickness of overburden, location of the water table, or other factors that affect mining of the materials, and neither do they indicate quality of the deposit. Soils that have little or no sand or gravel are rated as *unsuited.*

Topsoil is used for topdressing an area where vegetation is to be established and maintained. Suitability is affected mainly by ease of working and spreading the soil material, as when preparing a seedbed; natural fertility of the material, or the response of plants when fertilizer is applied; and absence of substances toxic to plants. Texture of the soil material and its content of stone fragments are characteristics that affect suitability, but also considered in the ratings is damage that will result at the area from which topsoil is taken.

Pond reservoir areas hold water behind a dam or embankment. Soils suitable for pond reservior areas have low seepage, which is related to their permeability and depth to fractured or permeable bedrock or other permeable material.

Embankments and dikes require soil material resistant to seepage and piping and of favorable stability, shrink-swell potential, shear strength, and compactibility. Presence of stones or organic material in a soil are among the factors that are unfavorable.

Drainage of cropland and pasture is affected by such soil properties as permeability, texture, and structure; depth to claypan, rock, or other layers that influence rate of water movement; depth to the water table; slope stability in ditchbanks; susceptibility to stream overflow; salinity or alkalinity; and availability of outlets for drainage.

Irrigation of a soil is affected by such features as slope; susceptibility to stream overflow, water erosion, or soil blowing; soil texture; content of stones; accumulation of salts and alkali; depth of root zone; rate of water intake at the surface; permeability of soil layers below the surface layer and in fragipans or other layers that restrict movement of water; amount of water held available to plants; and need for drainage, or depth to water table or bedrock.

Terraces and diversions are embankments, or ridges, constructed across the slope to intercept runoff and seepage so that it soaks into the soil or flows slowly to a prepared outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock or other unfavorable material; presence of stones; permeability; and resistance to water erosion, soil slipping, and soil blowing. A soil suitable for these structures provides outlets for runoff and is not difficult to vegetate.

Formation, Morphology, and Classification of Soils

In this section the factors of soil formation and their effect on the soils of Ballard and McCracken Counties are discussed, the morphology of the soils is described, the system of soil classification is explained, and the soil series are placed in some of the higher categories. Also, the results of some laboratory tests on three representative soils are given.

Formation of Soils

The characteristics of the soil at any given point depend on climate, the physical and chemical composition of parent material, relief, plant and animal life, and time. Soil is formed by the interaction of these five factors. The relative importance of each factor differs from one area to another. In some areas one factor may dominate in the formation of soil characteristics, and in other areas another factor may dominate. Climate and plant and animal life are not likely to vary much over an area the size of one to three contiguous counties, but there may be many local differences in relief and parent material.

Because the interrelationships among the five factors are complex, the effects of any one factor are hard to determine. Following is a brief discussion of some of the ways in which each of these factors has influenced soil formation in Ballard and McCracken Counties.

Climate

The soils of Ballard and McCracken Counties formed in a humid, temperate climate, which is characteristic of the south-central part of the United States. There is little variation in climate within the survey area, and climate has been a uniform factor in soil formation. The slight variations in climate that affect soil formation result from differences in relief. As is typical of soils that formed in humid, temperate climates, many of these soils, such as those of the Henry and Calloway series, are strongly weathered, highly leached, and acid. The high rainfall results in intense leaching and downward movement of soluble and colloidal materials in the soil. Because the soil is frozen for only short periods and to only a shallow depth, weathering and translocation of materials continue almost without interruption.

Parent material

Several different kinds of parent material have been identified in Ballard and McCracken Counties. These are loess, alluvium, and gravelly and loamy Coastal Plain deposits.

Loess, a windblown silty material, covers nearly all the upland areas. Thickness of the loess averages about 10 feet on gently sloping uplands and ranges from little or none to more than 30 feet. Because the loess is extensive and is the uppermost layer in which soil forming processes are active, it is the most important parent material on uplands. Most of the upland soils, such as the Memphis, Loring, Grenada, Calloway, and Henry soils, formed in loess that is 48 inches or more thick. The Brandon soils formed in a thin layer of loess and in the underlying Coastal Plain deposits.

Most of the alluvium and colluvium in which the Vicksburg, Falaya, Collins, and Waverly soils on first bottoms and the Calloway and Grenada soils on stream terraces formed was washed from soils that formed in loess. A small part of the alluvium is of Coastal Plain origin.

The alluvium deposited by the Ohio, Tennessee, and Mississippi Rivers is washed from many kinds of parent material. The Nolin, Newark, and Lindside soils formed in this alluvium. They are mostly medium acid to neutral, loamy soils on first bottoms near the rivers. The Wheeling, Dubbs, Dundee, and Chavies soils formed on the terraces of these streams. They have a mostly strongly acid or very strongly acid subsoil, but some areas are flooded frequently enough that the surface layer is medium acid to neutral. The Rosebloom and Arkabutla soils are poorly drained and somewhat poorly drained, loamy soils that formed in swales near uplands. These soils receive deposits from the tributary branches and creeks as well as the river, and all horizons are strongly acid or very strongly acid except where the surface layer has been limed.

The Flomaton and Saffell soils on uplands formed in gravelly and very gravelly deposits of Coastal Plain origin. On terraces, these soils are believed to be beaches of an ancient lake (*10*).

A fragipan tends to form in loamy parent material that has a low content of carbonates or no carbonates and a high content of silt or very fine sand. Because loess is a silty, loamy material and is the parent material of most upland soils, soils that have a fragipan are extensive in the two counties. The Calloway and Grenada soils are examples. Much of the alluvium along creeks is from loess, and most of the soils on stream terraces along creeks have a fragipan.

Such soils as the Memphis, Henry, and Loring soils, which formed in loess, have a higher base saturation than the Flomaton and Saffell soils, which formed in Coastal Plain deposits. This is at least partly because the loess deposit is more recent. The percentage of base saturation and other chemical data suggest that the more poorly drained soils that formed in loess have been subject to more severe weathering and leaching than the better drained ones. Therefore, natural fertility varies not only with parent material but also with the soil-forming factors of relief and time.

Relief

The relief of Ballard and McCracken Counties is variable. Slopes range from nearly level to steep. The maximum difference in elevation between the valleys and the adjacent hilltops is about 150 feet in the southern part of the survey area near Mayfield Creek. In the relatively level interstream areas, dissection is slight, and the difference in elevation between the interstream areas and the alluvial valleys rarely exceeds 50 feet.

Relief affects soil characteristics mainly by influencing the amount of rainfall that runs off the surface and the amount that enters and remains in the soil. Less rainfall percolates through steeper soils because much of the rainfall runs off; therefore, little leaching and translocation of clay and colloidal material take place in steep soils. The Flomaton series is an example of soils that have mostly moderately steep or steep slopes that slow the soil-forming processes.

The Memphis soils are examples of well-drained soils that formed on gently sloping to sloping topography. Some surface runoff occurs on these soils, but a higher percentage of the rainfall enters the soil. Less soil is lost through erosion, and the downward percolation of water causes the soil-forming processes to be active. The Grenada soils formed on nearly level to sloping topography, so more rainfall enters these soils. The reduced iron compounds and the soil-forming processes cause the lower part of the solum to be gray in color and to be brittle and slowly permeable to water and air. Most Grenada soils, even those that are nearly level to sloping, have a convex surface. Water does not stand on these soils.

The Calloway and Henry soils are examples of somewhat poorly drained and poorly drained soils that are nearly level to gently sloping and have a concave surface. Nearly all the rainfall enters these soils, and in places there is some run-in water from adjoining convex slopes. Because of the soil-forming processes, as influenced by a fluctuating water table, the gray, brittle, slowly permeable layers are nearer the surface and are more restrictive to movement of air and water in the Calloway and Henry soils than in the Grenada soils.

The Waverly and Rosebloom series are examples of poorly drained, nearly level soils on bottom lands where the water table is at or near the surface for long periods. There are no restrictive layers in these soils to prevent movement of air and water, but the level relief and position on the landscape cause an accumulation of excess water, which in turn reduces the iron compounds and makes the soil gray in color.

Relief modifies the effects of climate, even though temperature and rainfall are about the same throughout both counties. Runoff from sloping areas collects on flat areas or in depressions, making the nearly level soils wetter than the sloping soils. The amount of solar radiation an area receives also is affected by slope and aspect.

Plant and animal life

The native vegetation, like the climate, was fairly uniform and is relatively unimportant in accounting for differences among soils in Ballard and McCracken Counties. The vegetation, however, has had a strong influence on the common characteristics of the soils.

The soils in this survey area formed under a dense forest of mixed hardwoods. Most of the soils have an Ap horizon that has been mixed by plowing. Much of the acreage of the Brandon and Saffell soils, however, has not been plowed, so these soils have a dark-gray or very dark grayish-brown A1 horizon, which indicates an accumulation of organic matter, over a brown, leached A2 horizon.

Not much is known of the fungi and microlife, although they undoubtedly had a strong influence on soil formation and development. The greatest activity of earthworms and other small animals is in the uppermost layers of the soil. Mixing of soil material by rodents does not appear to have been of much importance in this survey area.

The complex of living organisms in the soil has been changed as a result of the clearing of forests, the cultivation of fields, the introduction of new species of plants, and artificial drainage of wet areas. These activities will affect the rate and direction of soil genesis in the future. Some of the results of man's effect on soil genesis are now evident, but others may not become apparent for many centuries.

Time

Time is required for soils to form. The soils in this survey area range from very young to old. The age of soils that formed in similar parent material and under similar conditions is indicated by the degree of development of the horizons. The soils in this survey area that formed in alluvium range from young to old. For example, the Vicksburg soils are on flood plains and are young soils that have weakly developed or no developed horizons. The Grenada soils, which formed in similar parent material on stream terraces or uplands, are older soils that have strongly developed horizons.

Morphology of Soils

Most of the soils in this survey area have strongly developed horizons. The exceptions are some of the alluvial soils, such as the Vicksburg, Nolin, and Robinsonville soils, or soils that formed in very gravelly material, such as the Flomaton and Saffell soils, all of which have weakly developed horizons.

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The differentiation of horizons of the soils is the result of several soil-forming processes. The most important of these are (1) accumulation of organic matter, (2) leaching of carbonates and salts, (3) chemical weathering of the primary minerals and parent materials into siliceous clay minerals, (4) translocation of silicate clay minerals and probably some silt-size particles from one horizon to another, and (5) chemical change and transfer of iron. One or more of these processes has taken place in all the soils in the survey area. The degree of activity of each process, however, varies from soil to soil.

In all the soils, some organic matter has accumulated to form an A1 horizon, but the A1 horizon has lost its identity in most places as a result of plowing and cultivation and has become part of an Ap horizon. In severely eroded areas, the original A horizon has been lost or nearly all lost. The content of organic matter accumulated ranges from low to medium, but in most severely eroded soils the organic-matter content is very low.

Leaching of carbonates and salts has occurred in all the soils, but it has been of little importance in horizon differentiation. The effects have been indirect; the leaching has permitted translocation of silicate minerals in most of the soils, and most are deeply leached of carbonates and salts. This is reflected in the fact that most of the soils are strongly acid or very strongly acid.

The main result of the weathering of primary minerals to silicate minerals, largely by the process of hydrolysis, is the production of clays that have a mixed mineralogy. In the Memphis, Loring, Grenada, Calloway, and Henry soils, fairly large amounts of montmorillonite, illite, vermiculite, kaolinite, and quartz are in the coarse clay fraction (2.0 to 0.20 mm.) of the A and B horizons. Montmorillonite is the predominant mineral in the medium and fine clay of all the soils that formed in loess and is most abundant in the poorly drained soils. Vermiculite is more abundant in the poorly drained soils than in the well-drained soils, and distribution of illite is generally just the opposite (*12*).

The translocation and development in place of silicate clay minerals have had a strong influence on the development of horizons in the soils on uplands and stream terraces. Clay has moved, in part, from the A to the B horizon. This is true of all soils that have a moderate to strongly developed B horizon and of some soils that have a weakly developed B horizon. The greatest accumulation of clay is in the upper part of the B horizon for the well-drained Brandon and Memphis soils, but the greatest accumulation of clay is in the lower part of the B horizon or the fragipan of the Grenada, Calloway, and Henry soils.

The reduction and transfer of iron has occurred to some degree in all soils that have impeded drainage. This process, known as gleying, has been of great importance in the level and gently sloping soils. It has particularly affected the Alligator, Henry, Okaw, Sharkey, Rosebloom, Falaya, and Calloway soils and the fragipan of the Grenada and Loring soils.

Iron that is reduced under conditions of poor aeration generally becomes mobile. It can move from the soil entirely, but in this survey area it mostly has moved only a short distance, stopping either in the horizon where it originated or in a lower horizon. Part of this iron can be reoxidized and is segregated to form the yellowish-brown or strong-brown mottles common in the gleyed horizons of all soils that have impeded drainage.

Classification of Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us to understand their behavior and their response to manipulation (*6*). First through classification, and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

The narrow categories of classification, such as those used in detailed soil surveys, allow us to organize and apply knowledge about soils in managing farms, fields, and woodlands; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison in large areas, such as countries and continents.

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965. Because this system is under continual study, readers interested in the system should refer to the latest literature (*24, 26*).

The current system of classification has six categories. Beginning with the broadest, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. In this system the criteria used as a basis for classification are soil properties that are observable and measurable. The properties are chosen so that soils of similar genesis, or mode of origin, are grouped. In table 7, the soil series of Ballard and McCracken Counties are placed in three categories of the current system. Categories of the current system are briefly defined in the paragraphs that follow.

Order.—Ten soil orders are recognized. The properties used to differentiate among soil orders are those that tend to give broad climatic groupings of soils. The two exceptions to this are the Entisols and Histosols, which occur in many different climates. Each order is named with a word of three or four syllables ending in *sol* (Ent-i-sol).

Suborder.—Each order is divided into suborders that are based primarily on those soil characteristics that seem to produce classes that have the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the order. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of waterlogging or soil differences that result from climate or vegetation. The names of suborders have two syllables, the last of which indicates the order. An example is

TABLE 7.—*Classification of soil series into higher categories*

Series	Family	Subgroup	Order
Alligator	Very fine, montmorillonitic, acid, thermic.	Vertic Haplaquepts	Inceptisols.
Arkabutla	Fine-silty, mixed, acid, thermic	Aeric Fluvaquents	Entisols.
Brandon	Fine-silty, mixed, thermic	Typic Hapludults	Ultisols.
Bruno	Sandy, mixed, thermic	Typic Udifluvents	Entisols.
Calloway	Fine-silty, mixed, thermic	Glossaquic Fragiudalfs	Alfisols.
Cascilla	Fine-silty, mixed, thermic	Fluventic Dystrochrepts	Inceptisols.
Chavies	Coarse-loamy, mixed, mesic	Ultic Hapludalfs	Alfisols.
Collins	Coarse-silty, mixed, acid, thermic	Aquic Udifluvents	Entisols.
Colp	Fine, montmorillonitic, mesic	Aquic Hapludalfs	Alfisols.
Dubbs, clayey subsoil variant	Fine, mixed, thermic	Ultic Hapludalfs	Alfisols [1].
Dundee, clayey subsoil variant	Fine, mixed, thermic	Aeric Ochraqualfs	Alfisols [1].
Falaya	Coarse-silty, mixed, acid, thermic	Aeric Fluvaquents	Entisols.
Flomaton [2]	Sandy-skeletal, siliceous, thermic	Psammentic Paleudults	Ultisols.
Grenada	Fine-silty, mixed, thermic	Glossic Fragiudalfs	Alfisols.
Henry	Coarse-silty, mixed, thermic	Typic Fragiaqualfs	Alfisols.
Lindside	Fine-silty, mixed, mesic	Fluvaquentic Eutrochepts	Inceptisols.
Loring	Fine-silty, mixed, thermic	Typic Fragiudalfs	Alfisols.
Memphis	Fine-silty, mixed, thermic	Typic Hapludalfs	Alfisols.
Molena	Sandy, mixed, thermic	Psammentic Hapludults	Ultisols.
Newark	Fine-silty, mixed, nonacid, mesic	Aeric Fluvaquents	Entisols.
Nolin	Fine-silty, mixed, mesic	Dystric Fluventic Eutrochrepts	Inceptisols.
Okaw	Fine, montmorillonitic, mesic	Typic Albaqualfs	Alfisols.
Robinsonville	Coarse-loamy, mixed, nonacid, thermic.	Typic Udifluvents	Entisols.
Rosebloom	Fine-silty, mixed, acid, thermic	Typic Fluvaquents	Entisols.
Saffell	Loamy-skeletal, siliceous, thermic	Typic Hapludults	Ultisols.
Sharkey [3]	Very-fine, montmorillonitic, nonacid, mesic.	Vertic Haplaquepts	Inceptisols.
Vicksburg	Coarse-silty, mixed, acid, thermic	Typic Udifluvents	Entisols.
Waverly	Coarse-silty, mixed, acid, thermic	Typic Fluvaquents	Entisols.
Wheeling	Fine-loamy, mixed, mesic	Ultic Hapludalfs	Alfisols.

[1] Limited laboratory data indicate the classification of the Dubbs and Dundee soils in this survey area to be marginal between Alfisols and Ultisols.

[2] The Flomaton soils in this survey area have less sand in the upper 10 inches of the A horizon than the defined range for the series and are taxadjuncts to the series.

[3] The Sharkey soils in this survey area have less clay in the soil profile than the defined range for the series and are taxadjuncts to the series.

Aquent (*Aqu,* meaning water or wet; and *ent,* from Entisol).

Great group.—Soil suborders are separated into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus has accumulated; those that have pans that interfere with growth of roots, movement of water, or both; and thick, dark-colored surface horizons. The features used are the self-mulching properties of clay, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), dark-red and dark-brown colors associated with basic rocks, and the like. The names of great groups have three or four syllables and are made by adding a prefix to the name of the suborder. An example is *Fluvaquents* (*Fluv,* meaning river or flood plain; *aqu,* for wetness or water; and *ent,* from Entisols).

Subgroup.—Great groups are divided into subgroups, one that represents the central (typic) segment of the group and others, called intergrades, that have properties of the group and also one or more properties of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside the range of any great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives in front of the name of the great group. An example is *Typic Fluvaquents* (a typical Fluvaquent).

Family.—Soil families are established within a subgroup mainly on the basis of properties important to the growth of plants or on the behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence. A family name consists of a series of adjectives preceding the subgroup name. The adjectives are the class names for texture, mineralogy, and so on that are used as family differentiae (see table 7). An example is the coarse-silty, mixed, acid, thermic family of Typic Fluvaquents.

Series.—The series consists of a group of soils that formed from a particular kind of parent material. These soils have genetic horizons that, except for texture of the surface layer, have similar characteristics and arrangement in the soil profile. Among these characteristics are color, structure, reaction, consistence, and mineralogical and chemical composition.

The Dubbs and Dundee soil series in this survey area are marginal between two orders. They have more clay in the subsoil than normal and so were named clayey subsoil variants of the established Dubbs and Dundee series. The Flomaton soils have less sand in the upper 10 inches, and the Sharkey soils have less clay in the profile than normal. These soils are tax adjuncts to the series for which they are named.

Laboratory Data

Physical and chemical laboratory data considered representative of selected soils in Ballard and McCracken Counties are in table 8. The soils sampled are those of the Dubbs, Dundee, and Nolin series.

The data are useful to soil scientists in classifying soils and in developing concepts of soil genesis. This information is helpful for estimating fertility, texture, acidity, organic-matter content, and other properties that affect soil management. It also serves as a guide for making field estimates of soil properties.

The samples were collected from carefully selected pits. A sample was taken from each horizon, and analyses were made by the Agronomy Department of the University of Kentucky. The profiles were chosen to represent the series, and descriptions of them are in the section "Descriptions of the Soils."

All laboratory analysis was made on ovendry material that passed a 2-millimeter sieve. Clay content was determined by the pipette method (*13, 14, 18*). The soil reaction was determined with a glass electrode, using a soil-water ratio of 1:1. Organic matter was determined by wet combustion, using a modification of the Walkley-Black method (*19*) and multiplying the organic carbon percentage by a factor of 1.72.

Extractable cations were determined by a calcium oxalate precipitation and titration, and magnesium was determined as ammonium phosphate (*19*). Extractable sodium and potassium in the ammonium acetate extract were determined with a flame spectrophotometer (*19*). Total exchangeable bases were determined by the sum of the extractable cations. The cation-exchange capacity at pH 7 was determined by direct distillation of absorbed ammonia (*19*). Base saturation was determined by dividing the total exchangeable bases by the cation-exchange capacity and

TABLE 8.—*Chemical and physical*

[The analysis was made by the Agronomy Department, Agricultural Experiment Station, University of

Soil, sample number, and location	Horizon	Depth	Particle-size distribution					
			Sand					Silt (0.05–0.002 mm)
			Very coarse (2.0–1.0 mm)	Coarse (1.0–0.5 mm)	Medium (0.5–0.25 mm)	Fine (0.25–0.1 mm)	Very fine (0.1–0.05 mm)	
		Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Dubbs silty clay loam, clayey subsoil variant:								
No. S69Ky73-51; 0.15 mile west of Massac Creek and 0.45 mile north of High Point; in McCracken County.	Ap	0–9	0.3	1.1	1.3	1.4	1.2	61.9
	B21t	9–13	.1	1.1	1.8	2.2	1.5	56.8
	B22t	13–26	----------	.2	.9	1.7	1.3	50.8
	B23t	26–38	----------	.5	1.8	3.0	2.3	49.6
	B24t	38–52	----------	.3	4.9	12.5	7.3	43.0
	IIB3	52–65	----------	2.0	42.3	26.4	8.6	12.6
	IIB&C	65–79	----------	3.4	55.3	31.8	2.3	7.2
	IIC	79–85	----------	3.0	68.9	21.2	1.7	4.5
	Lamellae	--------	----------	7.3	55.5	17.6	2.5	4.9
Dundee silty clay loam, clayey subsoil variant:								
No. S69Ky73-55; 100 feet west of farm road, 0.5 mile south of Dam 52 on the Ohio River; in McCracken County.	Ap	0–8	----------	.1	.1	2.9	3.7	57.7
	B21t	8–17	----------	.1	.1	3.4	3.4	56.6
	B22t	17–25	(1)	.7	1.1	2.0	1.9	54.7
	B23t	25–36	(1)	.7	1.0	1.9	1.8	50.2
	B24t	36–52	(1)	.5	2.0	1.8	1.9	52.3
	B31t	52–65	(1)	.6	1.0	1.9	2.1	54.6
	B32t	65–81	(1)	.6	1.0	1.9	2.0	54.3
Nolin silty clay loam:								
No. S69Ky73-54; 100 feet east of private road, 500 yards south of the Ohio River and Dam 52; in McCracken County.	Ap	0–7	----------	.1	.1	2.9	3.7	58.3
	B21	7–17	----------	.1	.1	3.4	3.4	58.5
	B22	17–35	----------	.1	.3	2.0	9.4	54.2
	B23	35–45	----------	.1	.1	1.0	11.3	60.3
	B24	45–90	----------	.1	.1	1.4	10.0	50.3
	C	90–108	----------	(1)	.1	.5	1.7	61.2

[1] Trace.

multiplying by 100. Readily soluble phosphorus was determined by the modified Truog Method (*19*).

General Nature of the Area

This section contains information about the history and development and the geology, physiography, relief, and drainage of Ballard and McCracken Counties. It also describes farming and industry, natural resources, and climate in the two counties.

History and Development

Ballard and McCracken Counties are two of the eight counties that make up the Jackson Purchase. This territory was acquired from the Chickasaw Indians in 1818. General Andrew Jackson was one of the negotiators with the Indians, and his name is usually associated with the area. In 1821 this territory was organized as Hickman County, with the county seat at Columbus. McCracken County was established in 1824 out of a part of Hickman County. It was the 78th county formed in the State and was named in honor of Captain John McCracken. Wilmington was the first county seat, but the location was soon changed to Paducah. Paducah is on the Ohio River immediately below the mouth of the Tennessee River. It is the fifth largest city of the State in population.

In 1842 Ballard County was created from parts of Hickman and McCracken Counties. It was the 93rd county in Kentucky and was named in honor of Captain Bland Ballard, who fought with General George Rogers Clark during the Indian battles around Louisville. Blandville was the first county seat, and Wickliffe is the present county seat. In 1886 the part of Ballard County south of Mayfield Creek became what is now Carlisle County. The new county was created because Mayfield Creek was flooded frequently, causing hardships for residents who wished to go to the county seat.

The 1970 census showed a population of 31,627 in Paducah, 58,281 in McCracken County, 1,211 in Wick-

characteristics of some representative soils

Kentucky at Lexington. Dashes indicate that the material was not present in measurable amounts]

Particle-size distribution—Continued: Sand and silt: Sand coarser than very fine (2.0–0.1 mm)	Very fine sand plus silt (0.1–0.002 mm)	Clay (<0.002 mm)	Reaction	Organic matter content	Extractable cations: Ca	Mg	K	Na	Total exchangeable bases	Cation exchange capacity	Base saturation	Phosphorus
Percent	*Percent*	*Percent*	*pH*	*Percent*	*Meq/100 grams*	*Meq/100 grams*	*Meq/100 grams*	*Meq/100 grams*	*Meq/100 grams*	*Meq/100 grams*	*Percent*	*Parts/million*
4.1	63.1	32.7	6.2	3.5	13.0	2.9	0.5	0.1	16.5	18.2	91	37
5.2	58.3	36.5	5.2	.96	5.8	.9	.1	.1	6.9	15.9	43	9
2.8	52.1	45.1	5.0	.45	5.5	1.2	.2	.1	7.0	19.0	37	3
5.3	51.9	42.8	5.1	.45	5.5	1.4	.2	.1	7.2	19.0	38	8.5
17.7	50.3	32.0	4.9	.22	2.4	1.6	.2	.1	4.3	14.4	30	3.5
70.7	21.2	15.2	4.8	.11	.8	1.7	.1	.1	2.7	7.1	38	20
90.5	9.5	---------	5.5	.06	.6	.4	.1	([1])	1.1	1.8	61	15
93.1	6.2	.7	5.9	.05	.4	.9	.1	([1])	1.4	.8	175	9
80.4	7.4	12.2	5.0	.10	2.4	1.1	.1	([1])	3.6	6.1	59	26
3.1	61.4	35.6	6.4	2.73	14.1	2.3	.3	.1	16.8	18.5	91	29
3.6	60.0	36.4	5.2	1.35	7.7	1.7	.2	.1	9.7	17.7	54	12
3.8	56.6	39.6	5.0	.71	4.6	1.3	.2	.1	6.2	17.0	37	7
3.6	52.0	44.4	4.9	.52	4.0	1.8	.2	.1	6.1	17.2	35	6
4.3	54.2	41.5	5.0	.38	5.2	2.8	.2	.1	8.3	18.6	45	10
3.5	56.7	39.8	5.0	.58	5.0	2.7	.2	.1	8.0	18.0	44	10
3.5	55.4	40.2	5.0	.51	5.5	1.9	.2	.1	7.7	20.5	38	11
3.1	62.0	34.9	6.4	2.45	11.1	3.5	.4	.1	15.1	15.8	96	36
3.6	61.9	34.5	6.7	1.84	10.9	3.3	.3	.1	14.6	16.1	90	23
2.4	63.6	33.7	6.7	1.73	11.4	3.4	.3	.1	15.2	16.1	94	36
1.2	71.6	27.2	6.7	1.47	10.8	2.4	.2	.1	13.5	14.8	91	36
1.6	60.3	38.1	6.6	1.91	13.0	2.9	.3	.1	16.3	17.8	92	53
0.6	62.9	36.5	6.5	1.36	13.9	3.4	.3	.1	17.7	20.1	88	24

liffe, and 8,276 in Ballard County. Blandville had a population of 116.

Geology, Physiography, Relief, and Drainage

The geologic formations of Ballard and McCracken Counties are among the youngest in Kentucky. About one-fourth of Ballard County and one-tenth of McCracken County consist of alluvial plains bordering the Ohio, Mississippi, and Tennessee Rivers. The uplands of both counties are covered with a moderately thick to thick mantle of loess. Underlying the loess are unconsolidated Coastal Plain deposits left by a northern extension of the Gulf of Mexico in Quaternary, Tertiary, and Cretaceous times. Coastal Plain deposits are dominantly gravelly loamy material in these two counties, but in some areas at an elevation of more than 380 feet, the deposits are mainly sand, clay, or silt. Below an elevation of 380 feet, on the nearly level uplands of the Calloway-Henry soil association in the northern part of Ballard and McCracken Counties, the loess is underlain by clayey silt of the Pleistocene series of the Quarternary system that contains little or no gravel. This area is very slightly dissected and appears to be a high, large stream terrace covered by loess.

Physiographically, the area where the ridges are at an elevation of more than 380 feet is a plain that slopes gently to the north. It is modified by a dendritic drainage system into three relief subdivisions: fairly smooth uplands, fairly rough uplands, and valleys. The smooth uplands are shown on the general soil map as the Grenada-Calloway association. The rough uplands are shown as the Loring-Memphis-Brandon association. The small branch and creek valleys are included with the surrounding uplands on the general soil map, but the larger creeks are shown as the Falaya-Waverly-Vicksburg association. The Henry and Okaw soils in the east-central and northern parts of McCracken County formed in the sediment of an ancient lake (*10*). The elevation of the Henry-Okaw association ranges from about 330 to 355 feet.

The survey area is within the Mississippi River watershed, where the Tennessee River flows into the Ohio River and the Ohio into the Mississippi River. The central, northern, and western parts of both counties are drained by tributaries of the Ohio River. A small area in the eastern part of McCracken County is drained by tributaries of the Tennessee River. The southern part of Ballard County and much of the southern part of McCracken County drain through Mayfield Creek into the Mississippi River.

Farming and Industry

Farming is the main source of income in Ballard County, and industry furnishes most of the income in McCracken County. In 1969 the Census of Agriculture showed that the 848 farms in Ballard County had an average size of 147.2 acres. McCracken County had 919 farms that averaged 91.8 acres. In Ballard County 75.3 percent of the land was in farms, and in McCracken County, 52.9 percent. In both counties, livestock furnished slightly more of the farm income than crops. Ballard County had 195 part-time farms, and McCracken County had 364 part-time farms.

Ballard County is slightly larger than McCracken County and has about the same kinds of soil and natural resources. The population, economic resources, and value of wholesale and retail trade sales are much larger in McCracken County than in Ballard County because of manufacturing, railroads, and other forms of industrial employment.

Industrial and urban developments in rural areas furnish employment and keep the larger cities from becoming more crowded, but industrial developments can cause pollution of the water and air. Even if existing urban structures were removed, the soils have been so disturbed that many areas in McCracken County have greatly reduced potential for farming.

Natural Resources

The chief natural resources of Ballard and McCracken Counties, other than soil, are abundant water and gravel. The Jackson Purchase is the most favorable region in Kentucky for the development of ground water supplies. Large supplies of water for public and industrial use can be obtained at many places, and domestic supplies can be obtained at almost any place. Water is pumped from bedrock of Paleozoic age, the Tuscaloosa and Ripley Formations of Cretaceous age, sand of Eocene age, gravel of Pliocene age, and alluvium of Quaternary age (*15*).

In addition to abundant ground water, these counties have important water resources in the Ohio, Mississippi, and Tennessee Rivers. These rivers provide inexpensive transportation of heavy or bulky material, encourage industrial development, and furnish employment and recreation.

Gravel is intermittently excavated from many pits and is used for road building and other uses. There have been more all-weather roads for a longer period of time in the Jackson Purchase area than in any other part of Kentucky because of the ease of obtaining gravel.

Many of the natural resources are shown on the Geologic Quadrangle Maps made by the United States Geological Survey of the U.S. Department of the Interior in cooperation with the Kentucky Geological Survey of the University of Kentucky. These maps show clay deposits that are potential sources of ceramic-grade clay and lignite beds in the Claiborne Formation near Blandville. Argillaceous silt near Ragland may have potential for use in ceramics and as lightweight aggregate material. The Porters Creek clay has potential value as a fuller's earth type of clay. Sand has been quarried near Lone Oak and from levee deposits along the flood plain of the Ohio River.

Climate [5]

The climate of the two counties is temperate. Winters are moderately cold and summers are warm and humid. Temperature, rainfall, and humidity remain

[5] By ALLEN B. ELAM, JR., climatologist for Kentucky, National Weather Service, U.S. Department of Commerce.

TABLE 9.—*Temperature and precipitation data*

[Data from records kept at Paducah, McCracken County, Kentucky, for the period 1939–68, unless otherwise noted]

Month	Temperature				Precipitation				
	Average daily maximum	Average daily minimum	Average monthly maximum	Average monthly minimum	Average monthly total	One year in 10 will have—[1] Less than—	One year in 10 will have—[1] More than—	Days with snow cover of 1 inch or more	Average depth of snow on days with snow cover
	°F	°F	°F	°F	Inches	Inches	Inches	Number [2]	Inches [2]
January	45	26	70	5	4.1	1.2	9.4	3	2
February	49	29	69	11	3.8	1.3	7.1	2	2
March	59	36	78	20	4.9	1.7	8.0	1	5
April	70	47	85	31	4.3	2.1	7.0	0	0
May	79	56	90	41	4.9	1.9	7.9	0	0
June	88	65	97	51	3.9	1.1	7.3	0	0
July	91	68	98	57	3.5	1.1	6.5	0	0
August	90	66	98	54	3.2	1.3	5.4	0	0
September	84	58	95	43	3.2	.8	6.2	0	0
October	74	47	87	31	2.4	1.0	5.0	0	0
November	59	37	77	19	3.8	1.3	7.4	1	1
December	48	29	68	10	3.6	1.4	6.2	1	2
Year	70	47	100	2	45.6	[3] 34.6	[3] 55.8	8	2

[1] From "Dependability of Monthly Precipitation in Kentucky." Progress Report 183, Univ. of Ky. Agr. Exp. Stn.
[2] Data from records kept at Paducah Airport from 1950–69.
[3] Data from records kept from 1882–1969.

within limits agreeable to man and suitable for varied plant and animal life. All seasons are marked by weather changes that come from passing weather fronts and associated centers of high and low pressure. This activity is least late in spring and in summer, somewhat greater in fall, and greatest in winter and early in spring. Temperatures are most stable during the period of minimum activity and vary most during the period of greatest activity.

Data on temperature and precipitation are shown in table 9. Average precipitation is fairly well distributed throughout the year. There is no wet season and no dry season, but periods of dry and wet weather do occur. For example, January has less than 29 percent of the average precipitation in 1 out of 10 years and almost 230 percent also in 1 out of 10 years. Most floods occur during winter and spring. October usually has the least rainfall.

Thunderstorms occur on an average of about 52 days a year. They are most frequent in spring and summer but can occur in any month. Rainfall of short duration and high intensity often accompanies thunderstorms. The probability of heavy precipitation in a short period of time is shown in table 10. Such heavy precipitation can occur without accompanying thunderstorms.

Snowfall varies from year to year, and some winters have very little snow. The greatest annual total for the period of this summary was 26.3 inches in 1960. The least was a trace in 1953 and in 1957.

Annual free water evaporation from shallow lakes, farm ponds, and other bodies of water averages about 37 inches, almost 9 inches less than the average annual precipitation. About 75 percent of this evaporation occurs during the 6-month period from May to October.

TABLE 10.—*Probability of heavy precipitation in a short period of time*

Frequency	Duration of heavy precipitation		
	1 hour	6 hours	12 hours
	Inches	Inches	Inches
1 year in 100	3.2	5.0	6.0
1 year in 25	2.6	4.2	4.9
1 year in 5	2.0	3.2	3.8
Annually	1.3	2.2	2.7

Winds blow most frequently from south to southwest. Windspeed averages 6 to 8 miles per hour from May to October and from 9 to 11 miles per hour from November to April.

Relative humidity and sunshine records are not available for the survey area, but estimates can be made using data from stations in the surrounding area. Relative humidity rises and falls in a manner opposite to that of temperature during a typical day, with the highest humidity usually occurring with the minimum temperature of the day and the lowest humidity usually with the highest temperature. The percentage of possible sunshine averages 45 percent in January, 62 percent in April, 75 percent in July, and 73 percent in October.

The growing season is defined as the number of days between the last freezing temperature in spring and the first in fall. As shown in table 11, at Paducah

TABLE 11.—*Probabilities of last freezing temperatures in spring and first in fall*

[Dates marked (P) are for the Paducah station, dates marked (A) are for the Paducah airport station, and dates marked (L) are for the Lovelaceville station]

Probability	Dates for given probability and temperature		
	32° F or lower	28° F or lower	24° F or lower
Spring:			
1 year in 10 later than	(P) April 22 (A) April 21 (L) April 30	(P) April 13 (A) April 14 (L) April 23	(P) March 28 (A) April 1 (L) April 11
2 years in 10 later than	(P) April 17 (A) April 16 (L) April 25	(P) April 7 (A) April 8 (L) April 17	(P) March 22 (A) March 26 (L) April 5
5 years in 10 later than	(P) April 7 (A) April 6 (L) April 15	(P) March 27 (A) March 28 (L) April 6	(P) March 10 (A) March 14 (L) March 24
Fall:			
1 year in 10 earlier than	(P) October 11 (A) October 12 (L) October 4	(P) October 19 (A) October 20 (L) October 13	(P) October 25 (A) October 25 (L) October 22
2 years in 10 earlier than	(P) October 16 (A) October 17 (L) October 9	(P) October 25 (A) October 26 (L) October 19	(P) November 2 (A) November 2 (L) October 28
5 years in 10 earlier than	(P) October 26 (A) October 27 (L) October 19	(P) November 3 (A) November 4 (L) October 28	(P) November 12 (A) November 12 (L) November 7

in 5 years in 10 the growing season begins on April 7 and ends on October 26. Only the tenderest plants are killed at 32° F.; most plants are damaged at a temperature of 28°, and most cultivated plants are killed at 24°.

The temperature and growing season vary to some extent at different locations. The Paducah station is within 1 or 2 miles of the Ohio River, the Paducah airport station is about 8 miles south of the Ohio River, and the Lovelaceville station is about 13 miles or more south of the Ohio River and 15 miles east of the Mississippi River. The growing season is shorter at Lovelaceville than at the other stations.

Literature Cited

(1) Allan, Philip F., Garland, Lloyd E., and Dugan, R. Franklin. 1963. Rating northeastern soils for their suitability for wildlife habitat. Transactions of the Twenty-eighth North American Wildlife and Natural Resources Conference, pp. 247–261, illus.

(2) American Association of State Highway Officials. 1961. Standard specifications for highway materials and methods of sampling and testing. Ed. 8, 2 vol., illus.

(3) Beck, Donald E. 1962. Yellow-poplar site index curves. U.S. Dep. Agric., Forest Serv., Southeastern Forest Exp. Stn., Research Note 180, 2 pp., illus.

(4) Broadfoot, W. M. 1960. Field guide for evaluating cottonwood sites. U.S. Dep. Agric., Forest Serv., Southeastern Forest Exp. Stn., Occas. Paper 178, 6 pp., illus.

(5) ——— and Krinard, R. M. 1959. Guide for evaluating sweetgum sites. U.S. Dep. Agric., Forest Serv., Southeastern Forest Exp. Stn., Occas. Paper 176, 8 pp., illus.

(6) Cline, Marlin G. 1949. Basic principles of soil classification. Soil Sci. 67: 81–81.

(7) Coile, T. S. and Schumacher, F. X. 1953. Site index of young stands of loblolly and shortleaf pines in the piedmont plateau region. J. of Forestry 51: 432–435.

(8) Collins, R. L. 1882. History of Kentucky. vol. 2, 26 pp., Covington, Kentucky.

(9) Cotterill, R. S. 1917. History of pioneer Kentucky. 254 pp., illus., Cincinnati, Ohio.

(10) Finch, Warren I., Olive, Wilds W., and Wolfe, Edward W. 1964. Ancient lake in Western Kentucky and Southern Illinois. U.S. Geol. Survey Prof. Paper 501–c, pp. C130–C133.

(11) Gibbs, Harold J. and Holland, William Yates. 1960. Petrographic and engineering properties of loess. U.S. Dep. Inter., Engineering Monograph 28, 37 pp., illus.

(12) Hutcherson, T. B. Jr., Lewis, R. J., and Seay, W. A., 1959. Chemical and clay mineralogical properties of certain memphis catena soils of Western Kentucky. Soil Sci. Soc. of Amer. Proc. 23: 474–478.

(13) Kilmer, V. J. and Alexander, L. T. 1949. Methods of making mechanical analysis of soils. Soil Sci. 68: 15–24.

(14) ——— and Mullins, J. F. 1954. Improved stirring and pipetting apparatus for mechanical analysis of soils. Soil Sci. 77: 437–441, illus.

(15) MacCary, L. M. and Lambert, T. W. 1962. Reconnaissance of ground-water resources of the Jackson Purchase Region, Kentucky. U.S. Dep. Inter., U.S. Geol. Survey, Hydrologic Investigations, Atlas Ha–13, 9 pp., illus.

(16) McCarthy, E. F. 1933. Yellow-poplar characteristics, growth and management. U.S. Dep. Agric. Tech. Bul. 356, 58 pp., illus.

(17) Nelson, T. C., Clutter, J. L., and Chaiken, L. E. 1961. Yield of virginia pine. U.S Dep. Agric., Forest Serv., Southeastern Forest Exp. Stn. Paper 124, 11 pp., illus.

(18) Olmstead, L. B., Alexander, L. T., and Middleton, H. E. 1930. A pipette method of mechanical analysis of soils based on improved dispersion procedure. U.S. Dep. Agric. Tech. Bul. 170, 22 pp., illus.

(19) Peech, Michael, Alexander, L. T., Dean, L. A., and Reed, J. Fielding. 1947. Methods of soil analysis for soil-fertility investigations. U.S. Dep. Agric. Circ. 757, 25 pp.

(20) Portland Cement Association. 1962. PCA soil primer. 52 pp., illus.

(21) Putnam, John A., Furnival, George M., and McKnight, J. S. 1960. Management and inventory of southern hardwoods, U.S. Dep. Agric., Forest Serv., Agric. Handb. 181, 102 pp., illus.

(22) Schnur, G. Luther. 1937. Yield, stand, and volume tables for even-aged upland oak forests. U.S. Dep. Agric. Tech. Bul. 560, 88 pp., illus. [Reprinted 1961]
(23) Schumacher, F. X. and Coile, T. S. 1960. Growth and yields of natural stands of southern pines. T. S. Coile, Inc., 115 pp., illus.
(24) Simonson, Roy W. 1962. Soil classification in the United States. Sci. 137: 1027–1034.
(25) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus. [Supplement issued in 1962]
(26) ——— 1970. Soil taxonomy of the national cooperative soil survey. Illus.
(27) United States Department of Defense. 1968. Unified soil classification system for roads, airfields, embankments and foundations. MIL-STD-619B, 30 pp., illus.

Glossary

Acid soil. See Reaction, soil.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates such as crumbs, blocks, or prisms, are called peds. Clods are aggregated produced by tillage or logging.

Alkali soil: Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crop plants is low from this cause.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Argillaceous material. A material of, or containing, clay.

Available water capacity (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Catena. A sequence, or "chain," of soils on a landscape, developed from one kind of parent material but having different characteristics because of differences in relief and drainage.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

Coastal Plain deposits or materials. The alluvium left is a marine deposit when an ancient sea covered the area or the alluvium deposited on a marine terrace or in the first bottoms of streams shortly after the ancient sea had retreated to the south.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Cover crop. A close-growing crop grown primarly to improve and protect the soil between periods of regular crop production; or a crop grown between trees and vines in orchards and vineyards.

Depth, soil. In this survey it refers to the depth of the soil over bedrock. All the soils in this survey are more than 40 inches to bedrock and are considered deep. Also see root zone depth.

Drainage class (natural). Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and the C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time, and some soils commonly have mottling at a depth below 6 to 16 inches.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Flood plain. Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

Fragipan. A loamy, brittle, subsurface horizon that is very low in organic-matter content and clay but is rich in silt or very fine sand. The layer is seemingly cemented. When dry, it is hard or very hard and has a high bulk density in comparison with the horizon or horizons above it. When moist, the fragipan tends to rupture suddenly if pressure is applied, rather than to deform slowly. The layer is generally mottled, is slowly or very slowly permeable to water, and has few or many bleached fracture planes that form polygons. Fragipans are a few inches to several feet thick; they generally occur below the B horizon, 15 to 40 inches below the surface.

Gleyed soil. A soil in which waterlogging and lack of oxygen have caused the material in one or more horizons to be neutral gray in color. The term "gleyed" is applied to soil horizons with yellow and gray mottling caused by intermittent waterlogging.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons.

O horizon.—The layer of organic mater on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an 0 horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Loam. A textural class for soils. Loam contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand.

Loess. Fine-grained material, dominantly of silt-sized particles, that has been deposited by wind.

Mottling, soil. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent.* The size measurements are these: *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse,* more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

Parent material. Disintegrated and partly weathered rock from which soil has formed.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Permeability. The quality of a soil horizon that enables water or air to move through it. Terms used to described permeability are (1) *slow,* less than 0.2 inch per hour; (2) *moderately slow,* 0.2 to 0.63 inch per hour; (3) *moderate,* 0.63 to 2.0 inches per hour; (4) *moderately rapid,* 2.0 to 6.3 inches per hour; and (5) *rapid,* more than 6.3 inches per hour.

pH value. A numerical means for designating acidity and alkalinity in soils. A pH value of 7.0 indicates precise neutrality; a higher value, alkalinity; and a lower value, acidity.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline is reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Mildly alkaline	7.4 to 7.8
Very strongly acid	4.5 to 5.0	Moderately alkaline	7.9 to 8.4
Strongly acid	5.1 to 5.5	Strongly alkaline	8.5 to 9.0
Medium acid	5.6 to 6.0	Very strongly alkaline	9.1 and higher
Slightly acid	6.1 to 6.5		
Neutral	6.6 to 7.3		

Residual material. Unconsolidated, partly weathered mineral material that accumulates over disintegrating solid rock. Residual material is not soil but, in many places, is the material in which a soil has formed.

Root zone depth. The part of the soil that is penetrated or can be penetrated, by plant roots. Bedrock, or a fragipan are examples of features that limit the depth of the root zone. The following terms are used in this report to indicate the depth of the root zone:

	Inches
Very shallow	Less than 10
Shallow	10 to 20
Moderately deep	20 to 36
Deep	36 or more

Runoff. Rainwater that flows over the surface of the soil without sinking in.

Sand. Individual rock or mineral fragments in a soil range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Slope. Among the characteristics of a soil are the lengths, shape, pattern, and degree of its incline, or slope. In this survey the slope classes are as follows: 0 to 2 percent, nearly level; 2 to 6 percent, gently sloping; 6 to 12 percent, sloping; 12 to 20 percent, strongly sloping; 20 to 30 percent, moderately steep; 30 to 60 percent, steep.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Stratified. Composed of, or arranged in, strata, or layers, such as stratified alluvium. The term is confined to geological material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

Stripcropping. Growing crops in a systematic arrangement of strips or bands to serve as a vegetative barrier to wind and water erosion. Stripcropping is commonly practiced as a part of contour farming.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particle adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. Technically, the part of the soil below the solum.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand,* *loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine.

Topsoil. A presumed fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

U.S. GOVERNMENT PRINTING OFFICE: 1975 O—563-423

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. Pasture and hayland groups are discussed on page 44. Other information is given in tables as follows:

Acreage and extent, table 1, page 10.
Estimated yields, table 2, page 46.
Woodland, table 3, page 48.
Wildlife, table 4, page 52.
Engineering uses of the soils, tables 5 and 6, pages 56 through 69.

Map symbol	Mapping unit	Page	Capability unit: Symbol	Woodland group: Number	Pasture and hayland group: Number
Ag	Alligator silty clay	10	IIIw-5	1w2	4
Av	Alluvial land, steep	11	VIIe-1	3r1	8
Ay	Arkabutla silt loam	11	IIw-1	1w1	2
BdD	Brandon silt loam, 10 to 20 percent slopes	12	VIe-2	3o1	7
BdE	Brandon silt loam, 20 to 30 percent slopes	12	VIIe-1	3r1	7
BrD3	Brandon silty clay loam, 10 to 30 percent slopes, severely eroded	13	VIIe-3	4r1	10
BsF	Brandon and Memphis silt loams, 30 to 60 percent slopes	13	VIIe-1	3r1	7
Bu	Bruno loamy fine sand	14	IIIs-1	3s1	14
CaA	Calloway silt loam, 0 to 2 percent slopes	15	IIIw-3	1w1	12
CaB	Calloway silt loam, 2 to 6 percent slopes	15	IIIw-7	1w1	12
Cc	Cascilla silt loam	16	I-1	1o1	1
ChA	Chavies fine sandy loam, 0 to 4 percent slopes	16	I-6	2o1	6
CpA	Colp silt loam, 0 to 2 percent slopes	18	IIIw-2	3w2	12
CpC	Colp silt loam, 2 to 12 percent slopes	18	IVe-6	3w2	12
Db	Dubbs silty clay loam, clayey subsoil variant	19	IIs-3	2o1	5
Du	Dundee silty clay loam, clayey subsoil variant	20	IIw-6	1w1	5
Fc	Falaya-Collins silt loams	21	IIw-1	1w1	2
GrA	Grenada silt loam, 0 to 2 percent slopes	23	IIw-3	3o1	11
GrB	Grenada silt loam, 2 to 6 percent slopes	23	IIe-4	3o1	11
GrB3	Grenada silt loam, 2 to 6 percent slopes, severely eroded	24	IIIe-14	4o1	9
GrC3	Grenada silt loam, 6 to 12 percent slopes, severely eroded	24	IVe-11	4o1	9
Gu	Gullied land	24	VIIe-3	---	10
Hn	Henry silt loam	25	IVw-1	1w2	12
LoB	Loring silt loam, 2 to 6 percent slopes	26	IIe-5	3o1	6
LoC	Loring silt loam, 6 to 12 percent slopes	27	IIIe-5	3o1	6
LoC3	Loring silt loam, 6 to 12 percent slopes, severely eroded	27	IVe-11	4o1	9
LoD	Loring silt loam, 12 to 20 percent slopes	28	VIe-1	3o1	8
LoD3	Loring silt loam, 12 to 20 percent slopes, severely eroded	28	VIe-5	4o1	9
MmB	Memphis silt loam, 2 to 6 percent slopes	29	IIe-1	2o1	6
MmC	Memphis silt loam, 6 to 12 percent slopes	29	IIIe-1	2o1	6
MmD	Memphis silt loam, 12 to 20 percent slopes	29	VIe-1	2o1	8
MmE	Memphis silt loam, 20 to 30 percent slopes	29	VIe-1	3r1	8
MpC3	Memphis silty clay loam, 6 to 12 percent slopes, severely eroded	30	IVe-9	3o1	9
MpE3	Memphis silty clay loam, 12 to 30 percent slopes, severely eroded	30	VIe-5	3r1	9
MsB	Molena loamy fine sand, 0 to 6 percent slopes	31	IIIs-1	3s1	14
Nd	Newark-Lindside silty clay loams	31	IIw-1	1w1	2
No	Nolin silty clay loam	33	IIs-2	1o1	1
Nr	Nolin-Robinsonville silt loams	33	I-1	1o1	1
Oc	Okaw silt loam	34	IVw-2	3w2	12

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Page	Capability unit	Woodland group	Pasture and hayland group
			Symbol	Number	Number
Ro	Rosebloom silt loam	35	IIIw-1	1w2	3
SaC	Saffell gravelly loam, 0 to 12 percent slopes	36	IIIs-2	4f1	13
SfE	Saffell and Flomaton soils, 20 to 60 percent slopes	36	VIIe-2	4f1	13
Sh	Sharkey silty clay	37	IIIw-5	1w2	4
Sw	Swamp	37	VIIw-1	---	--
Vb	Vicksburg silt loam	38	I-1	1o1	1
Wa	Waverly silt loam	39	IIIw-1	1w2	3
WhA	Wheeling silt loam, 0 to 2 percent slopes	40	I-5	2o1	6
WhB	Wheeling silt loam, 2 to 6 percent slopes	41	IIe-1	2o1	6
WhC	Wheeling silt loam, 6 to 12 percent slopes	41	IIIe-1	2o1	6

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