

SOIL SURVEY OF

Pope, Hardin, and Massac Counties, Illinois



United States Department of Agriculture
Soil Conservation Service and Forest Service
In cooperation with
Illinois Agricultural Experiment Station

Major fieldwork for this soil survey was done in the period 1963-70. Soil names and descriptions were approved in 1971. Unless otherwise indicated, statements in the publication refer to conditions in the counties in 1971. This survey was made cooperatively by the Forest Service, Soil Conservation Service, and the Illinois Agricultural Experiment Station. It is part of the technical assistance furnished to the Pope-Hardin Soil and Water Conservation District and the Massac County Soil and Water Conservation District.

Either enlarged or reduced copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, United States Department of Agriculture, Washington, D.C. 20250. Illinois Agricultural Experiment Station Soil Report No. 94.

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, or other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Pope, Hardin, and Massac 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 three counties in numerical order by map symbol and gives the management group (capability classification) of each. It also shows the page where each soil and each management group is described, and the woodland, wildlife, and recreation group in which the soil has been placed.

Individual colored maps showing 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 with a moderate limitation can be colored yellow, and those with 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 discussions of the management, woodland, wildlife, and recreation groups.

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

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Wildlife."

Community planners and others can read about soil properties that affect the choice of sites for dwellings and recreation areas in the sections "Residential Uses of Soils" and "Recreational 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 and Classification of Soils."

Newcomers in Pope, Hardin, and Massac 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 given in the section "General Nature of the Counties."

Cover: Conservation farming in Massac County in a rolling area of a Hosmer silt loam. Belknap silt loam is in the fields in the right foreground.

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SOIL SURVEY OF POPE, HARDIN, AND MASSAC COUNTIES, ILLINOIS

BY WALTER D. PARKS, SOIL CONSERVATION SERVICE

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

POPE, HARDIN, AND MASSAC COUNTIES are in the southeastern corner of Illinois (fig. 1). The Ohio River forms the southern and eastern boundaries of the three-county area. Massac County, which is the southwesternmost of the three counties, is bounded by Pulaski County on the west and by Johnson County on the north. Pope County, in the middle, is bounded by Johnson County on the west and by Saline County on the north. Hardin County, to the east, is bounded by Saline and Gallatin Counties on the north.

Massac County has an area of 245 square miles, Pope County an area of 381 square miles, and Hardin County an area of 183 square miles. Metropolis is the county seat of Massac County, Golconda of Pope County, and Elizabethtown of Hardin County.

General Nature of the Counties

Massac County was established in 1813, Pope County was established in 1816, and Hardin County was formed from part of Pope County in 1839. Golconda is at the site of an important pioneer crossing of the Ohio River, Luck's Ferry, which started in 1798. Metropolis is at the site of Fort Massac, established originally by the French in 1757. The cave at Cave in Rock, dating from about the close of the Revolutionary War, was once a notorious hideout for pirates.

According to the U.S. Census, the population of Pope County in 1970 was 3,857, including 922 in Golconda. Hardin County had a population of 4,914, including 436 in Elizabethtown, 503 in Cave in Rock, and 1,421 in Rosiclare. The population of Massac County was 13,889, including 529 in Joppa, 1,046 in Brookport, and 6,940 in Metropolis.

The three-county area is served by six State highways and a number of hard-surfaced county roads. Crossing the Ohio River to Kentucky is a bridge at Brookport or a ferry at Cave in Rock. Interstate Highway 24 crosses the Ohio River near Brookport and continues in a north-westerly direction across Massac County. Several railroads are in Massac County, and one is in Pope County.

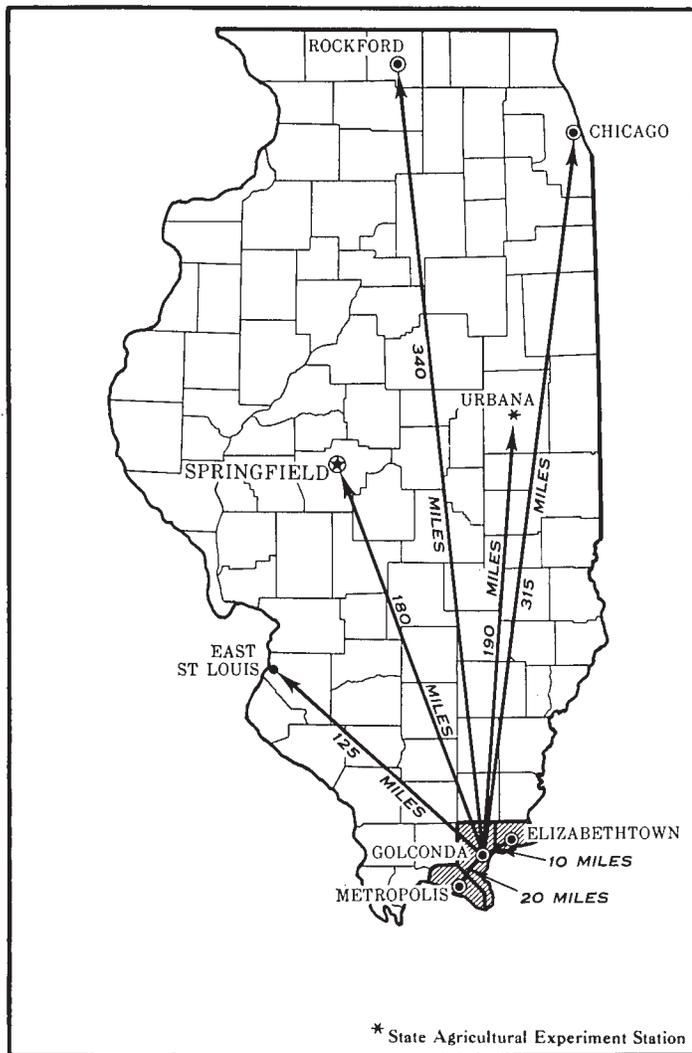


Figure 1.—Location of Pope, Hardin, and Massac Counties in Illinois.

A spur from the latter railroad serves Golconda and Rosiclare. Barge traffic on the Ohio River is an important method of commercial and industrial transportation.

Farming and Industry

Farming is the largest single occupation in Pope, Hardin, and Massac Counties. The main source of farm income is the sale of cash-grain crops and beef cattle. In 1970, Conservation Needs Inventory data (25) reported 132,027 acres, or about 25 percent of the acreage of the three counties, in cropland. More than half of this acreage was in Massac County, about one-third was in Pope County, and about one-sixth was in Hardin County. The main crops were corn and soybeans; acreage in each was about equal. Minor acreages were in wheat, grain sorghum, and sunflowers.

Pasture occupies about 116,114 acres, 22 percent of the area of the three counties. The percentage of land in pasture is about the same in each county. In 1969, the U.S. Bureau of the Census reported that 12,102 cows and 12,846 calves were in the three counties. The greatest number of cows were in Hardin County, and the greatest number of calves were in Massac County. Also, there were 8,592 brood sows listed, of which Massac and Pope Counties had about equal numbers, and Hardin County had one-fourth as many.

The University of Illinois Agricultural Experiment Station maintains the Dixon Springs Agricultural Center in Pope County. The Center does extensive research on agricultural work related to extreme southern Illinois, especially on livestock and pasture.

Forestry is an extensive occupation. The Conservation Needs Inventory listed 137,811 acres in farm woodland, about 27 percent of the acreage of the three counties. The largest proportion is in Hardin County, and the smallest is in Massac County. An additional 97,368 acres are in the Shawnee National Forest; thus 41 percent of the three-county area is wooded.

Recreational activities such as camping, boating, horseback riding, fishing, hunting, and scenic driving are expanding. There are three State parks, and Shawnee National Forest has developed several recreation areas. Also, potential for private development is considerable.

Several light and heavy industries are in or near Joppa and Metropolis in Massac County. In 1963, the manufacturing value added to the county was 8.7 million dollars, and projected data estimated a 31 percent increase by 1980. Hardin County has several large fluorspar mines and is the major producer of this mineral. Several limestone quarries in the three counties produce crushed rock, agricultural limestone, and cement limestone. Small gravel pits in Massac County and southern Pope County supply Coastal Plain gravel for local use.

Physiography

Hardin County, most of Pope County, and part of Massac County are in the Shawnee Hills section of the Interior Low Plateaus Province. (15). This complex, dissected upland is popularly known as the Illinois Ozarks. Most of Massac County and part of southern Pope County are in the Coastal Plains province, which is a north-

ern extension of the coastal plains of the southeastern part of the United States.

The second highest point in Illinois, 1,064 feet above sea level, is at Williams Hill in northern Pope County. The general upland elevation of northern Pope and Hardin Counties is between 660 and 740 feet, but relief ranges from 300 to 500 feet between creek bottom lands and ridgetops. A high ridge, 800 to 840 feet above sea level, forms an east-west drainage divide across the northern side of the counties. The central part of Pope County has a general elevation between 600 and 640 feet. The southern part of Pope County and the northern and eastern parts of Massac County have a general elevation between 500 and 580 feet above sea level, with an average relief of 300 feet between creek bottom lands and ridgetops. The sinkhole area of Hardin County has elevations ranging from 460 to 500 feet. A gently rolling area across central Massac County has a general elevation between 360 and 440 feet and a relief of 40 to 100 feet. The Ohio River and Cache River bottom lands are between 300 and 330 feet above sea level, and the Ohio River terraces are between 340 and 360 feet above sea level.

The three counties are drained by a number of creeks that flow south and east into the Ohio River. A part of eastern and northern Massac County drains west to the Cache River. The northernmost parts of Pope and Hardin Counties drain northward to the Saline River. The three largest streams, Bay Creek, Lusk Creek, and Big Grand Pierre Creek, are all in Pope County.

Climate¹

Pope, Hardin, and Massac Counties have the continental climate typical of southern Illinois. The annual temperature range is about 100 degrees. Summer maximums reach 100° F. or more about two-thirds of the summers. Winter minimums are zero or below during about half the winters. Temperatures in the northern parts of the counties average one to three degrees lower per day than do those in the extreme south. Low-pressure areas and their associated weather fronts bring frequent changes in temperature, humidity, cloudiness, and wind direction much of the year.

Table 1 gives monthly and yearly temperature and precipitation averages at New Burnside. Comparison of weather records from the Brookport dam in Massac County, the Dixon Springs Agricultural Center in Pope County, the Golconda dam in Pope County, and Elizabethtown in Hardin County shows uniformity with records at New Burnside. Most of the other stations vary only one degree more or less from temperature averages at New Burnside, but Brookport averages about two degrees warmer. Rainfall varies from the New Burnside averages by one-half to two inches. New Burnside data have been used because that station has long-term records.

Annual precipitation averages about 46 inches and, since 1931, has ranged from about 32 to 70 inches. In more than 7 years in 10, 40 inches or more of precipitation will fall. Precipitation is fairly evenly distributed throughout the year. Each month generally has 4 to 7

¹ By WILLIAM L. DENMARK, climatologist for Illinois, National Weather Service, U.S. Department of Commerce.

TABLE 1.—*Temperature and precipitation data*

[Based on records, 1931-64, at New Burnside]

Month	Temperature		Precipitation			
	Average daily maximum ¹	Average daily minimum ¹	Average total	One year in 10 will have—		Average snowfall
				Less than—	More than—	
	° F.	° F.	Inches	Inches	Inches	Inches
January.....	44	24	4.1	0.9	5.9	3.3
February.....	50	28	3.5	1.4	5.1	3.5
March.....	56	34	5.0	1.2	8.6	2.6
April.....	70	45	4.4	2.2	7.5	.1
May.....	78	54	4.7	2.3	9.1	0
June.....	87	62	4.0	2.1	9.5	0
July.....	90	66	3.4	1.9	5.3	0
August.....	89	64	3.6	1.3	7.4	0
September.....	84	57	3.3	1.5	6.0	0
October.....	73	46	2.7	1.0	5.8	0
November.....	58	35	3.8	1.5	7.6	1.3
December.....	46	27	3.3	1.6	5.5	2.3
Year.....	69	45	45.8	31.1	59.7	13.1

¹ Average daily temperature for any month is the average of the average daily maximum and the average daily minimum.

days that have precipitation of 0.1 inch or more. Each of the first 6 months, with the exception of February, averages 4 inches or more precipitation per month. September and October normally are the driest months of the year.

Normal July and August rainfall alone is insufficient to meet the demands of a vigorously growing field crop. Subsoil moisture must be stored during the previous fall through spring for best crop production in most seasons. Major droughts are infrequent. Rather prolonged dry periods during part of the growing season are not unusual. Such periods often result in reduced crop yields.

Summer precipitation occurs mostly in short showers or thunderstorms. A single thunderstorm often produces in excess of 1 inch of rain and occasionally is accompanied by hail and damaging winds. More than 6 inches of rain has fallen within a 24-hour period, and as much as 17 inches has fallen in 1 month.

Field crops are more likely to be damaged if hail falls in June, July, or August instead of in other months. Thunderstorm days average about 50 annually, of which about half are during the critical growing period. Hail-producing thunderstorms in the same area average less than three per year and only about one every 2 years in the summer months (10). Not all hailstorms have stones of sufficient size or quantity to produce extensive crop damage.

Only light snows occur during an average winter. The average annual snowfall ranges from 10 to 15 inches, but this total has been exceeded in a single month.

Summers are warm, and continuous warm periods can be prolonged, because cool-air invasions from the north often fail to penetrate as far as extreme southern Illinois in summer. July normally is the warmest month; the average daily maximum temperature is near 90° F. for both July and August. Summer maximum temperatures reached 100° F. or higher for 15 consecutive years, from

1931 to 1945, but have done so in only half of the years since.

January is normally the coldest month. February often has days as cold as January days, but cold periods are shorter. Both months have had temperatures as low as -15° F. The 5 months from November through March each have 14 to 24 days in which the minimum daily temperature falls below 32° F. December, January, and February average 3 to 5 days each in which the maximum daily temperature does not exceed 32° F.

The number of days between the average date of the last freezing temperature in spring and the average date of the first freezing temperature in fall has been termed the growing season. This averages approximately 200 days at Paducah, Kentucky and 187 days at New Burnside, Illinois. Growing season is a general term because different crops have different temperatures at which growth is affected. Table 2 indicates the probability of several different threshold temperatures (11). These data are for the vicinity of the Dixon Springs Agricultural Center. The dates are likely to be 2 or 3 days earlier in northern Pope and Hardin Counties, and 4 or 5 days later in southern Massac County. Temperatures often vary consistently between ridge and valley locations during radiation freezes, the most common type of freeze in Illinois.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Pope, Hardin, and Massac Counties, where they are located, and how they can be used. The soil scientists went into the counties 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

TABLE 2.—Probability of freezing temperature in spring and fall

For vicinity of Dixon Springs Agricultural Center in Pope County, Illinois. All data based on temperatures recorded in a standard National Weather Service shelter about 5 feet above the ground and in a representative location. At times the temperature is colder near the ground or in local areas subject to extreme air drainage]

Probability	Dates for given probability and temperature				
	32° F.	28° F.	24° F.	20° F.	16° F.
Last in spring:					
Average date.....	April 10	March 28	March 15	February 28	February 25
25 percent chance after.....	April 19	April 6	March 24	March 9	March 6
10 percent chance after.....	April 27	April 14	April 1	March 17	March 14
First in fall:					
Average date.....	October 20	November 8	November 14	November 23	December 7
25 percent chance before.....	October 11	October 30	November 5	November 14	November 28
10 percent chance before.....	October 4	October 23	October 29	November 7	November 7

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. Hosmer and Grantsburg, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

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, Alford silt loam, 4 to 7 percent slopes, eroded, is one of several phases within the Alford 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 Pope, Hardin, and Massac 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. Alford-Baxter complex, 12 to 18 percent slopes, eroded, 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. Brandon and Saffell soils, 12 to 30 percent slopes, is an undifferentiated soil group in these counties.

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. Sandstone rock 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 to 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 Pope, Hardin, and Massac 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 may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a survey area, who want to compare different parts of a survey 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 similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The eleven soil associations in Pope, Hardin, and Massac Counties are discussed in the following pages.

1. Alford-Wellston Association

Gently sloping to steep, well-drained, moderately permeable soils; on uplands

This association is on uplands in the eastern part of Hardin County in a landscape that is characteristically made up of high hills. About 75 percent of the area is hillsides where slopes range from 12 to 30 percent; about 20 percent is ridgetops and toe slopes where slopes range from 2 to 12 percent; and about 5 percent is bottom land.

This association makes up about 5 percent of the three-county area. About 62 percent of the association is Alford soils, and 16 percent is Wellston soils. The remaining 22 percent is minor soils.

Alford soils are on ridgetops and side slopes. They have slopes of 2 to 30 percent. These well-drained soils have a surface layer of brown silt loam and a subsoil of brown silty clay loam. In cultivated areas, most Alford soils that have slopes of more than 10 percent are severely eroded.

Wellston soils are on side slopes. These soils are steep and well drained. They have a dark grayish-brown surface layer. The subsoil is brown silty clay loam that commonly is partly material weathered from sandstone or shale.

Steep and stony Muskingum and Berks soils make up about 40 percent of the areas of minor soils, and well-drained to somewhat poorly drained Haymond, Waveland, and Belknap soils on bottom lands make up another 40 percent. The remaining 20 percent is slowly permeable Hosmer soils on ridgetops.

About 60 percent of this association is wooded, and much of the rest of it is in pasture. Crops are grown only on bottom land and the broader ridgetops. Wildlife and recreational uses have a high potential in this association. Erosion, water disposal, steep slopes, and stoniness are hazards to use. In places fluorspar is mined in areas of this association.

2. Alford-Baxter-Bedford Association

Gently sloping to steep, well-drained, moderately permeable soils, and strongly sloping to steep, moderately well drained, very slowly permeable soils that contain a fragipan; on uplands

This association is on uplands in southern Hardin County. It is mainly in a hilly area strongly pitted with sinkholes. In a minor part near the middle of this area, fewer sinkholes are present, and hillsides and ridgetops dominate the landscape. About 20 percent of the slopes are less than 12 percent in the more hilly areas as compared with about 60 percent in the less strongly pitted areas.

This association (fig. 2) makes up 3 percent of the three-county area. About 64 percent of the association is Alford soils, 10 percent is Baxter soils, and 9 percent is Bedford soils. The remaining 17 percent is minor soils.

Alford soils have slopes of 2 to 30 percent. These well-drained soils have a surface layer of brown silt loam and a subsoil of brown silty clay loam.

Baxter soils are on hillsides. These steep soils have a surface layer of dark grayish-brown cherty silt loam and a subsoil of brown to yellowish-red very cherty silty clay loam to silty clay. The underlying material is material weathered from cherty limestone.

Bedford soils have slopes of 7 to 30 percent. These soils have a surface layer of dark grayish-brown silt loam and a subsoil of brown silty clay loam over a fragipan. Material weathered from cherty limestone is below the fragipan.

Slowly permeable Hosmer soils that have a fragipan make up about one-third of the areas of minor soils. The remaining two-thirds is made up mainly of soils of the Belknap and Sharon series on bottom lands. Many areas of these soils are at the bottoms of sinkholes and are small and circular.

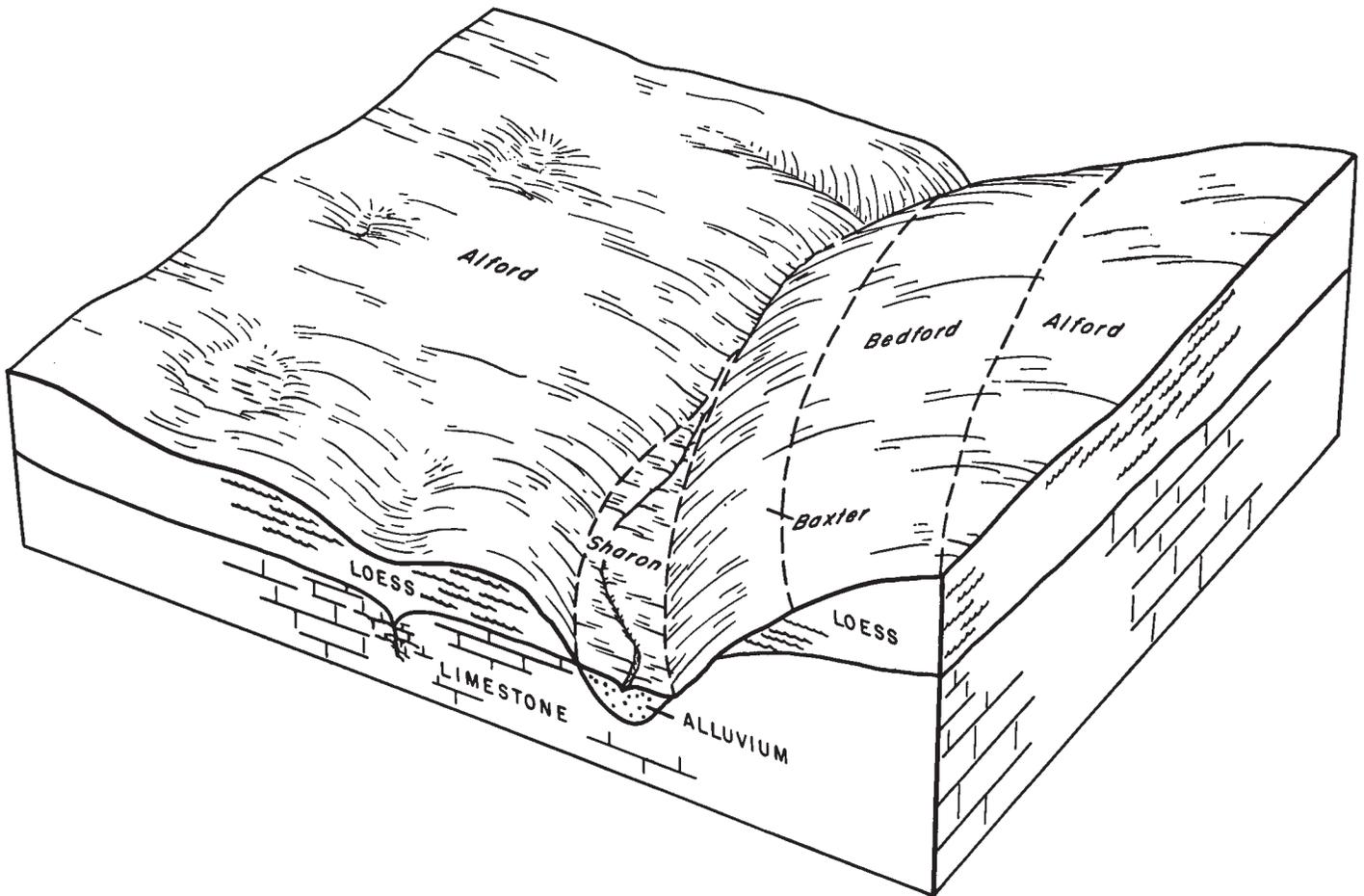


Figure 2.—Principal soils of association 2 and their relation to the landscape.

Most of this association is used for pasture and hay. Some areas are used for crops, trees, recreation, and homesites. Small areas of Belknap and Sharon soils are suited to intensive cropping. Erosion and steep slopes are the major hazards to use, but chertiness and restricted rooting depth, because of the fragipan, are concerns in some areas.

3. Hosmer-Zanesville-Wellston Association

Gently sloping to steep, moderately well drained, slowly permeable soils that contain a fragipan, and steep, well-drained, moderately permeable soils; on uplands

This association is on uplands in all three counties. It is characterized by hilly terrain that has narrow to broad ridgetops and steep, rocky hillsides. Slopes are generally less than 12 percent in about one-half of the area of this association, but in Hardin County only about one-third of the area has slopes of less than 12 percent.

This association makes up 14 percent of the three-county area. About 49 percent of the association is Hosmer soils, about 13 percent is Zanesville soils, and about 11 percent is Wellston soils (fig. 3). The remaining 27 percent is minor soils.

Hosmer soils have slopes of 2 to 30 percent. These moderately well drained soils have a surface layer of

brown silt loam and a subsoil of brown silty clay loam over a fragipan. In cultivated areas most of these soils that have slopes of more than 7 percent are severely eroded.

Zanesville soils are similar to Hosmer soils, except that the lower part of the fragipan is in material weathered from sandstone or shale, and Zanesville soils generally have slopes of more than 12 percent.

Wellston soils are steep. These well-drained soils have a dark grayish-brown surface layer. The subsoil is brown silty clay loam, and it commonly consists partly of material weathered from sandstone or shale over sandstone or shale bedrock.

The stony Muskingum and Berks soils together make up about 14 percent of the areas. These soils are closely associated with Wellston soils. The remaining minor soils are mainly well-drained to somewhat poorly drained soils of the Sharon, Burnside, and Belknap series on bottom lands.

About one-third of this association is wooded in Mas-sac County, about half is wooded in Pope County, and about two-thirds is wooded in Hardin County. The remainder is mainly used for pasture. Crops are grown on bottom lands and, in places, on broad ridgetops. Wildlife habitat and recreational uses have a good potential in this association. Use as homesites for part-time farm-



Figure 3.—Pasture on Hosmer silt loam in association 3. Wooded Zanesville and Wellston soils are in background.

ers and retirees is increasing. Restricted depth because of the fragipan, erosion, steep slopes, and rockiness are limitations to the use of these soils. In Hardin County, much of the fluorspar mining is in this association.

4. Hosmer-Lax-Alford Association

Gently sloping to steep, moderately well drained, slowly permeable soils that contain a fragipan, and gently sloping to steep, well-drained, moderately permeable soils; on uplands

This association is on uplands in Massac County and the southern part of Pope County. It is characterized by moderately hilly to very hilly terrain. About 40 percent of the area is ridgetops that have slopes of 2 to 12 percent; another 40 percent is hillsides that have slopes of more than 12 percent; and the remaining 20 percent is bottom land.

This association makes up about 9 percent of the three-county area. About 46 percent of the association is Hosmer soils, about 13 percent is Lax soils, and about 12 percent is Alford soils. Minor soils make up the remaining 29 percent.

Hosmer soils have slopes of 2 to 30 percent. These moderately well drained soils have a surface layer of brown silt loam and a subsoil of brown silty clay loam over a fragipan. In cultivated areas, most soils that have slopes of more than 7 percent are severely eroded.

Lax soils are similar to Hosmer soils, but Coastal Plain gravel generally is in the lower part of the fragipan, and slopes are more than 12 percent.

Alford soils have slopes of 2 to 30 percent. These well-drained soils have a surface layer of brown silt loam and a subsoil of brown silty clay loam.

Steep, gravelly Brandon and Saffell soils make up about half of the areas of minor soils. The other half is made up mainly of somewhat poorly drained Belknap soils and lesser amounts of well-drained Sharon and Burnside soils. These soils are on bottom lands.

About 45 percent of this association in most of Massac County is wooded. In the very hilly area of the eastern part of Massac County and the southern part of Pope County, about 75 percent is wooded. Much of the remaining area is in pasture. Many areas on bottom lands and some in hilly areas are used for crops. The bottom-land soils are suited to intensive cropping, and most of the soils on uplands are well suited to pasture. Wildlife and recreational uses have potential, especially in the eastern part of the association. Erosion, steep slopes, restricted depth because of the fragipan, and gravelly slopes are limitations to the use of these soils. The underlying material is a good source of gravel in many places.

5. Grantsburg-Bedford-Baxter Association

Gently sloping to steep, moderately well drained, slowly to very slowly permeable soils that contain a fragipan, and steep, well-drained, moderately permeable soils; on uplands

This association consists of very steep soils on hills and narrow ridgetops around Hicks Dome in Hardin County. In more than half the area of this association, slopes are 12 to 60 percent, and in about one-third of the area, which is on ridgetops, they are less than 12 percent. The rest of the association is bottom land.

This association occupies 3 percent of the three-county area. About 36 percent of the association is Grantsburg soils, about 33 percent is Bedford soils, and 14 percent is

Baxter soils. Minor soils make up the remaining 17 percent (fig. 4).

Grantsburg soils have slopes mostly of 4 to 18 percent. These moderately well drained soils have a surface layer of dark grayish-brown silt loam and a subsoil of brown silty clay loam underlain by a strongly developed fragipan. In cultivated areas, most soils that have slopes of more than 7 percent are severely eroded.

Bedford soils are similar to Grantsburg soils, but cherty material weathered from limestone generally begins in the lower part of the fragipan and extends to the bedrock.

Steep Baxter soils are on hillsides. These well-drained soils have a surface layer of dark grayish-brown cherty silt loam and a subsoil of brown to yellowish-red very cherty silty clay loam to silty clay material weathered from limestone. Around the rim of, and on the east side of, Hicks Dome, Clarksville cherty silt loam that contains 20 to 90 percent chert is in place of Baxter soils.

Well-drained to poorly drained soils of the Sharon, Burnside, Haymond, Belknap, and Bonnie series on bottom lands make up the minor soils.

About half of the association is wooded. In the areas of steep, cherty soils east and south of Hicks Dome, nearly 80 percent is wooded, but in the less hilly areas west of Hicks Dome, only about 15 percent is wooded.

Most of the remaining areas are in pasture, but a few areas on bottom lands are cultivated. Wildlife and recreational uses have a high potential in parts of this association. Erosion, steep slopes, cherty soils, and restricted depth because of a fragipan are limitations to the use of these soils. The U.S. Forest Service Kaskaskia Experimental Forest occupies most of the eastern part of the area.

6. Grantsburg-Zanesville Association

Gently sloping to moderately steep, moderately well drained, slowly to very slowly permeable soils that contain a fragipan; on uplands

This association is in the northern part of Pope County and the eastern part of Hardin County. It is mostly hilly and is characterized by narrow to broad ridgetops and steep rocky hillsides. Parts of the association in several areas between Robbs and Golconda are more rolling and are mostly Grantsburg soils. About 60 percent of the soils in the association have slopes of less than 12 percent.

This association (fig. 5) makes up about 25 percent of the three-county area. About 56 percent of the association is Grantsburg soils, and 19 percent is Zanesville soils. The remaining 25 percent is minor soils.

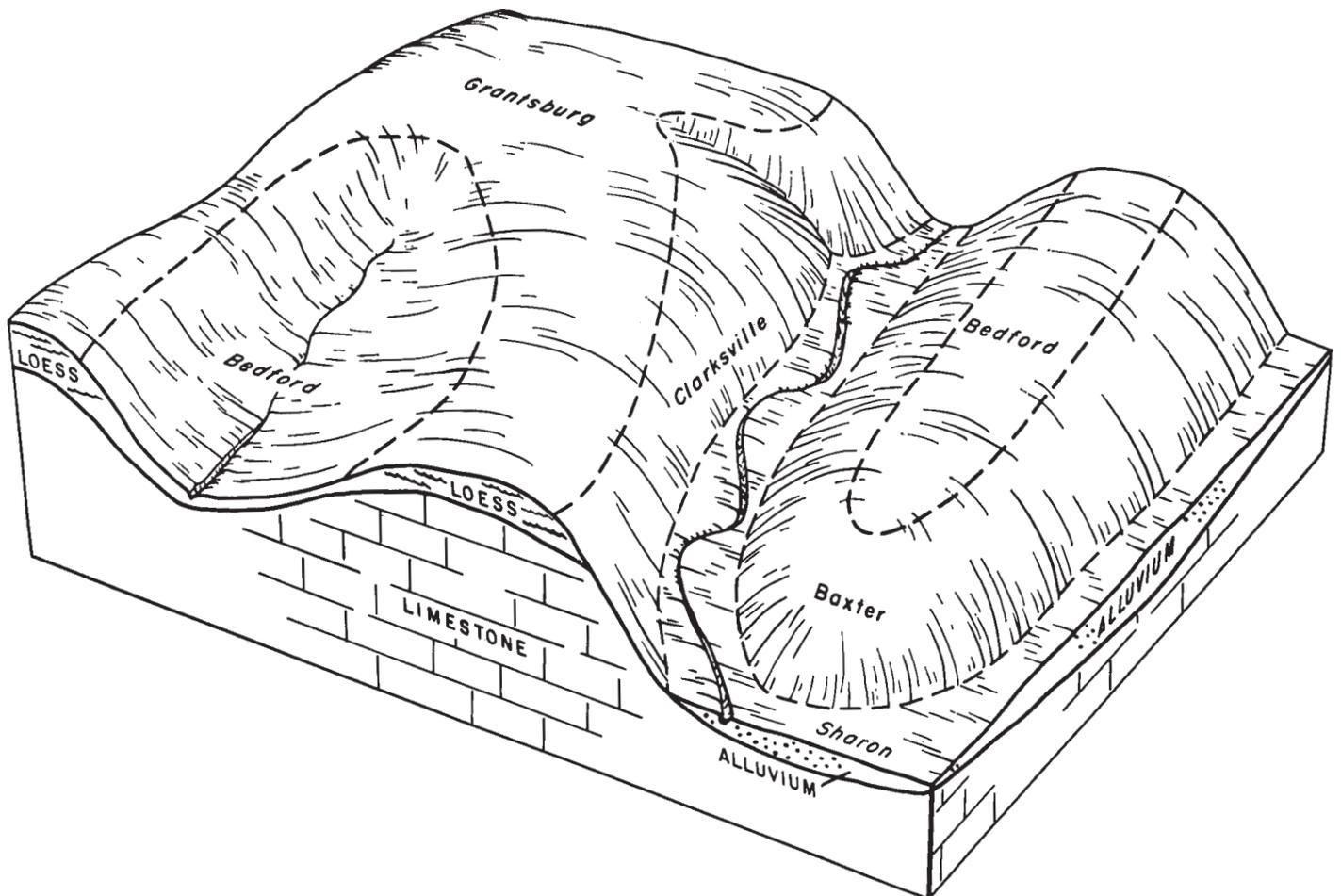


Figure 4.—Principal soils of association 5 and their relation to the landscape.

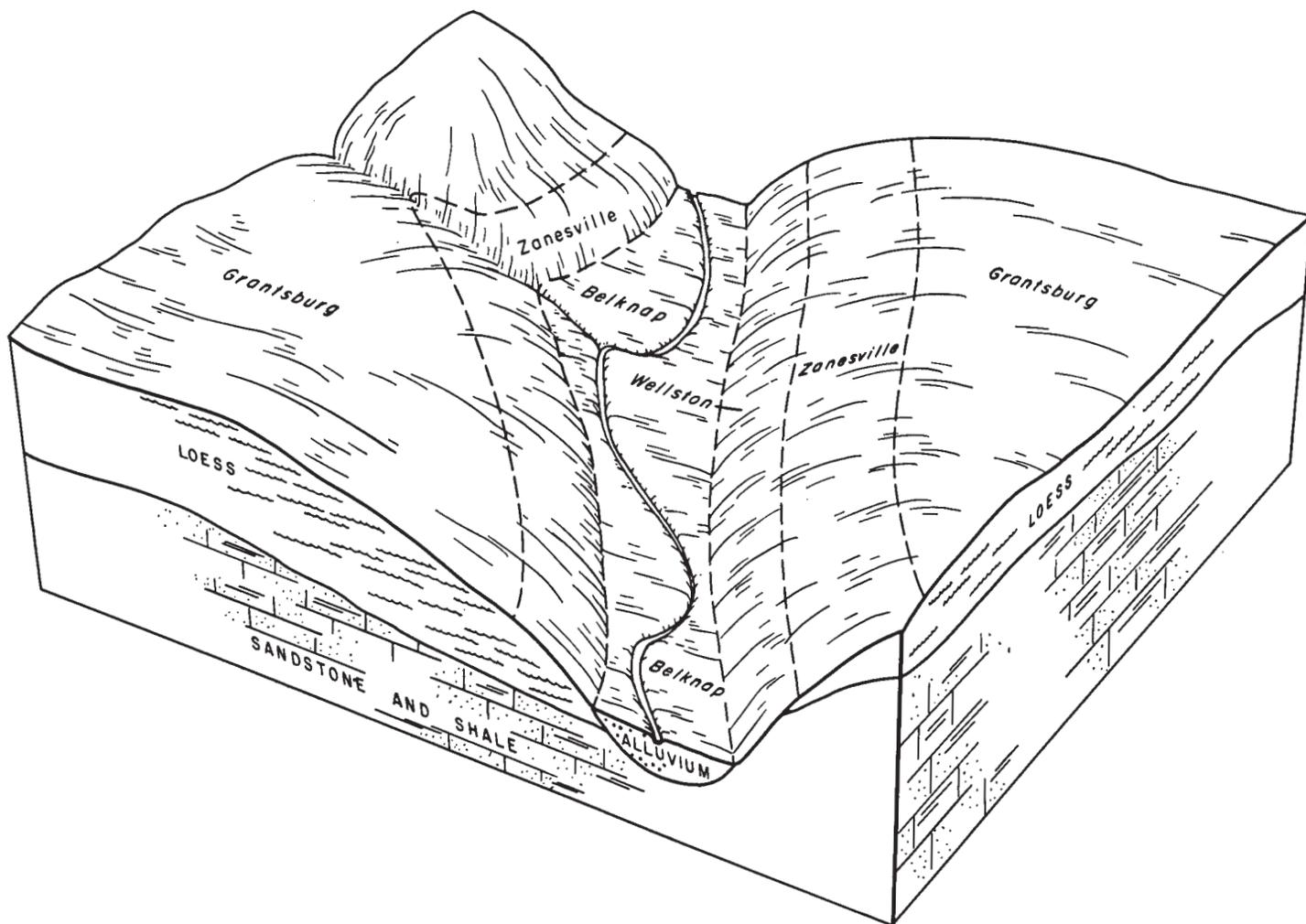


Figure 5.—Principal soils of association 6 and their relation to the landscape.

Grantsburg soils have slopes mostly of 2 to 12 percent. These moderately well drained soils have a surface layer of dark grayish-brown silt loam and a subsoil of brown silty clay loam underlain by a strongly developed fragipan. In cultivated areas, most soils that have slopes of more than 7 percent are severely eroded.

Zanesville soils are similar to Grantsburg soils, but the lower part of the fragipan layer is in material weathered from sandstone or shale, and they generally have slopes that range from 7 to 18 percent.

Moderately steep to very steep, stony Wellston, Muskingum, and Berks soils make up 15 percent of this association. The other 10 percent is made up of soils of the Burnside, Belknap, and Sharon series on bottom lands.

About 40 percent of this association is wooded, and much of the remainder is in pasture. Crops are grown only on bottom lands and on the broader ridgetops. More development of pasture from idle areas has potential in this association. Wildlife and recreational uses also have good potential. Use of the soils as homesites for part-time farmers and retirees is increasing. Restricted depth because of the fragipan, erosion, steep slopes, and rockiness are limitations to the use of these soils.

7. Grantsburg-Zanesville-Wellston Association

Moderately sloping to moderately steep, moderately well drained, slowly to very slowly permeable soils that contain a fragipan, and steep to very steep, well-drained, moderately permeable soils; on uplands

This association is in the northern part of Pope County. It consists of steep soils on long, rocky hills that have many sandstone bluffs and narrow ridgetops. In nearly two-thirds of the areas slopes are more than 12 percent.

This association makes up 10 percent of the three-county area. About 25 percent of the association is Grantsburg soils, 22 percent is Zanesville soils, and 15 percent is Wellston soils. The remaining 38 percent is minor soils.

Grantsburg soils in this association have slopes mostly of 4 to 12 percent. These moderately well drained soils have a surface layer of dark grayish-brown silt loam and a subsoil of brown silty clay loam underlain by a strongly developed fragipan.

Zanesville soils are similar to Grantsburg soils, but the lower part of the fragipan is in material weathered from sandstone or shale, and they generally have slopes that range from 7 to 18 percent.

Wellston soils are steep to very steep. These well-drained soils have a surface layer of dark grayish-brown stony silt loam and a subsoil of brown silty clay loam that commonly consists of material weathered from sandstone or shale. The subsoil is underlain by sandstone or shale bedrock.

Steep Muskingum and Berks soils are closely associated with Wellston soils in many rocky areas. These soils and sandstone rock land make up about 32 percent of the association. The remaining 6 percent is made up of Burnside and Sharon soils on narrow bottom lands.

Nearly 90 percent of this association is wooded. Most of the ridgetops once were farmed, but they have been abandoned and allowed to return to brush and trees. Several areas have been planted to pines. Some areas on ridgetops are in pasture, and a few small areas are cultivated. Much of the land is owned by Shawnee National Forest. Many places have scenic or recreational value, and wildlife habitat and recreational use have high potential. Timber production is the major enterprise, and a small accessory livestock enterprise is possible for the relatively small number of people who live in the area. Steep slopes and rockiness are major limitations to the use of these soils, but erosion and restricted depth be-

cause of the fragipan are also concerns in the areas on ridgetops.

8. Hosmer-Stoy Association

Nearly level to moderately steep, moderately well drained to somewhat poorly drained, slowly permeable soils that contain a fragipan; on uplands

This association is in an area of rolling hills across Massac County. Only in about 10 percent of the area are slopes more than 12 percent. About 20 percent of the area is on bottom lands. The entire area is underlain by Coastal Plain gravel.

This association (fig. 6) makes up about 10 percent of the three-county area. About 58 percent of the association is Hosmer soils, and 16 percent is Stoy soils. The remaining 26 percent is minor soils. In a part of this area west and north of Metropolis, however, nearly level and gently sloping soils are dominant, and 60 percent of this part is Stoy soils, and 12 percent is Weir soils.

Hosmer soils have slopes of 2 to 18 percent. These moderately well drained soils have a surface layer of brown silt loam and a subsoil of brown silty clay loam underlain by a moderately strong fragipan.

Stoy soils mostly have slopes of less than 4 percent. These somewhat poorly drained soils have a surface layer of brown silt loam and a subsurface layer of

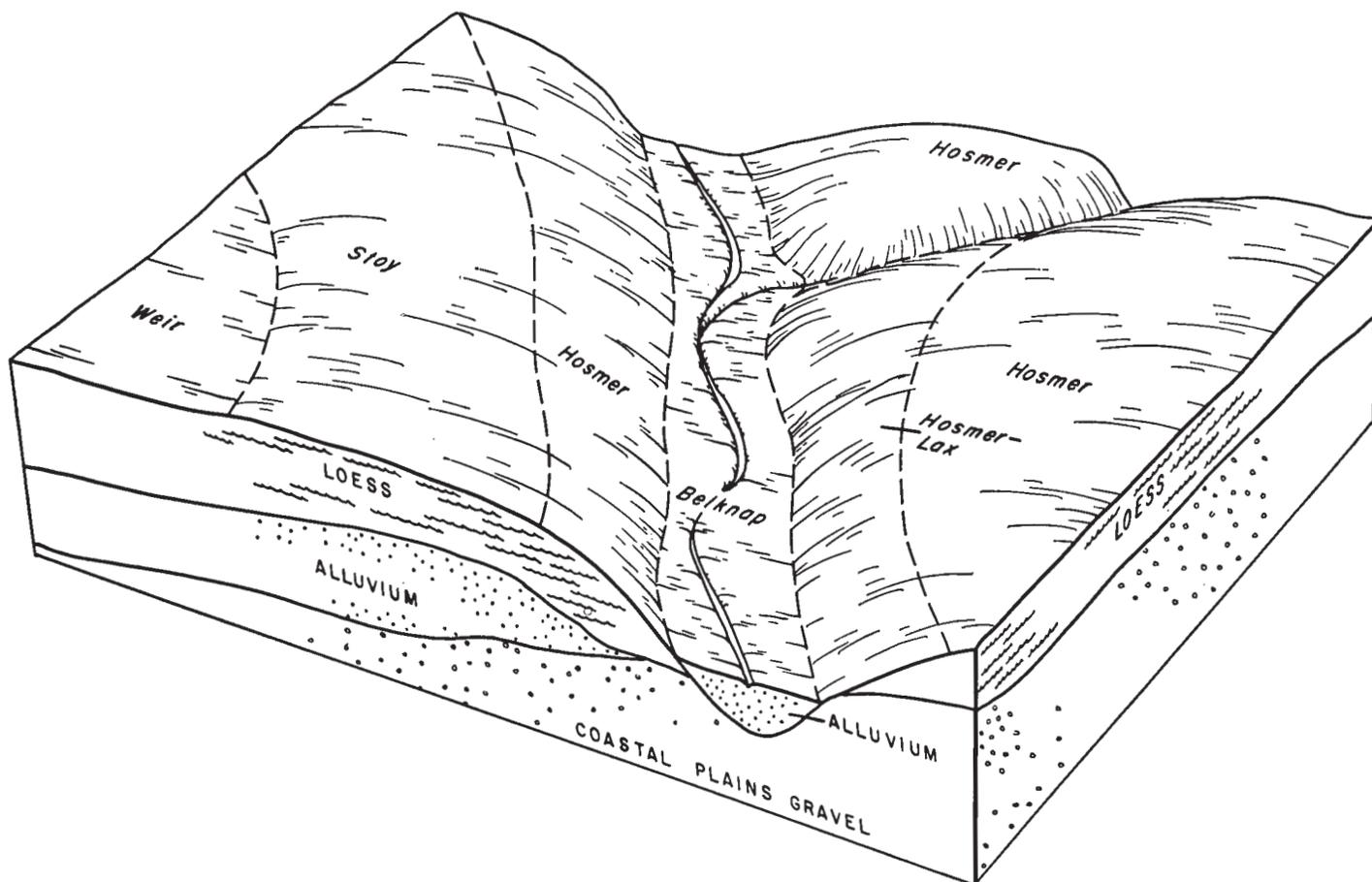


Figure 6.—Principal soils of association 8 and their relation to the landscape.

yellowish-brown silt loam. The subsoil is mottled yellowish-brown and gray silty clay loam underlain by a weak fragipan.

Minor soils on uplands are in the Weir and Lax series. The nearly level, poorly drained Weir soils are mainly north and west of Metropolis. Steep Lax soils are on the lower parts of hillsides throughout the association. Other minor soils are mainly Bonnie and Belknap soils on bottom land, but a few areas of Sharon and Burnside soils are also present.

This association is used mainly for crops and pasture. Only about one-eighth of the area is wooded. The soils in this association are well suited to most cultivated crops, but the strongly sloping and severely eroded areas are better suited to pasture. The number of nonfarm homes is increasing in the area. Slow permeability of the soil causes a limitation to waste disposal. Controlling erosion and maintaining fertility are concerns in areas used for crops and pasture.

9. Ginat-Weinbach-Sciotoville Association

Nearly level to strongly sloping, moderately well drained to poorly drained, moderately slowly to slowly permeable soils; on stream terraces

This association consists of soils on low stream terraces closely intermingled with narrow bottom lands. In places, the difference in elevation between the terraces and bottom lands is as little as 2 feet. In such places the terraces are difficult to distinguish from the bottom lands.

The soils on terraces are generally nearly level or gently sloping, but some short, strong slopes are present where the terraces join the bottom lands or are along drainage ways.

This association (fig. 7) makes up 12 percent of the three-county area. About 20 percent of this association is Ginat soils, 18 percent is Weinbach soils, and 17 percent is Sciotoville soils. The remaining 45 percent is minor soils.

Ginat soils are nearly level. These poorly drained soils have a surface layer of brown silt loam and a subsurface layer of gray silt loam. The subsoil is mottled gray and yellowish-brown silty clay loam.

Weinbach soils are nearly level or gently sloping. These somewhat poorly drained soils have a surface layer of brown silt loam and a subsurface layer of mottled, yellowish-brown and gray silt loam. The subsoil is mottled yellowish-brown and gray silty clay loam.

Sciotoville soils are nearly level to strongly sloping. These moderately well drained soils have a surface layer of brown silt loam and a subsoil of yellowish-brown heavy silt loam underlain by a weak fragipan.

The poorly drained Racoon soils, the well-drained Wheeling soils, the sandy Alvin and Lamont soils, and small areas of the Reesville, McGary, and Markland soils that are calcareous in the lower part of the subsoil are on terraces. These minor soils make up 27 percent of the association. Belknap, Bonnie, Cape, and Karnak soils are on bottom lands. These minor soils make up about 18 percent of the association.

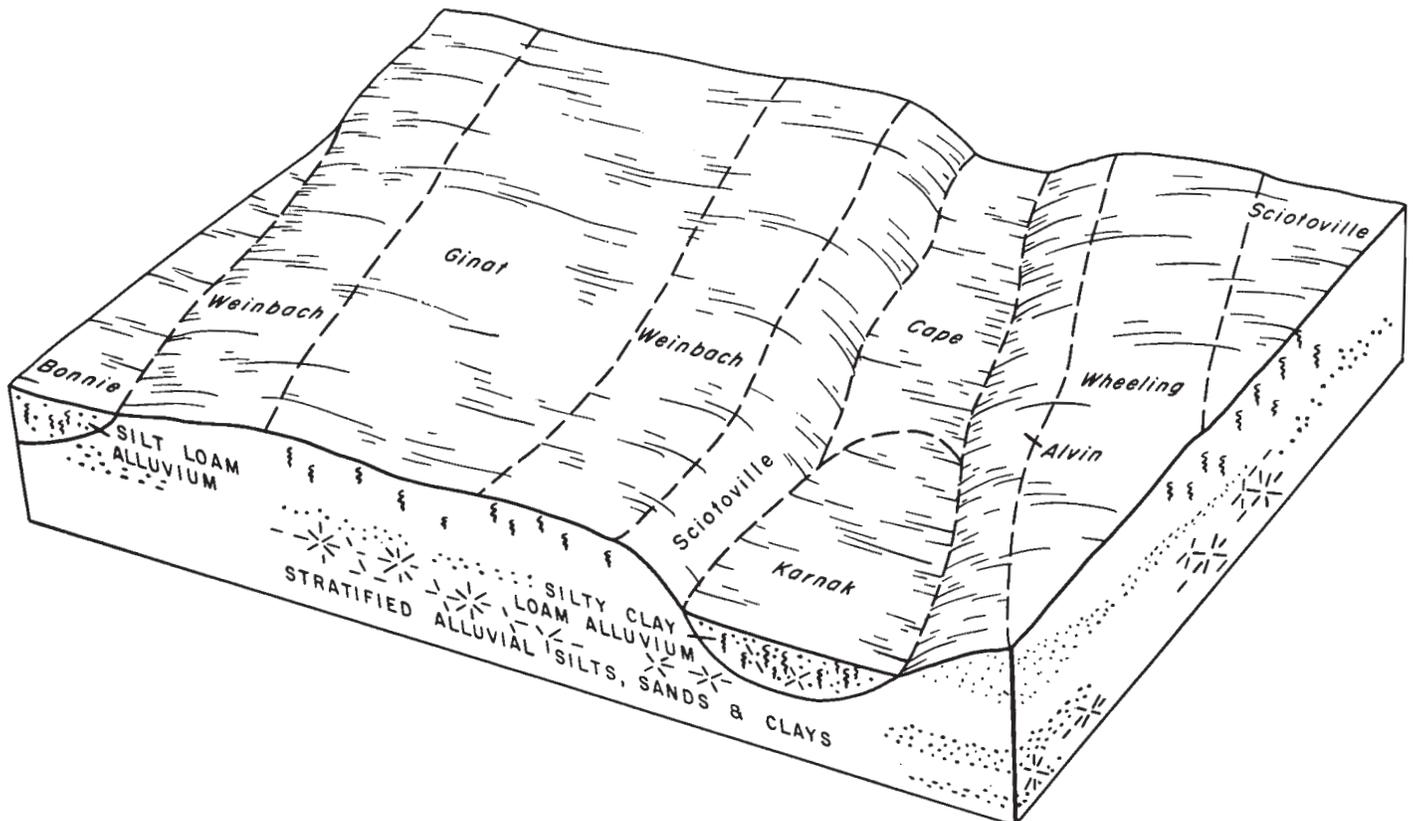


Figure 7.—Principal soils of association 9 and their relation to the landscape.

This association is used mainly for crops and pasture. Some areas of poorly drained soils are wooded. The soils are suited to most crops and pasture plants. Erosion is a hazard on sloping soils, and drainage is needed on poorly drained soils that are used for crops. Soils on bottom lands are subject to flooding. Most of the soils are strongly acid and low in natural fertility.

10. Armiesburg-Emma Association

Nearly level to moderately sloping, well drained and moderately well drained, moderately and moderately slowly permeable soils; on bottom lands

This association consists of bottom lands of the Ohio River. They are mostly nearly level or undulating but are dissected by remnants of bayous, sloughs, and stream channels.

This association (fig. 8) makes up about 4 percent of the three-county area. About 41 percent of the association is Armiesburg soils, and 22 percent is Emma soils. The remaining 37 percent is minor soils.

Armiesburg soils have a thick surface layer of dark-brown silty clay loam and a subsoil of brown silty clay loam. These well-drained soils are neutral in reaction.

Emma soils have a thinner dark-brown surface layer and a dark yellowish-brown subsoil. These moderately well drained soils are strongly acid.

Small amounts of Alluvial land and medium-textured Huntington soils are near the Ohio River and are asso-

ciated with Armiesburg soils. Other minor soils include the fine-textured Hurst, Cape, and Petrolia soils that are associated mainly with Emma soils on low terraces and bottom lands farther from the river.

Most of this association is used for annual row crops. A few poorly drained areas in old sloughs or channels are wooded. The soils are moderately productive to highly productive, but annual flooding is a serious hazard to use for winter crops or pasture. All of the association is subject to flooding, but some areas of Emma soils are covered only during the most severe floods. Recreational use is of minor importance along the river and on several lakes formed in stream channels.

11. Belknap-Bonnie-Cape Association

Nearly level, somewhat poorly drained and poorly drained, moderately slowly to very slowly permeable soils; on bottom lands

This association consists of two groups of soils. One group is made up of soils that formed in silty sediment. It is in scattered areas of converging bottom lands that range from $\frac{1}{4}$ mile to 1 mile in width. The other is made up of low, wet soils that formed in silty sediment over clayey sediment. It is along Main Ditch and New Columbia Ditch, around Mermet Lake in Massac County, and near New Burnside in Pope County.

This association makes up 5 percent of the three-county area. About 31 percent of the association is Belknap

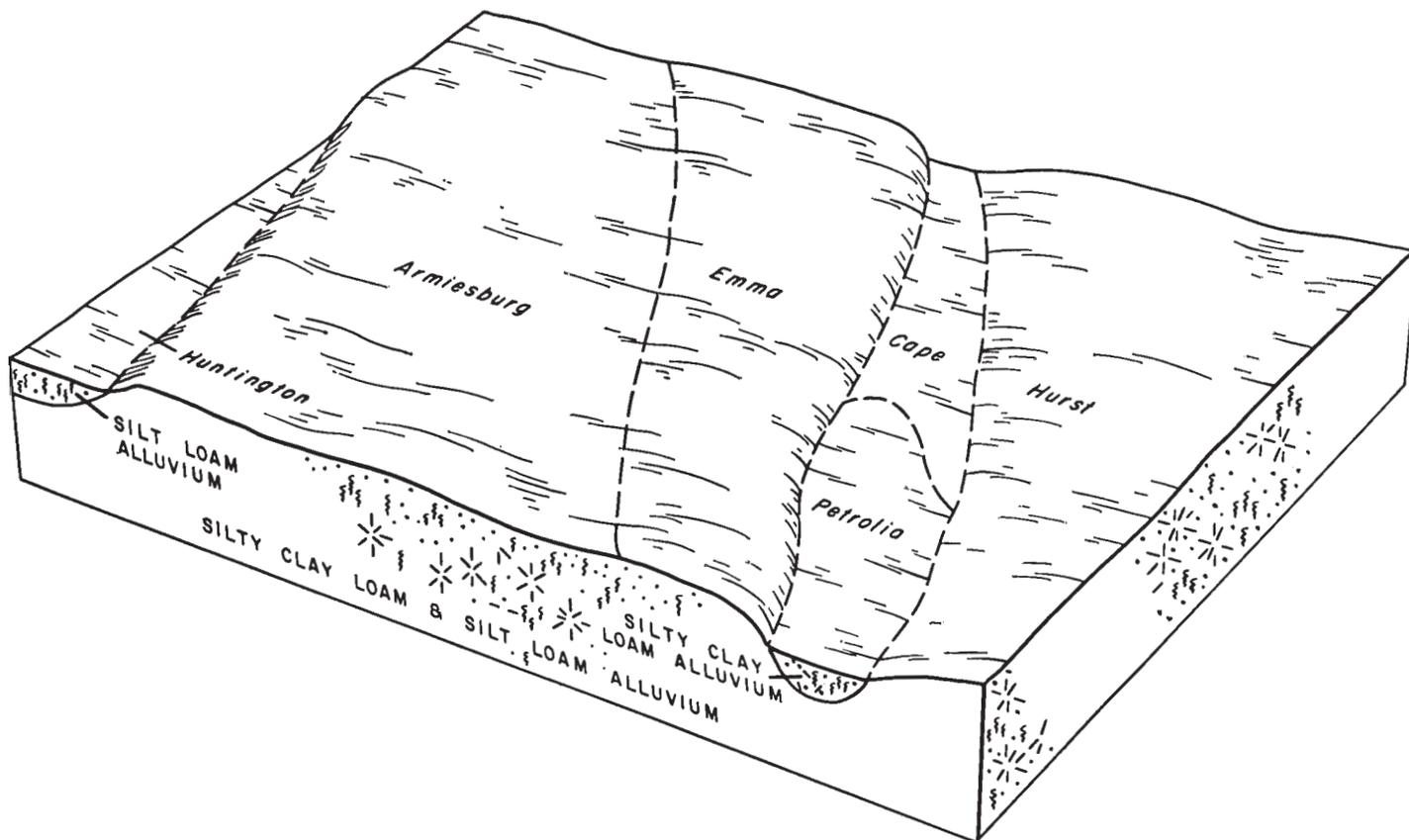


Figure 8.—Principal soils of association 10 and their relation to the landscape.

soils, 25 percent is Bonnie soils, and 21 percent is Cape soils. The remaining 23 percent is minor soils. In the areas dominated by soils that formed in silty sediment, however, 47 percent is Belknap soils, and 31 percent is Bonnie soils. In areas dominated by soils that formed in silty sediment over clayey sediment, 45 percent is Cape soils, and 28 percent is minor Karnak soils.

Belknap soils are somewhat poorly drained. These soils have a surface layer of brown silt loam and a subsoil of mottled brownish-gray and pale-brown silt loam.

Bonnie soils are poorly drained. These soils have a surface layer of grayish-brown silt loam and a subsoil of gray silt loam.

Cape soils are poorly drained. These soils have a surface layer of grayish-brown silty clay loam and a sub-surface layer of brownish-gray silty clay. The subsoil is gray silty clay.

The Karnak soils, which are important in the clayey part of the association, have a surface layer of dark grayish-brown silty clay and a subsoil of dark-gray silty clay. Other minor soils are on bottom land and include soils of the Sharon and Darwin series. They make up 18 percent of the association. Small areas of Ginat, Weinbach, Sciotoville, and Wheeling soils are on stream terraces and make up 5 percent of the association.

This association is mostly used for crops (fig. 9). The poorly drained soils are also used for trees, and all the soils are used, to a small extent, for pasture. Protection from flooding is the most common concern on these soils. Most areas are not flooded for long periods, but in places, flash flooding causes scouring and deposition of silt and debris. A few wooded areas remain wet and waterlogged until late in spring. Surface drainage is

generally needed on the poorly drained Bonnie, Cape, and Karnak soils, and drainage may be helpful in places on the somewhat poorly drained Belknap soils.

Descriptions of the Soils

This section describes the soil series and mapping units in Pope, Hardin, and Massac Counties. Each soil series is described in detail, and then, briefly, each mapping unit in that series. Unless it is 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. The profile described in the series is representative for mapping units in that series. If the profile of a given mapping unit is different from the one described for the series, these differences are stated in describing the mapping unit, or they are differences that are apparent in the name of the mapping unit. Color terms are for moist soil unless otherwise stated.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil se-



Figure 9.—Cultivated area of Belknap silt loam, association 11.

ries. Alluvial land and Sandstone rock land, for example, do not belong to a soil series, but nevertheless are listed in alphabetic order 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 management group, woodland suitability group, and recreation group in which the mapping unit has been placed. The page for the description of each management group can be learned by referring to the "Guide to Mapping Units" at the back of this survey.

The acreage and proportionate extent of each mapping unit are shown in table 3. 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 (22).²

Alford Series

The Alford series consists of deep, gently sloping to steep, well-drained soils on uplands. These soils formed in loess. They are mainly in the eastern part of Hardin County and in the limestone sinkhole area of that county. Also, they are common in Massac County in areas where the underlying material is Coastal Plain gravel.

In a representative profile the surface layer is about 5 inches of brown silt loam, and the subsurface layer is about 5 inches of yellowish-brown silt loam. The subsoil is about 40 inches thick. It is brown, firm silty clay loam in the upper part and brown, firm heavy silt loam in the lower part. The underlying material is brown silt loam.

Alford soils are low in content of organic matter. They have moderate permeability and high available water capacity.

Crops on these soils respond well to lime and fertilizer applied according to soil tests. Roots grow well in all layers.

Representative profile of Alford silt loam, 2 to 4 percent slopes, in a cultivated area of Hardin County, 150 feet north of well casing in the SE $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 19, T. 11 S., R. 10 E.:

- Ap—0 to 5 inches, brown (10YR 4/3) silt loam; weak, medium, granular structure; friable; slightly acid; abrupt, smooth boundary.
- A2—5 to 10 inches, yellowish-brown (10YR 5/6) silt loam; very weak, very coarse, platy structure parting to very weak, fine, granular; friable; neutral; abrupt, smooth boundary.
- B1—10 to 16 inches, brown (7.5YR 4/4) light silty clay loam; weak, fine, subangular blocky structure; friable; few, thin, brown (7.5YR 4/4) clay films; common, fine, very dark brown (10YR 2/2) iron concretions; very strongly acid; clear, smooth boundary.
- B21t—16 to 22 inches, brown (7.5YR 4/4) silty clay loam; moderate, medium, subangular blocky structure; firm; discontinuous, thin, brown (7.5YR 4/4) clay films; few, medium to coarse, very dark brown (10YR 2/2) iron stains; few, fine, very dark brown (10YR 2/2) iron concretions; very strongly acid; clear, smooth boundary.
- B22t—22 to 33 inches, brown (7.5YR 4/4) silty clay loam; very weak, medium, prismatic structure parting to moderate, medium, subangular blocky; firm; con-

tinuous, medium, brown (7.5YR 4/4) clay films and few, medium, pale-brown (10YR 6/3) silica coats on ped faces; common, fine, very dark brown (10YR 2/2) iron concretions; common, medium and coarse, very dark brown (10YR 2/2) stains; strongly acid; clear, smooth boundary.

- B23t—33 to 38 inches, brown (7.5YR 4/4) silty clay loam; very weak, medium, prismatic structure parting to moderate, medium, subangular blocky; firm; discontinuous, medium, brown (7.5YR 4/4) clay films on vertical ped faces and patchy, thin, yellowish-brown (10YR 5/4) coats on ped faces; common, fine, very dark brown (10YR 2/2) iron concretions; few, medium and coarse, very dark brown (10YR 2/2) stains; strongly acid; clear, smooth boundary.
- B3—38 to 50 inches, brown (7.5YR 4/4) heavy silt loam; weak, coarse, subangular blocky structure; firm; patchy, thin, brown (7.5YR 4/4) clay films and patchy, thin, pale-brown (10YR 6/3) silica coats on ped faces; common, fine, very dark brown (10YR 2/2) iron concretions; strongly acid; clear, smooth boundary.
- C—50 to 66 inches, brown (7.5YR 4/4) silt loam; massive; friable; few, thin, pale-brown (10YR 6/3) silica coats; common, fine, very dark brown (10YR 2/2) iron concretions; strongly acid.

The loess is generally 5 to 15 feet thick over limestone or Coastal Plain gravel, but in the eastern part of Hardin County, it is more than 20 feet thick over sandstone or limestone. A thin, compact layer, 4 to 10 inches thick, is in Alford soils in places at a depth of 40 to 55 inches.

The Ap and A2 horizons combined range from 4 to 14 inches in thickness. The B horizon has a few light brownish-gray to very pale brown mottles in the lower part in many places.

Alford soils are associated with Baxter, Bedford, Hosmer, Lax, and Wellston soils. They lack the characteristic fragipan of Bedford, Hosmer, and Lax soils. They formed entirely in loess, unlike Baxter soils, which formed in loess and cherty clayey material and Wellston soils, which formed in loess and material weathered from sandstone and shale.

Alford silt loam, 2 to 4 percent slopes (308B).—This soil is mostly in areas of less than 20 acres that are on ridgetops. It has the profile described as representative for the series.

Included with this soil in mapping were areas where slope is less than 2 percent. Also included were some areas of a soil that has gray mottles in the lower part of the subsoil.

Runoff is slow, and the hazard of erosion is slight.

This Alford soil is well suited to all uses. Management group IIe-1; woodland suitability group 1o1; recreation group 1.

Alford silt loam, 4 to 7 percent slopes, eroded (308C2).—Areas of this soil are mostly on narrow ridgetops of high hills or on ridges that are in an intricate pattern between sinkholes. Other areas are on broader ridgetops that are 100 to 400 feet wide (fig. 10). The profile of this soil is similar to that described as representative for the series, but the surface layer and subsurface layer are thinner, and in cultivated areas these layers have been mixed in with the plow layer.

Included with this soil in mapping were areas where the soil is not so eroded and where the combined thickness of the surface layer and subsurface layer is more than 7 inches. These areas make up about 15 percent of the total acreage of this soil. Also included were a few areas where the soil is severely eroded and where more than half of the plow layer is material that was formerly in the subsoil. In places small areas of soil that has slopes of less than 4 percent were included.

² Italic numbers in parentheses refer to Literature Cited, p. 124.

TABLE 3.—Approximate acreage and proportionate extent of the soils

Soil	Massac		Hardin		Pope		Total	
	Acres	Per cent						
Alford silt loam, 2 to 4 percent slopes.....	377	0.2	346	0.3	146	0.1	869	0.2
Alford silt loam, 4 to 7 percent slopes, eroded.....	2,268	1.4	5,909	5.1	895	.4	9,072	1.8
Alford silt loam, 7 to 12 percent slopes, eroded.....	1,718	1.1	4,362	3.7	335	.1	6,415	1.2
Alford soils, 7 to 12 percent slopes, severely eroded.....	496	.3	2,955	2.6	498	.2	3,949	.8
Alford silt loam, 12 to 18 percent slopes, eroded.....	776	.5	1,901	1.6	201	.1	2,878	.6
Alford soils, 12 to 18 percent slopes, severely eroded.....	995	.6	4,584	3.9	160	.1	5,739	1.1
Alford silt loam, 18 to 30 percent slopes, eroded.....	738	.5	2,252	1.9	212	.1	3,202	.6
Alford-Baxter complex, 12 to 18 percent slopes, eroded.....	0	0	179	.1	158	.1	337	.1
Alford-Baxter complex, 18 to 40 percent slopes, eroded.....	0	0	1,364	1.2	0	0	1,364	.3
Alluvial land.....	410	.3	312	.3	569	.2	1,291	.2
Alvin fine sandy loam, 0 to 2 percent slopes.....	58	(¹)	22	(¹)	112	(¹)	192	(¹)
Alvin fine sandy loam, 2 to 4 percent slopes.....	587	.4	37	(¹)	620	.3	1,244	.2
Alvin fine sandy loam, 4 to 7 percent slopes.....	202	.1	42	(¹)	338	.1	582	.1
Alvin fine sandy loam, 7 to 12 percent slopes, eroded.....	79	.1	83	.1	171	.1	333	.1
Alvin fine sandy loam, 12 to 18 percent slopes, eroded.....	142	.1	168	.1	121	.1	431	.1
Alvin fine sandy loam, 18 to 30 percent slopes.....	270	.2	130	.1	8	(¹)	408	.1
Armiesburg silty clay loam.....	4,351	2.8	1,573	1.3	2,272	.9	8,196	1.6
Baxter cherty silt loam, 12 to 18 percent slopes.....	0	0	190	.2	14	(¹)	204	(¹)
Baxter cherty silt loam, 18 to 30 percent slopes.....	0	0	3,535	3.1	28	(¹)	3,563	.7
Baxter cherty silt loam, 30 to 50 percent slopes.....	0	0	385	.3	6	(¹)	391	.1
Beasley silt loam, 12 to 18 percent slopes.....	0	0	222	.2	920	.4	1,142	.2
Beasley silt loam, 18 to 30 percent slopes.....	28	(¹)	633	.5	1,472	.6	2,133	.4
Beasley silt loam, 30 to 50 percent slopes.....	35	(¹)	409	.4	501	.2	945	.2
Beaucoup silty clay loam.....	494	.3	62	.1	97	(¹)	653	.1
Bedford silt loam, 7 to 12 percent slopes.....	0	0	512	.4	34	(¹)	546	.1
Bedford soils, 7 to 12 percent slopes, severely eroded.....	0	0	0	0	171	.1	171	(¹)
Bedford silt loam, 12 to 18 percent slopes, eroded.....	0	0	925	.8	427	.2	1,352	.3
Bedford soils, 12 to 18 percent slopes, severely eroded.....	0	0	2,430	2.1	207	.1	2,637	.5
Bedford silt loam, 18 to 30 percent slopes, eroded.....	0	0	1,859	1.6	12	(¹)	1,871	.4
Belknap silt loam.....	17,225	11.0	4,100	3.5	10,200	4.2	31,525	6.1
Bonnie silt loam.....	7,300	4.6	803	.7	2,950	1.2	11,053	2.1
Bonnie silt loam, wet.....	82	.1	34	(¹)	198	.1	314	.1
Brandon and Saffell soils, 1 to 4 percent slopes.....	206	.1	0	0	49	(¹)	255	(¹)
Brandon and Saffell soils, 4 to 12 percent slopes, eroded.....	223	.1	0	0	42	(¹)	265	(¹)
Brandon and Saffell soils, 12 to 30 percent slopes.....	1,922	1.2	0	0	1,829	.8	3,751	.7
Burnside silt loam.....	716	.5	3,168	2.7	6,795	2.8	10,679	2.0
Cape silty clay loam.....	5,485	3.5	61	.1	1,666	.7	7,212	1.4
Cape silty clay loam, wet.....	682	.4	0	0	271	.1	953	.2
Cape silt loam, overwash.....	992	.6	0	0	523	.2	1,515	.3
Clarksville cherty silt loam, 20 to 30 percent slopes.....	0	0	972	.8	46	(¹)	1,018	.2
Clarksville cherty silt loam, 30 to 60 percent slopes.....	0	0	922	.8	0	0	922	.2
Darwin silty clay.....	404	.3	48	(¹)	9	(¹)	461	.1
Darwin silty clay loam.....	548	.3	0	0	0	0	548	.1
Dupo silt loam.....	425	.3	39	(¹)	16	(¹)	480	.1
Emma silty clay loam, 0 to 2 percent slopes.....	944	.6	0	0	606	.2	1,550	.3
Emma silty clay loam, 2 to 7 percent slopes.....	1,196	.8	10	(¹)	557	.2	1,763	.3
Emma silty clay loam, 7 to 18 percent slopes, eroded.....	167	.1	0	0	169	.1	336	.1
Ginat silt loam.....	7,449	4.7	80	.1	2,777	1.1	10,306	2.0
Grantsburg silt loam, 2 to 4 percent slopes.....	0	0	216	.2	6,491	2.7	6,707	1.3
Grantsburg silt loam, 4 to 7 percent slopes, eroded.....	0	0	4,800	4.1	29,200	12.0	34,000	6.5
Grantsburg silt loam, 7 to 12 percent slopes, eroded.....	0	0	3,218	2.8	9,594	3.9	12,812	2.5
Grantsburg soils, 7 to 12 percent slopes, severely eroded.....	0	0	3,174	2.7	21,956	9.0	25,130	4.8
Grantsburg silt loam, 12 to 18 percent slopes, eroded.....	0	0	634	.5	2,256	.5	1,890	.4
Grantsburg soils, 12 to 18 percent slopes, severely eroded.....	0	0	1,499	1.3	2,170	.9	3,669	.7
Haymond silt loam.....	0	0	1,207	1.0	164	.1	1,371	.3
Hosmer silt loam, 2 to 4 percent slopes.....	8,191	5.2	405	.3	2,610	1.1	11,206	2.2
Hosmer silt loam, 4 to 7 percent slopes, eroded.....	13,900	8.9	4,200	3.6	8,127	3.3	26,227	5.1
Hosmer silt loam, 7 to 12 percent slopes, eroded.....	8,100	5.2	4,040	3.5	3,052	1.3	15,192	2.9
Hosmer soils, 7 to 12 percent slopes, severely eroded.....	10,600	6.8	3,075	2.6	5,962	2.4	19,637	3.8
Hosmer silt loam, 12 to 18 percent slopes, eroded.....	3,673	2.3	1,037	.9	1,406	.6	6,116	1.2
Hosmer soils, 12 to 18 percent slopes, severely eroded.....	5,913	3.8	2,307	2.0	2,216	.9	10,436	2.0
Hosmer silt loam, 18 to 30 percent slopes, eroded.....	1,552	1.0	104	.1	208	.1	1,864	.4
Hosmer-Lax silt loams, 12 to 18 percent slopes, eroded.....	731	.5	0	0	132	.1	863	.2
Hosmer-Lax complex, 12 to 18 percent slopes, severely eroded.....	1,504	1.0	0	0	589	.2	2,093	.4
Hosmer-Lax silt loams, 18 to 30 percent slopes, eroded.....	994	.6	0	0	112	(¹)	1,106	.2

See footnote at end of table.

TABLE 3.—Approximate acreage and proportionate extent of the soils—Continued

Soil	Massac		Hardin		Pope		Total	
	Acres	Per-cent	Acres	Per-cent	Acres	Per-cent	Acres	Per-cent
Huntington silt loam.....	540	0.3	258	0.2	931	0.4	1,729	0.3
Hurst silty clay loam.....	1,657	1.1	97	.1	1,201	.5	2,955	.6
Karnak silty clay.....	3,204	2.0	235	.2	318	.1	3,757	.7
Karnak silty clay, wet.....	248	.2	0	0	646	.3	894	.2
Karnak silt loam, overwash.....	205	.1	0	0	208	.1	413	.1
Karnak silty clay loam, ashy.....	407	.3	0	0	0	0	407	.1
Lamont fine sandy loam, 2 to 7 percent slopes.....	93	.1	96	.1	230	.1	419	.1
Lamont fine sandy loam, 7 to 12 percent slopes, eroded.....	81	(¹)	18	(¹)	65	(¹)	164	(¹)
Lax silt loam, 12 to 18 percent slopes.....	1,006	.6	0	0	638	.3	1,644	.3
Lax soils 12 to 18 percent slopes, severely eroded.....	553	.4	0	0	544	.2	1,097	.2
Lax silt loam, 18 to 30 percent slopes, eroded.....	2,128	1.4	0	0	882	.4	3,010	.6
Markland silt loam, 2 to 7 percent slopes, eroded.....	0	0	145	.1	117	(¹)	262	(¹)
Markland silt loam, 7 to 15 percent slopes, eroded.....	0	0	179	.2	435	.2	614	.1
McGary silt loam, 0 to 4 percent slopes.....	0	0	232	.2	137	.1	369	.1
Muskingum and Berks soils, 15 to 30 percent slopes.....	227	.1	2,450	2.1	3,511	1.4	6,188	1.2
Muskingum and Berks soils, 30 to 60 percent slopes.....	332	.2	2,542	2.2	7,107	2.9	9,981	1.9
Petrolia silty clay loam.....	337	.2	232	.2	184	.1	753	.1
Petrolia silty clay loam, wet.....	436	.3	0	0	0	0	436	.1
Racoon silt loam.....	2,962	1.9	132	.1	1,196	.5	4,290	.8
Reesville silt loam.....	471	.3	160	.1	70	(¹)	701	.1
Robbs silt loam, 1 to 4 percent slopes.....	0	0	92	.1	413	.2	505	.1
Sandstone rock land.....	76	(¹)	1,010	.9	1,877	.8	2,963	.6
Scioto silt loam, 0 to 2 percent slopes.....	837	.5	36	(¹)	692	.3	1,565	.3
Scioto silt loam, 2 to 4 percent slopes.....	2,029	1.3	350	.3	1,424	.6	3,803	.7
Scioto silt loam, 4 to 7 percent slopes, eroded.....	792	.5	369	.3	732	.3	1,893	.4
Scioto silt loam, 7 to 12 percent slopes, eroded.....	250	.2	215	.2	377	.2	842	.2
Scioto soils, 7 to 12 percent slopes, severely eroded.....	148	.1	99	.1	162	.1	409	.1
Scioto silt loam, 12 to 18 percent slopes, eroded.....	81	(¹)	0	0	254	.1	335	.1
Sharon silt loam.....	3,730	2.4	2,498	2.1	5,268	2.2	11,496	2.2
Stoy silt loam, 0 to 2 percent slopes.....	1,817	1.2	6	(¹)	26	(¹)	1,849	.4
Stoy silt loam, 2 to 4 percent slopes.....	3,153	2.0	78	.1	185	.1	3,416	.7
Stoy silt loam, 4 to 7 percent slopes, eroded.....	1,046	.7	4	(¹)	98	(¹)	1,148	.2
Wakeland silt loam.....	0	0	2,569	2.2	143	.1	2,712	.5
Weinbach silt loam, 0 to 2 percent slopes.....	2,648	1.7	210	.2	1,634	.7	4,492	.9
Weinbach silt loam, 2 to 4 percent slopes.....	2,359	1.5	252	.2	1,234	.5	3,845	.7
Weinbach silt loam, 4 to 7 percent slopes, eroded.....	433	.3	126	.1	240	.1	799	.1
Weir silt loam.....	1,273	.8	73	.1	5	(¹)	1,351	.3
Wellston silt loam, 12 to 18 percent slopes.....	176	.1	3,098	2.7	9,511	3.9	12,785	2.5
Wellston soils, 12 to 18 percent slopes, severely eroded.....	51	(¹)	813	.7	846	.4	1,710	.3
Wellston silt loam, 18 to 30 percent slopes.....	696	.4	4,639	4.0	8,397	3.4	13,732	2.7
Wellston-Berks complex, 12 to 18 percent slopes.....	0	0	188	.2	932	.4	1,120	.2
Wellston-Berks complex, 18 to 30 percent slopes.....	281	.2	5,500	4.7	18,103	7.4	23,884	4.6
Wellston-Berks complex, 30 to 60 percent slopes.....	380	.2	980	.8	2,685	1.1	4,045	.8
Wheeling silt loam, 0 to 2 percent slopes.....	421	.3	45	(¹)	820	.3	1,286	.2
Wheeling silt loam, 2 to 4 percent slopes.....	860	.5	122	.1	966	.4	1,948	.4
Wheeling silt loam, 4 to 7 percent slopes, eroded.....	388	.2	144	.1	264	.1	796	.2
Wheeling silt loam, 7 to 12 percent slopes, eroded.....	263	.2	146	.1	108	(¹)	517	.1
Wheeling silt loam, 12 to 25 percent slopes, eroded.....	326	.2	115	.1	58	(¹)	499	.1
Zanesville silt loam, 7 to 12 percent slopes, eroded.....	7	(¹)	130	.1	1,404	.6	1,541	.3
Zanesville soils, 7 to 12 percent slopes, severely eroded.....	25	(¹)	373	.3	7,877	3.2	8,275	1.6
Zanesville silt loam, 12 to 18 percent slopes, eroded.....	314	.2	2,586	2.2	11,217	4.6	14,117	2.7
Zanesville soils, 12 to 18 percent slopes, severely eroded.....	281	.2	4,277	3.7	11,498	4.7	16,056	3.1
Zanesville silt loam, 18 to 30 percent slopes, eroded.....	235	.2	523	.4	826	.3	1,584	.3
Water.....	784	.5	335	.3	117	(¹)	1,263	.2
Quarries and gravel pits.....	97	.1	186	.2	6	(¹)	289	.1
Mine dumps.....	0	0	272	.2	56	(¹)	328	.1
Borrow pits.....	130	.1	62	.1	54	(¹)	246	(¹)
Made land, cuts and fills.....	506	.3	33	(¹)	2	(¹)	541	.1
Total.....	156,928	100.0	116,864	100.0	243,584	100.0	517,376	100.0

¹ Less than 0.05 percent.

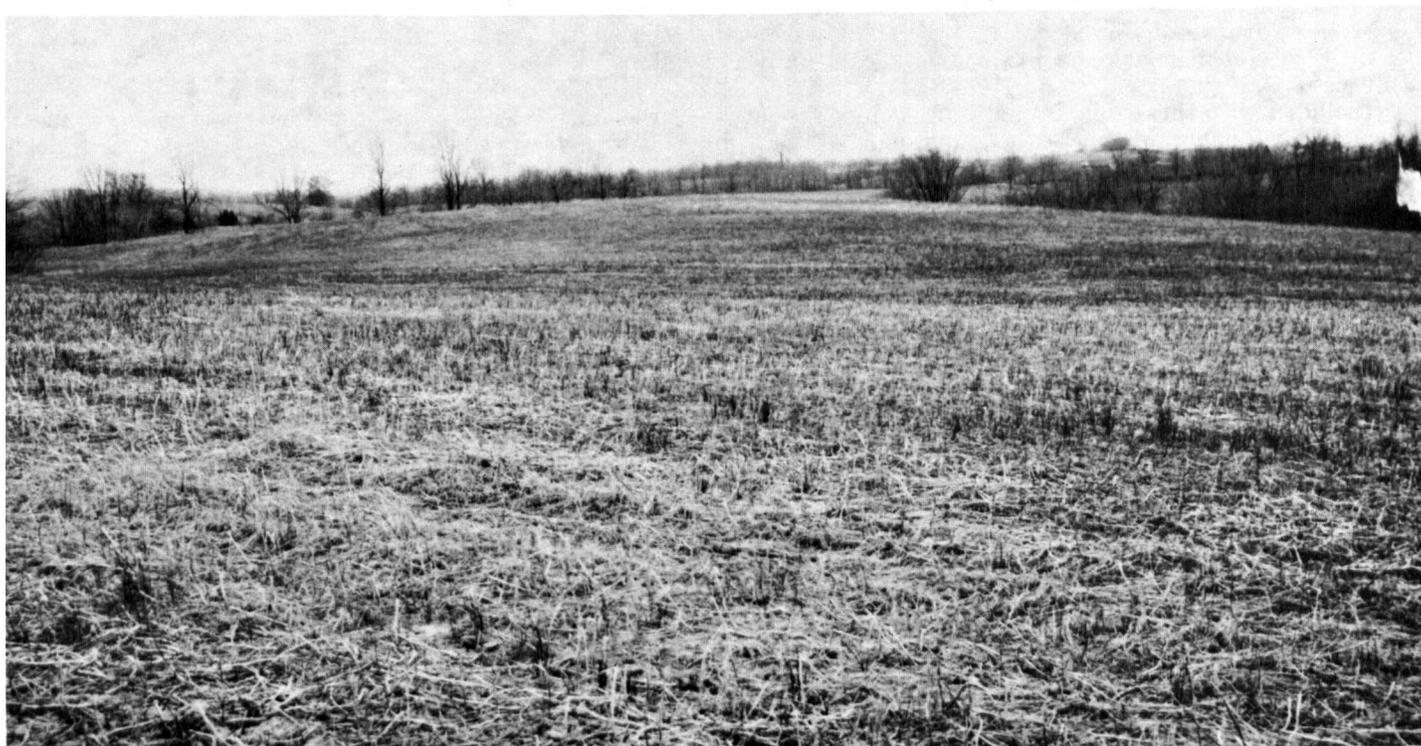


Figure 10.—Cropland in a ridgetop area of Alford silt loam, 4 to 7 percent slopes, eroded.

Runoff is medium, and the hazard of erosion is moderate.

This Alford soil is well suited to all uses. Management group IIe-1; woodland suitability group 1o1; recreation group 1.

Alford silt loam, 7 to 12 percent slopes, eroded (308D2).—Nearly two-thirds of the acreage of this soil is on ridgetops or side slopes around sinkholes. The rest is on the narrow ridgetops of high hills. The profile of this soil is similar to that described as representative for the series, but the surface layer is less than 7 inches thick, and in some places subsoil material has been mixed with the surface layer by plowing.

Included with this soil in mapping were areas where the soil is only slightly eroded and the combined thickness of the silt loam surface and subsurface layers is more than 7 inches. These areas make up about 12 percent of the total acreage of this soil.

Runoff is medium, and the hazard of erosion is severe.

This Alford soil is suited to all farm uses and most nonfarm uses. Management group IIIe-1; woodland suitability group 1o1; recreation group 3.

Alford soils, 7 to 12 percent slopes, severely eroded (308D3).—These soils are on the sides of drainageways and sinkholes in areas where slopes are 75 to 150 feet long and on ridgetops of high hills. The profile of these soils is similar to that described as representative for the series, but most or all of the surface and subsurface layers have been removed by erosion. The present plow layer is mainly subsoil material and is heavy silt loam or silty clay loam.

Included with these soils in mapping were a few places

near the Saline River in northeastern Hardin County where the lower part of the subsoil is calcareous.

Runoff is rapid, and the hazard of further erosion is severe.

These Alford soils are moderately well suited to most uses. Management group IVe-1; woodland suitability group 1o1; recreation group 3.

Alford silt loam, 12 to 18 percent slopes, eroded (308E2).—Nearly two-thirds of the acreage of this soil is on the sides of sinkholes. The rest is mostly along drainageways. The profile of this soil is similar to that described as representative for the series, but the surface and subsurface layers are thinner and in cultivated areas are incorporated into the plow layer.

Included with this soil in mapping were areas where the soil is less eroded, and the combined thickness of the silt loam surface and subsurface layers is more than 7 inches. These areas make up about one-third of the acreage of this soil. Also included were small areas of severely eroded soils. Limestone bedrock or material weathered from cherty limestone outcrops on the lower parts of a few slopes.

Runoff is rapid, and the hazard of further erosion is severe.

This Alford soil is well suited to pasture, trees, or wildlife habitat, but it has limited suitability for crops. Management group IVe-1; woodland suitability group 1r2; recreation group 4.

Alford soils, 12 to 18 percent slopes, severely eroded (308E3).—Areas of these soils are on sides of sinkholes and drainageways and on ridgetops and foot slopes. Areas generally are 10 to 20 acres in size. The profile of these soils is similar to that described as representative for the

series, but most or all of the surface and subsurface layers have been removed by erosion. The present plow layer is mainly subsoil material and is silty clay loam or heavy silt loam.

Included with these soils in mapping were a few areas near the Saline River where the lower part of the subsoil is calcareous. Also included were small areas that are severely gullied. In places, limestone or sandstone bedrock crops out on the lower parts of slopes.

Runoff is rapid, and the hazard of further erosion is severe.

These Alford soils are not suited to crops. They are well suited to pasture or trees. Management group VIe-1; woodland suitability group 1r2; recreation group 4.

Alford silt loam, 18 to 30 percent slopes, eroded (308F2).—This soil is in areas 10 to 100 acres or more in size. Slopes are long. The profile of this soil is similar to that described as representative for the series, but the surface and subsurface layers are thinner. In about 30 percent of the acreage, this soil is severely eroded, and in these areas the present surface layer is mainly silty clay loam subsoil material. Most of the eroded areas are used for crops or pasture, or they have been so used in the past. In about 40 percent of the acreage, this soil has remained wooded, and wooded areas are generally only slightly eroded.

Included with this soil in mapping were a few areas near the Saline River where the lower part of the subsoil is calcareous. Also included, in Hardin County, were areas where sandstone or limestone bedrock outcrops on the lower parts of some slopes. In Massac County, Coastal Plain gravel is exposed on the lower parts of slopes in places.

Runoff is rapid, and the hazard of further erosion is very severe.

This Alford soil is suited to pasture, trees, and wildlife habitat. Management group VIe-1; woodland suitability group 1r2; recreation group 5.

Alford-Baxter complex, 12 to 18 percent slopes, eroded (954E2).—This complex is along drainageways and around sinkholes. Areas are generally 5 to 10 acres in size. About 65 to 75 percent of each area is an Alford soil, and 25 to 35 percent is a Baxter soil. Baxter soil formed in cherty and clayey material over limestone. The limestone crops out on the lower one-fourth to one-third of the slope. Alford soil is on the upper parts of the slope.

In about one-third of the areas of this complex, the soil is severely eroded. The surface layer in these areas is silty clay loam or cherty silty clay loam. In most of the remaining areas the soil is moderately eroded, and the combined thickness of the surface and subsurface layers is less than 7 inches.

Runoff is rapid, and the hazard of erosion is severe.

The soils of this complex are suited to pasture, trees, or wildlife habitat. Management group VIe-3; woodland suitability group 3r2; recreation group 4.

Alford-Baxter complex, 18 to 40 percent slopes, eroded (954F2).—The soils of this complex have slopes that are 200 to 500 feet long. Areas are long and irregular in shape and range from 10 to 100 acres in size. About 40 to 60 percent of each area is Alford silt loam, and 40 to 60 percent is Baxter cherty silt loam. Baxter soil generally is dominant on south-facing slopes and at the heads of

drainageways. Alford soil is on the upper two-thirds of the slope, and Baxter soil is on the lower part of the slope.

Included with this complex in mapping were areas of eroded soils where the combined thickness of the silt loam surface and subsurface layers is less than 7 inches. These areas make up more than two-thirds of the acreage of this complex. Also included were a few areas of soils that are severely eroded and that have a plow layer mainly of silty clay loam subsoil material. Areas of this complex where slopes are more than 40 percent were also included.

Runoff is rapid, and the hazard of erosion is severe.

The soils of this complex are suited to pasture, trees, and wildlife habitat. Management group VIIe-1; woodland suitability group 3r2; recreation group 5.

Alluvial Land

Alluvial land (455) is a land type consisting of sediment recently deposited in areas adjacent to the Ohio River. The sediment varies in texture and is stratified in many places. Alluvial land is subject to frequent damaging river overflow, and the resulting deposition or scouring is so extensive that any detailed separation of the soils is temporary and impractical.

The surface layer ranges from silty clay loam to loamy sand. It is mostly dark brown or brown, but is yellowish brown in areas where texture is loamy sand.

Alluvial land has moderate to moderately rapid permeability and high to moderate available water capacity. It is neutral to moderately alkaline in reaction. Fertility is high, but this land type is severely limited for use because of the frequency of flooding.

Alluvial land is well suited to special wildlife habitat and recreational uses. Some areas are suited to limited use for crops. Management group IIw-2; woodland suitability group 1o4; recreation group 14.

Alvin Series

The Alvin series consists of deep, nearly level to steep, well-drained soils that formed in loamy sediment. These soils are on terraces adjacent to bottom lands along Bay Creek and the Ohio River and on uplands near Rosiclare in Hardin County and in the northeastern part of Massac County.

In a representative profile the surface layer is about 2 inches of very dark grayish-brown fine sandy loam. The subsurface layer is about 8 inches of mainly dark yellowish-brown fine sandy loam. The subsoil is mainly dark-brown, friable heavy fine sandy loam about 48 inches thick. The underlying material, to a depth of 65 inches, is dark-brown loamy fine sand.

Alvin soils are low in content of organic matter. They have moderate permeability in the subsoil and moderate available water capacity.

Crops on these soils respond moderately well to lime and fertilizer applied according to soil tests.

Representative profile of Alvin fine sandy loam, 2 to 4 percent slopes, in a wooded area of Massac County, 1,070 feet west of north-south field lane and 20 feet south of centerline of east-west field lane in the SW $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 11, T. 14 S., R. 3 E.:

- A1—0 to 2 inches, very dark grayish-brown (10YR 3/2) fine sandy loam; grayish brown (10YR 5/2) dry; weak, fine, granular structure; friable; very strongly acid; abrupt, smooth boundary.
- A2—2 to 10 inches, dark yellowish-brown (10YR 4/4) (80 percent) and yellowish-brown (10YR 5/4) (20 percent) fine sandy loam; weak, fine, granular structure; friable; few, very fine, black (N 2/0) iron-manganese concretions; very strongly acid; clear, smooth boundary.
- B1—10 to 16 inches, dark yellowish-brown (10YR 4/4) fine sandy loam; weak, medium, subangular blocky structure; friable; strongly acid; clear, smooth boundary.
- B21t—16 to 28 inches, dark-brown (7.5YR 4/4) heavy fine sandy loam; moderate, medium, subangular blocky structure; friable; discontinuous, thin, reddish-brown (5YR 4/4) clay films; very strongly acid; gradual, smooth boundary.
- B22t—28 to 42 inches, dark-brown (7.5YR 4/4) heavy fine sandy loam; weak, medium, subangular blocky structure; friable; patchy, thin, reddish-brown (5YR 4/4) clay films; very strongly acid; gradual, smooth boundary.
- B3—42 to 58 inches, dark-brown (7.5YR 4/4) fine sandy loam; very weak, coarse, subangular blocky structure; friable; very strongly acid; clear, smooth boundary.
- IIC—58 to 65 inches, dark-brown (7.5YR 4/4) loamy fine sand; massive; friable; strongly acid.

In cultivated areas the Ap horizon includes the A1 horizon and all or part of the A2 horizon. The Ap horizon ranges from 3 to 10 inches in thickness. The A1 and A2 horizons or Ap and A2 horizons combined range from 3 to 16 inches in thickness.

The B horizon ranges from yellowish brown to dark brown. The texture of the B horizon is fine sandy loam, loam, or sandy clay loam. Reaction ranges from very strongly acid to medium acid in the B horizon.

The C horizon is fine sandy loam or loamy fine sand.

Alvin soils are near Lamont and Wheeling soils and have similar natural drainage. They have more clay in the B horizon than Lamont soils, and they have more sand in the A and B horizons than Wheeling soils.

Alvin fine sandy loam, 0 to 2 percent slopes (131A).—This soil is in irregularly shaped areas mostly 10 acres or less in size. The profile of this soil is similar to that described as representative for the series, but the subsoil generally is sandy clay loam and the combined thickness of the surface and subsurface layers ranges from 10 to 16 inches.

Included with this soil in mapping were a few sandy areas and, in places, small areas that are somewhat poorly drained.

This Alvin soil is well suited to most uses. Management group I-1; woodland suitability group 2o1; recreation group 1.

Alvin fine sandy loam, 2 to 4 percent slopes (131B).—Areas of this soil are on the sides and convex tops of stream terraces. They are irregular or long and narrow in shape and generally less than 15 acres in size. Slopes are 50 to 200 feet long. This soil has the profile described as representative for the series.

Included with this soil in mapping were a few areas of eroded soils that have a surface layer less than 7 inches thick. Also included were small areas of somewhat poorly drained soils.

Runoff is slow on this soil, and the hazard of erosion is slight.

This Alvin soil is well suited to most uses. Management group IIe-1; woodland suitability group 2o1; recreation group 1.

Alvin fine sandy loam, 4 to 7 percent slopes (131C).—Areas of this soil are mostly on the long narrow sides of

stream terraces, but one area near Rosiclare is on an upland ridgetop. Areas are long and narrow and are less than 15 acres in size. Slopes are 50 to 150 feet long. The profile of this soil is similar to that described as representative for the series, but the fine sandy loam surface layer ranges from 3 to 10 inches in thickness.

Runoff is slow to medium on this soil and the hazard of erosion is slight to moderate.

This Alvin soil is well suited to most uses. Management group IIIe-1; woodland suitability group 2o1; recreation group 1.

Alvin fine sandy loam, 7 to 12 percent slopes, eroded (131D2).—Areas of this soil are mostly on the sides of stream terraces, but one area near Rosiclare, where the soil is severely eroded, is on an upland ridgetop. Areas are narrow and 10 acres or less in size. Slopes are 50 to 150 feet long. The profile of this soil is similar to that described as representative for the series, but the fine sandy loam surface layer is less than 7 inches thick, and in places subsoil material has been mixed with the surface layer by plowing.

Included with this soil in mapping were areas of severely eroded soils where the surface layer ranges from fine sandy loam to sandy clay loam. These areas make up about 20 percent of the acreage of this mapping unit. Also included were a few areas of soils that are only slightly eroded and that have a surface layer more than 7 inches thick.

Runoff is medium, and the hazard of erosion is moderate.

This Alvin soil is suited to most uses. Management group IIIe-1; woodland suitability group 2o1; recreation group 3.

Alvin fine sandy loam, 12 to 18 percent slopes, eroded (131E2).—This soil is in irregularly shaped areas mostly less than 15 acres in size. Slopes are 100 to 200 feet long in these areas. This soil is also on narrow terrace breaks where slopes are 50 to 100 feet long. The profile of this soil is similar to that described as representative for the series, but the fine sandy loam surface layer generally is less than 7 inches thick.

Included with this soil in mapping were areas of severely eroded soils where the present surface layer includes fine sandy loam and sandy clay loam subsoil material. These areas make up about one-fourth of the acreage of this soil.

Runoff is rapid, and the hazard of further erosion is severe.

This Alvin soil is suited to pasture or trees. It has limited suitability for crops. Management group IVe-1; woodland suitability group 2r2; recreation group 4.

Alvin fine sandy loam, 18 to 30 percent slopes (131F).—Areas of this soil are mostly on upper parts of hillsides. Slopes are 200 to 400 feet long. A few small areas are on narrow terrace breaks and have slopes 50 to 100 feet long. The profile of this soil is similar to that described as representative for the series, but the subsurface layer and subsoil are thinner.

Included with this soil in mapping were a few places where slope is 30 to 50 percent.

Runoff is rapid, and the hazard of erosion is severe.

This Alvin soil is mostly wooded. It is better suited to trees or, if management is good, to pasture than to other

uses. Management group VIe-1; woodland suitability group 2r2; recreation group 5.

Armiesburg Series

The Armiesburg series consists of deep, nearly level to gently undulating, well-drained soils on bottom lands along the Ohio River. These soils formed in water-deposited sediment.

In a representative profile the surface layer is about 15 inches of silty clay loam. The upper 6 inches is very dark grayish brown, and the lower 9 inches is dark brown. The subsoil is about 52 inches thick. The upper 27 inches is brown, firm silty clay loam, and the lower 25 inches is dark yellowish-brown, firm silty clay loam that has some fine sand. The underlying material, to a depth of 130 inches, is dark yellowish-brown silt loam that has some very fine sand.

Armiesburg soils are moderate in content of organic matter. They have high available water capacity and moderate permeability.

Natural productivity in these soils is high. Annual flooding in spring is a limitation to use of these soils.

Representative profile of Armiesburg silty clay loam, in a cultivated field in Massac County, 360 feet north of an east-west gravel road and 310 feet east of the center of a north-south gravel road in the NE $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 28, T. 16 S., R. 6 E.:

- Ap—0 to 6 inches, very dark grayish-brown (10YR 3/2) light silty clay loam; weak, fine, granular structure; friable; neutral; abrupt, smooth boundary.
- A1—6 to 15 inches, dark-brown (10YR 3/3) silty clay loam; weak, coarse, subangular blocky structure; firm; many worm channels; mildly alkaline; gradual, smooth boundary.
- B1—15 to 30 inches, brown (10YR 4/3) silty clay loam; weak, very coarse to medium, subangular blocky structure; firm; continuous dark grayish-brown (10YR 4/2) clay films on ped surfaces; few channels lined with very dark brown (10YR 2/2) and very dark grayish-brown (10YR 3/2) clay films; mildly alkaline; diffuse, smooth boundary.
- B21—30 to 42 inches, brown (7.5YR 4/4) silty clay loam and few sand grains; weak, coarse to fine, subangular blocky structure; firm; fine pores; discontinuous dark grayish-brown (10YR 4/2) clay films; few, fine, black (N 2/0) iron concretions; few, fine, shiny particles, possibly mica; mildly alkaline; diffuse, smooth boundary.
- B22—42 to 67 inches, dark yellowish-brown (10YR 4/4) silty clay loam that contains some fine sand; weak, medium and fine, subangular blocky structure; firm; fine pores in peds; dark grayish-brown (10YR 4/2) worm casts and clay films on worm channels; fine shiny grains, possibly mica; few black (N 2/0) iron concretions; mildly alkaline; gradual, wavy boundary.
- C—67 to 130 inches, dark yellowish-brown (10YR 4/4) silt loam that contains some very fine sand; massive; friable; dark grayish-brown (10YR 4/2) worm casts and root channel clay films; few, fine, black (N 2/0) iron concretions; more shiny particles than horizons above, possibly mica; mildly alkaline.

Reaction ranges from neutral to mildly alkaline throughout the profile.

The Ap and A1 horizons combined range from 10 to 20 inches in thickness. These horizons tend to be thicker upriver in Hardin County than they are downriver in Massac County. The silty clay loam material is generally many feet thick but silt loam, loam, or fine sandy loam strata are below a depth of about 4 feet in places.

Armiesburg soils are near Huntington, Emma, Hurst, and

Petrolia soils. They contain more clay in the solum than Huntington soils and have a thicker A horizon and are less acid than Emma soils. They are better drained than Hurst and Petrolia soils and are less acid in the solum than Hurst soils.

Armiesburg silty clay loam (597).—This soil is mostly nearly level and has slopes of less than 2 percent, but in some areas it is gently undulating and has slopes of as much as 4 percent. Areas where this soil is undulating are on the bottoms and sides of drainageways. Slope of the soil on the sides of drainageways is generally about 4 percent. The areas in drainageways are lower in elevation and subject to more frequent flooding than most areas of Armiesburg soil.

Included with this soil in mapping were areas near Emma soils where the surface layer is lighter brown and the subsoil is medium acid below a depth of 20 inches. Also included were areas that have silt loam or very fine sandy loam overwash, and a few areas that have fine sandy loam at a depth of 20 to 50 inches.

The hazards of rill formation and sheet erosion are moderate on the sides of drainageways. This Armiesburg soil is well suited to annual cultivated crops. It is subject to flooding in winter or spring (fig. 11) and is seldom used for winter crops or pasture. Management group I-2; woodland suitability group 1o4; recreation group 9.

Baxter Series

The Baxter series consists of moderately steep to very steep, well-drained soils. These soils formed in thin loess mixed with chert, and the underlying cherty clayey material weathered from cherty limestone. They are near Hicks Dome and in the limestone sinkhole area of Hardin County.

In a representative profile the surface layer is about 1 inch of very dark grayish-brown and dark grayish-brown cherty silt loam. The subsurface layer is about 9 inches of yellowish-brown cherty silt loam. Below this the subsoil extends to a depth of about 60 inches. The upper 5 inches is strong-brown, friable cherty silty clay loam. The next 9 inches is yellowish-red, friable very cherty silty clay. The next 23 inches is yellowish-red, firm to very firm cherty clay. The lower 13 inches is mainly yellowish-red, firm clay that contains chert fragments.

Baxter soils are low in content of organic matter. They have moderate permeability and moderate available water capacity.

These soils are used for pasture and trees. They are not suited to cultivated crops.

Representative profile of Baxter cherty silt loam, 18 to 30 percent slopes, in a wooded area of Hardin County, at entrance of old westbound lane, 425 feet north along ridgetop on right and 100 feet upslope from drainageway beyond site near center of the SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 5, T. 12 S., R. 8 E.:

- O1—1 inch to 0, very dark brown (10YR 2/2) organic material, partly decomposed leaves, silt, fine chert, and densely matted roots.
- A1—0 to 1 inch, very dark grayish-brown (10YR 3/2) and dark grayish-brown (10YR 4/2) cherty silt loam; moderate, medium, granular structure; friable; very strongly acid; abrupt, smooth boundary.
- A2—1 to 10 inches, yellowish-brown (10YR 5/4) cherty silt loam; weak, medium, granular structure; friable; extremely acid; abrupt, smooth boundary.



Figure 11.—Deposits of silt as a result of spring flooding of Armiesburg silty clay loam.

- B1—10 to 15 inches, strong-brown (7.5YR 5/8) cherty silty clay loam; weak, very fine, subangular blocky structure; yellowish-brown (10YR 5/4) ped surfaces; friable; extremely acid; abrupt, smooth boundary.
- B21t—15 to 24 inches, yellowish-red (5YR 5/6) very cherty silty clay; moderate, fine and very fine, subangular blocky structure; friable; patchy, thin, yellowish-brown (10YR 5/4) clay films; very strongly acid; clear, smooth boundary.
- B22t—24 to 36 inches, yellowish-red (5YR 5/8) cherty clay; moderate, fine, subangular blocky structure parting to moderate, very fine, subangular and angular blocky; firm, sticky when wet; few reddish-yellow (7.5YR 6/6) clay films; very strongly acid; clear, smooth boundary.
- B23t—36 to 47 inches, yellowish-red (5YR 5/8) clay that contains chert fragments $\frac{1}{2}$ to $\frac{3}{4}$ inch in diameter; moderate to strong, fine and very fine, angular blocky structure; very firm; very strongly acid; clear, smooth boundary.
- B3—47 to 60 inches, mixed yellowish-red (5YR 5/8), brownish-yellow (10YR 6/8), and brown (7.5YR 4/4) clay; moderate, medium, angular blocky structure; firm; thin, continuous, dark-brown (7.5YR 4/4) and reddish-brown (5YR 4/4) clay films; common chert fragments $\frac{1}{2}$ to 1 inch in diameter; very strongly acid.

The depth to limestone bedrock ranges from 4 to 10 feet or more. The solum is typically less than 35 percent chert, but chert in individual horizons ranges from 15 to 40 percent. Individual chert fragments range in size from $\frac{1}{4}$ inch to 4 inches in diameter.

The combined thickness of the A1 and A2 horizons ranges from 5 to 20 inches. The cherty clay, silty clay, or silty clay loam B2 horizon ranges from red to strong brown and is 12 to 50 inches thick.

Baxter soils are near Clarksville and Bedford soils and have a profile similar to Clarksville, Bedford, Wellston, and Beasley soils. They have more clay in the B horizon and are redder than Clarksville soils. Baxter soils contain chert fragments, but the fragments in Wellston and Beasley soils are

sandstone or shale. Baxter soils lack the characteristic fragipan of Bedford soils.

Baxter cherty silt loam, 12 to 18 percent slopes (599E).—This soil is in areas that are 5 to 20 acres in size. Slopes range from 150 to 300 feet in length. The profile of this soil is similar to that described as representative for the series, but in some places the silt loam surface and subsurface layers are thinner because of erosion.

Included with this soil in mapping were a few places where this soil has been cleared of trees and is severely eroded. In these areas the surface layer consists mainly of cherty silty clay loam subsoil material.

Runoff is rapid, and the hazard of erosion is severe.

This Baxter soil is suited to pasture where stoniness does not interfere with management, but most areas are better suited to trees or to wildlife habitat than to other uses. Management group VIe-3; woodland suitability group 3r2; recreation group 4.

Baxter cherty silt loam, 18 to 30 percent slopes (599F).—This soil is in areas that are 10 to 80 acres in size. Slopes range from 100 to 400 feet in length. The surface is normally cherty or very cherty. This soil has the profile described as representative for the series.

Included with this soil in mapping were a few places where this soil has been cleared of trees and is severely eroded. In these areas the surface layer consists mainly of cherty silty clay loam subsoil material.

Runoff is very rapid, and the hazard of erosion is very severe.

This Baxter soil is mostly wooded. It is better suited to trees or to wildlife habitat than to other uses. Management group VIIe-1; woodland suitability group 3r2; recreation group 5.

Baxter cherty silt loam, 30 to 50 percent slopes (599G).—This soil is in areas that are 20 to 60 acres in size. Slopes range from 200 to 400 feet in length. The surface is generally very cherty.

Runoff is very rapid, and the hazard of erosion is very severe.

All areas of this Baxter soil are wooded. The soil is suited mainly to trees and to wildlife habitat. Management group VIIe-1; woodland suitability group 3r3; recreation group 5.

Beasley Series

The Beasley series consists of moderately steep to very steep, moderately well drained soils on uplands. These soils formed in loess and underlying clayey material weathered from shale. They are mainly in the northern part of Pope County.

In a representative profile the surface layer is about 1 inch of brown silt loam, and the subsurface layer is about 6 inches of yellowish-brown silt loam. The subsoil is about 15 inches thick. The upper 7 inches is strong-brown, very firm silty clay that has light yellowish-brown mottles, and the lower 8 inches is yellowish-brown clay that has light olive-brown and strong-brown mottles. The underlying material, to a depth of about 36 inches, is light brownish-gray clay. Mottles in this horizon are yellowish brown and light olive brown. Olive, olive-gray, and greenish-gray, soft, calcareous shale is at a depth of 36 inches.

Beasley soils are low in content of organic matter. They have moderately slow permeability in the subsoil and moderate available water capacity. Runoff is rapid to very rapid.

Nearly all areas of these soils are wooded.

Representative profile of Beasley silt loam, 18 to 30 percent slopes, in a wooded area of Pope County 460 feet along gravel road northeast from centerline of Illinois Route 146 and 125 feet southwest from centerline of gravel road in the SE $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 18, T. 13 S., R. 7 E.:

- A1—0 to 1 inch, brown (10YR 4/3) silt loam; pale brown (10YR 6/3) dry; moderate, fine, granular structure; friable; many roots; neutral; abrupt, smooth boundary.
- A2—1 to 7 inches, yellowish-brown (10YR 5/4) silt loam; very weak, fine, platy structure parting to weak, medium, granular; friable; many roots; medium acid; clear, smooth boundary.
- B21t—7 to 14 inches, strong-brown (7.5YR 5/6) silty clay; common, fine, distinct, light yellowish-brown (10YR 6/4) mottles; weak, medium, angular blocky structure parting to moderate, very fine, angular blocky; very firm; common roots; yellowish-red (5YR 5/6) ped faces; small fragments of sandstone; few, very fine, black (N 2/0) iron-manganese concretions; medium acid; gradual, wavy boundary.
- IIB22t—14 to 22 inches, yellowish-brown (10YR 5/6) clay; common, fine, faint, yellowish-brown (10YR 5/4), light olive-brown (2.5Y 5/4), and strong-brown (7.5YR 5/6) mottles; weak, fine and very fine, angular blocky structure; very firm; common, very fine, black (N 2/0) iron-manganese concretions; neutral; clear, wavy boundary.
- IIC1—22 to 36 inches, light brownish-gray (2.5YR 6/2) clay; common, very fine and fine, distinct, yellowish-brown (10YR 5/6) and light olive-brown (2.5Y 5/6) mottles; massive; very firm; light-gray (5Y 6/1) and light olive-gray (5Y 6/2) slickensides; 15 to 30 percent small fragments of olive (5Y 5/6) and olive-

gray (5Y 5/2) shale; shale fragments strongly effervescent; mildly alkaline; gradual, wavy boundary.

IIC2—36 to 60 inches, olive (5Y 5/3), olive-gray (5Y 5/2), and greenish-gray (5G 6/1), soft, calcareous shale.

The depth to calcareous shale ranges from 36 to 60 inches. The loess mantle averages about 10 inches in thickness, but it ranges from 0 to 24 inches.

The content of coarse fragments in the A and B horizons ranges from 1 to 20 percent. The A1 and A2 horizons combined range from 2 to 12 inches in thickness.

A silty clay loam B1 horizon formed in the loess in places. The B2 horizon is silty clay or clay. It ranges from yellowish brown through strong brown to yellowish red in color. The lower part of the B horizon is mottled with light gray or light brownish gray in places. The IIB22t horizon ranges from neutral to mildly alkaline in reaction.

Beasley soils have a profile similar to Wellston, Muskingum, and Berks soils. They are neutral or calcareous in the lower part of the B horizon, and the other soils are strongly acid or very strongly acid. They have shale in the underlying material, but in Wellston, Muskingum, and Berks soils sandstone is the main component of the underlying material.

Beasley silt loam, 12 to 18 percent slopes (691E).—Areas of this soil are on ridgetops and hillsides. They are 10 to more than 100 acres in size. Slopes range from 100 to 400 feet in length. The profile of this soil is similar to that described as representative for the series, but the loess is generally thicker and the upper part of the subsoil that formed in the loess is silty clay loam. Some sandstone and limestone fragments are in the upper part of the profile and probably are the result of colluvial action from outcrops on the slope above.

Included with this soil in mapping were areas of eroded soils where the combined thickness of the surface and subsurface layers is less than 7 inches. These areas make up about one-third of the acreage of this soil. About 30 percent of the areas that were included have no loess cover. The soils in these areas have a calcareous, silty clay loam surface layer. Also included in mapping were areas of soils that contain no calcareous material and that are medium acid to slightly acid throughout. In large areas of this soil, small areas or bands of Muskingum, Wellston, and Zanesville soils were included.

Runoff is rapid, and the hazard of erosion is severe where the trees are removed.

This Beasley soil is mostly wooded. This soil is suited to trees. It is suited to pasture in cleared areas. Management group VIe-3; woodland suitability group 2r2; recreation group 4.

Beasley silt loam, 18 to 30 percent slopes (691F).—Areas of this soil are on hillsides. They generally are less than 50 acres in size. Slopes range from 100 to 500 feet in length. This soil has the profile described as representative for the series. Sandstone and limestone fragments are in the soil in many areas and probably are the result of colluvial action from outcrops on the slopes above.

Included with this soil in mapping were areas that have no loess cover and that have a silty clay loam surface layer that ranges from medium acid to mildly alkaline in reaction. These areas make up about one-half of the mapped acreage. Also included were areas where no calcareous material is in the soil and the soil material is medium acid to slightly acid throughout. These areas make up about one-fourth of the mapped acreage. Included in areas where slopes are longer were areas of Zanesville, Wellston, and Muskingum soils.

Runoff is rapid, and the hazard of erosion is very severe where trees are removed.

Nearly all areas of this Beasley soil are wooded. This soil is better suited to trees and to wildlife habitat than to other uses. Management group VIIe-1; woodland suitability group 2r2; recreation group 5.

Beasley silt loam, 30 to 50 percent slopes (691G).—Areas of this soil are on hillsides. They are less than 50 acres in size. Slopes range from 100 to 400 feet in length. The profile of this soil is similar to that described as representative for the series, except that the combined thickness of the surface layer and subsoil is less.

Included with this soil in mapping, and making up about half of the acreage, were areas where no loess cover is present and the surface layer is silty clay loam that ranges from medium acid to mildly alkaline in reaction. Also included in mapping were areas where no calcareous material is in the soil, and the soil is medium acid to slightly acid throughout. These areas make up about 40 percent of the mapped acreage. Thin bands of strongly acid Wellston and Muskingum soils were included in areas where slopes are longer.

Nearly all areas of this Beasley soil are wooded. This soil is better suited to trees and to wildlife habitat than to other uses. Management group VIIe-1; woodland suitability group 3r3; recreation group 5.

Beaucoup Series

The Beaucoup series consists of deep, dark-colored, nearly level, poorly drained soils that formed in clayey sediment more than 50 inches thick. These soils are on bottom lands, mainly near the New Columbia and Bear Creek Ditches in Massac County.

In a representative profile the surface layer is about 10 inches of very dark gray silty clay loam. The subsoil is firm silty clay loam about 38 inches thick. The upper 12 inches is very dark gray and has strong-brown mottles. The next 14 inches is gray and has yellowish-brown and olive-yellow mottles. The lower 12 inches is dark gray and has strong-brown and yellowish-brown mottles. The underlying material, to a depth of about 60 inches, is yellowish-brown, mottled silty clay loam. It is gray, mottled silt loam from a depth of 60 to 90 inches.

Beaucoup soils are high in content of organic matter. They have moderate permeability and very high available water capacity.

These soils are subject to flooding, and the water table is at or near the surface in winter and spring. Crops respond moderately well to fertilizer applied according to soil tests.

Representative profile of Beaucoup silty clay loam in a cultivated field in Massac County, 100 feet north and 100 feet east of the southwest corner of the SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 33, T. 14 S., R. 4 E.:

Ap—0 to 10 inches, very dark gray (10YR 3/1) silty clay loam; light brownish gray (10YR 6/2) dry; moderate, fine, granular structure; friable; many roots; neutral; abrupt, smooth boundary.

B1—10 to 22 inches, very dark gray (10YR 3/1) silty clay loam; common, very fine to medium, strong-brown (7.5YR 5/6) mottles; weak, medium, prismatic structure parting to weak, fine, subangular blocky; firm; many roots; few, thin, dark-gray (10YR 4/1) clay films; neutral; clear, smooth boundary.

B21g—22 to 36 inches, gray (10YR 5/1) silty clay loam; common, fine, prominent, olive-yellow (2.5Y 6/6) and common, fine, distinct, yellowish-brown (10YR 5/6)

mottles; weak, medium, prismatic structure parting to weak, fine and medium, subangular blocky; firm; thin gray (10YR 5/1) clay films in root channels; common, very fine, strong-brown (7.5YR 5/6) iron-manganese concretions; neutral; gradual, smooth boundary.

B22g—36 to 48 inches, dark-gray (10YR 4/1) silty clay loam; few, fine, distinct, strong-brown (7.5YR 5/8) and yellowish-brown (10YR 5/6) mottles; weak, medium, prismatic structure parting to weak, fine and medium, subangular blocky; firm; thin gray (10YR 5/1) clay films in root channels; neutral; gradual, smooth boundary.

C1—48 to 60 inches, yellowish-brown (10YR 5/6 and 5/8) silty clay loam; many, fine, distinct, light brownish-gray (10YR 6/2) and few, medium, distinct, grayish-brown (10YR 5/2) mottles; massive; gray (10YR 5/1) clay films in root channels; mildly alkaline; gradual, smooth boundary.

C2—60 to 70 inches, gray (10YR 5/1) silt loam; many, fine, distinct, yellowish-brown (10YR 5/6 and 5/8) mottles; massive; friable; few, very fine, black (N 2/0) iron-manganese concretions; mildly alkaline; gradual, smooth boundary.

C3—70 to 90 inches, mottled yellowish brown (10YR 5/6 and 5/8) and gray (10YR 6/1) silt loam; massive; friable; mildly alkaline.

The A horizon is 10 to 20 inches thick and ranges from very dark grayish brown to black.

The B2 horizon is light gray to dark gray and light olive gray to olive gray. Mottles range from few to many and from strong brown to olive. The B horizon ranges from slightly acid to mildly alkaline in reaction.

In places the C horizon is stratified with materials ranging from silt loam to silty clay.

Beaucoup soils are near Darwin, Cape, Karnak, and Petrolia soils. They are not so fine textured as Darwin and Karnak soils, and they have a darker colored, thicker A horizon than Cape, Karnak, and Petrolia soils.

Beaucoup silty clay loam (70).—This soil is nearly level. Most of the acreage is in a few large areas that are 70 to 100 acres in size. The rest is in widely scattered, rounded areas that are 5 to 15 acres in size. The texture of this soil ranges from light to heavy silty clay loam, especially in the layers below a depth of 20 inches.

Wetness and spring flooding are limitations in most areas.

This Beaucoup soil is well suited to most commonly grown crops, especially in areas that are protected from flooding. Management group IIw-3; woodland suitability group 2w5; recreation group 12.

Bedford Series

The Bedford series consists of strongly sloping to steep, moderately well drained soils that are moderately deep to a dense layer, or fragipan. These soils formed in loess and the underlying cherty material over limestone. They are on uplands mainly in the Hicks Dome area and in sinkhole areas of Hardin County.

In a representative profile the surface layer is about 1 inch of dark grayish-brown silt loam. The subsurface layer is about 5 inches of dark yellowish-brown silt loam. The subsoil below this extends to a depth of about 73 inches. The upper 13 inches is mainly strong-brown silty clay loam. The next 3 inches is yellowish-brown and light-gray silt loam. The next 26 inches is a fragipan that consists of firm to extremely firm, yellowish-brown heavy silt loam mottled with light brownish gray. This layer contains chert in the lower 18 inches. Below the fragipan is about 13 inches of yellowish-brown and pale-brown very

cherty loam that is underlain by about 11 inches of yellowish-red silty clay and mottled cherty clay loam.

Bedford soils are low in content of organic matter. They have very slow permeability in the fragipan and moderate available water capacity.

Pasture crops on these soils respond well to lime and fertilizer applied according to soil tests.

Representative profile of Bedford silt loam, 18 to 30 percent slopes, eroded, in Hardin County in road right-of-way at top of hill, 130 feet south of middle culvert and 30 feet east of centerline of road in the NW $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 24, T. 11 S., R. 7 E.:

- A1—0 to 1 inch, dark grayish-brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak, medium, granular structure; friable; very strongly acid; abrupt, smooth boundary.
- A2—1 to 6 inches, dark yellowish-brown (10YR 4/4 silt loam; light yellowish brown (10YR 6/4) dry; weak, medium, platy structure parting to weak, medium, granular; friable; very strongly acid; abrupt, smooth boundary.
- B1—6 to 11 inches, strong-brown (7.5YR 5/6) light silty clay loam; moderate, fine and medium, subangular blocky structure; friable to firm; extremely acid; clear, smooth boundary.
- B21t—11 to 16 inches, strong-brown (7.5YR 5/6) silty clay loam; common, fine, faint, light yellowish-brown (10YR 6/4) mottles; moderate, medium, subangular blocky structure; firm, extremely acid; clear, smooth boundary.
- B22t—16 to 19 inches, dark yellowish-brown (10YR 4/4) silty clay loam; common, fine, distinct, pale-brown (10YR 6/3) mottles; moderate, medium, subangular and angular blocky structure; brown (7.5YR 4/4) ped faces; firm; extremely acid; abrupt, smooth boundary.
- A'2—19 to 22 inches, yellowish-brown (10YR 5/4) (50 percent) and light-gray (10YR 7/2) (50 percent) silt loam; weak, medium, platy structure; friable; extremely acid; abrupt, smooth boundary.
- B'x1—22 to 30 inches, yellowish-brown (10YR 5/4) heavy silt loam; few, medium, distinct, light brownish-gray (10YR 6/2) mottles and fine streaks; weak, fine, prismatic structure parting to moderate, medium, angular blocky; firm and brittle, friable when crushed; patchy, thin, dark-brown (7.5YR 4/4) clay films; extremely acid; gradual, smooth boundary.
- IIB'x2—30 to 37 inches, yellowish-brown (10YR 5/4) cherty heavy silt loam; common, medium, distinct, light brownish-gray (10YR 6/2) mottles and nearly vertical streaks $\frac{1}{4}$ inch wide; weak, coarse, angular blocky structure; extremely firm and very brittle; gray streaks harder than matrix; very strongly acid; gradual, smooth boundary.
- IIB'x3—37 to 48 inches, yellowish-brown (10YR 5/4) cherty heavy silt loam (skeletal); common, large, distinct, light brownish-gray (10YR 6/2) mottles; moderate, fine, angular blocky structure; firm and brittle; very strongly acid; gradual, smooth boundary.
- IIB16—48 to 61 inches, yellowish-brown and pale-brown (10YR 5/4 and 6/3) very cherty loam; massive; friable; very strongly acid; gradual, smooth boundary.
- IIB2tb—61 to 73 inches, yellowish-red (5YR 4/6) silty clay and mottled strong-brown and reddish-yellow (7.5YR 5/6, 6/6, 7/6, and 8/6) cherty clay loam (about 20 percent chert); weak, fine, angular blocky structure; firm; discontinuous reddish-brown (5YR 4/4) clay films; strongly acid.

Depth to limestone bedrock ranges from 7 to 10 feet. Depth to material that contains chert commonly ranges from 30 to 40 inches, but in places chert fragments are common above this depth.

The A horizon is about 7 to 14 inches thick in areas of uneroded or slightly eroded soils. An A'2 horizon, 3 to 4 inches thick, is common.

The B horizon is 12 to 20 inches thick and is dark yellowish brown, yellowish brown, brown, or strong brown. The Bx horizon is dark yellowish brown, yellowish brown, or strong brown. Depth to the IIB2tb horizon ranges from 55 to 72 inches.

Bedford soils are near and have a profile similar to Clarksville, Baxter, Zanesville, Grantsburg, and Hosmer soils. They are deeper to cherty material and have a fragipan that is not characteristic of the Clarksville and Baxter soils. Bedford soils are similar to Zanesville, Grantsburg, and Hosmer soils in that they have a fragipan. Unlike these soils, however, Bedford soils contain cherty material in the B horizon.

Bedford silt loam, 7 to 12 percent slopes (598D).—

Areas of this soil are mostly on narrow, meandering ridgetops above areas of Clarksville cherty silt loam, 20 to 30 percent slopes, and Clarksville cherty silt loam, 30 to 50 percent slopes. The profile of this soil is similar to that described as representative for the series, except that in most places the soil is uneroded or only slightly eroded, and the combined thickness of the silt loam surface and subsurface layers ranges from 7 to about 14 inches.

Included with this soil in mapping were areas of Grantsburg and Clarksville soils on narrow ridgetops.

Runoff is medium, and the hazard of erosion is severe in cultivated areas.

Most areas of this Bedford soil are wooded because the areas are not wide enough to be cultivated satisfactorily. This soil is suited to moderate use for crops or pasture, trees, or wildlife habitat. Management group IIIe-2; woodland suitability group 3d2; recreation group 3.

Bedford soils, 7 to 12 percent slopes, severely eroded (598D3).—

Areas of these soils are mainly along the sides and at the heads of drainageways. Areas are 5 to 15 acres in size. The profile of this soil is similar to that described as representative for the series, except that most or all of the surface and subsurface layers have been removed by erosion. The present surface layer consists mainly of silty clay loam or heavy silt loam subsoil material.

Runoff is rapid, and the hazard of further erosion is severe.

These Bedford soils are suited to pasture or trees, but they have limited suitability for crops. Management group IVe-2; woodland suitability group 3d2; recreation group 3.

Bedford silt loam, 12 to 18 percent slopes, eroded (598E2).—

This soil is mainly along drainageways. Areas are 5 to 20 acres in size. Slopes range from 100 to 200 feet in length. The profile of this soil is similar to that described as representative for the series, but in about 30 percent of the areas, this soil is uneroded or only slightly eroded. The combined thickness of the silt loam surface and subsurface layers ranges from 7 to about 14 inches.

Runoff is rapid, and the hazard of erosion is severe.

Much of the acreage of this Bedford soil is wooded or has been reforested. It is not suited to crops because of the hazard of erosion. It is suited to trees or pasture. Management group IVe-2; woodland suitability group 3d2; recreation group 4.

Bedford soils, 12 to 18 percent slopes, severely eroded (598E3).—

Areas of these soils are mainly along drainageways. They are 5 to 30 acres in size. Slopes range from 100 to 200 feet in length. The profile of this soil is similar to that described as representative for the series, except that most or all the surface and subsurface layers have

been removed by erosion. The present surface layer consists mainly of silty clay loam or heavy silt loam subsoil material.

Runoff is rapid, and the hazard of further erosion is very severe.

Most of these Bedford soils were once cultivated. Because of the very severe hazard of erosion, they are not suited to crops. They are suited to pasture or trees. Management group VIe-2; woodland suitability group 3d2; recreation group 4.

Bedford silt loam, 18 to 30 percent slopes, eroded (598F2).—Areas of this soil are on hillsides. They range from 10 to 40 acres in size. Slopes are 100 to 400 feet long. This soil has the profile described as representative for the series.

Included with these soils in mapping, and making up about one-third the acreage were areas of only slightly eroded soils. In these areas the combined thickness of the silt loam surface and subsurface layers is more than 7 inches. Also included were areas of severely eroded soils that have a surface layer of mainly silty clay loam subsoil material. These areas make up about one-seventh of the acreage of this soil. In places the larger areas and on longer slopes, small areas of Grantsburg silt loam, 18 to 30 percent slopes, eroded, and Clarksville cherty silt loam, 20 to 30 percent slopes, were included.

Runoff is rapid, and the hazard of erosion is very severe where the soil is unprotected.

Most areas of this Bedford soil are wooded. This soil is suited to limited use for pasture, but it is better suited to trees or wildlife habitat than to other uses. Management group VIe-2; woodland suitability group 3d2; recreation group 5.

Belknap Series

The Belknap series consists of deep, nearly level, somewhat poorly drained soils on bottom lands. These soils formed in sediment more than 50 inches thick along streams throughout the three counties.

In a representative profile the surface layer is about 9 inches of dark-brown and brown silt loam. The subsoil is friable silt loam about 35 inches thick. The upper 25 inches is mainly light brownish gray, and mottles are brown, pale brown, and light gray. The lower 10 inches is grayish brown, and mottles are light brownish gray, light gray, and dark red. The underlying material is brown silt loam that has light-gray, strong-brown, light brownish-gray, and yellowish-brown mottles.

Belknap soils are low in content of organic matter. They have moderately slow permeability and very high available water capacity.

Crops on these soils respond well to lime and fertilizer applied according to soil tests. These soils are subject to flooding in spring, and the water table is generally within a depth of 3 feet.

Representative profile of Belknap silt loam, in a cultivated field in Massac County, 95 feet west and 200 feet south of the ash tree at section corner in the NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 13, T. 14 S., R. 4 E.:

Ap—0 to 6 inches, dark-brown (10YR 4/3) silt loam; pale brown (10YR 6/3) dry and dark brown (10YR 4/3) crushed; weak, medium, granular structure; friable; medium acid; abrupt, smooth boundary.

A12—6 to 9 inches, brown (10YR 5/3) silt loam; common, fine, distinct, light brownish-gray (10YR 6/2) mottles; moderate, medium, platy structure; friable; common, fine, black (N 2/0) iron-manganese concretions; medium acid; abrupt, smooth boundary.

B1—9 to 12 inches, brown (10YR 5/3) silt loam; common, fine, distinct, light brownish-gray (10YR 6/2) mottles; weak, medium, subangular blocky structure to structureless (massive); friable; common, fine, black (N 2/0) and dark-brown (7.5YR 3/2) iron-manganese concretions; very strongly acid; clear, wavy boundary.

B21—12 to 23 inches, light brownish-gray (10YR 6/2) silt loam; common, fine, faint, brown and pale-brown (10YR 5/3 and 6/3) mottles; weak, medium, subangular blocky structure; friable; slightly vesicular; many, fine, dark-brown (7.5YR 3/2) iron concretions; very strongly acid; clear, wavy boundary.

B22—23 to 34 inches, light brownish-gray (10YR 6/2) silt loam; common, fine, faint, light-gray (10YR 7/1) and brown (10YR 5/3) mottles; weak, medium, subangular blocky structure; friable; slightly brittle; slightly vesicular; yellowish-red (5YR 4/6) and dark-brown (7.5YR 4/4) iron stains along channels; very strongly acid; gradual, smooth boundary.

B3—34 to 44 inches, grayish-brown (10YR 5/2) silt loam; common, fine, faint, light brownish-gray and light-gray (10YR 6/2 and 7/1) and few, medium to coarse, prominent, dark-red (2.5YR 3/6) mottles; weak, fine and medium, subangular blocky structure; friable; yellowish-red (5YR 4/6) and dark-brown (7.5YR 4/4) iron stains along root channels; very strongly acid; clear, smooth boundary.

C1—44 to 54 inches, brown (10YR 4/3) silt loam; common, fine, distinct, light-gray (10YR 7/1) and few, fine, distinct, strong-brown (7.5YR 5/6 and 5/8) mottles; massive; friable; very strongly acid; gradual, smooth boundary.

C2—54 to 65 inches, brown (10YR 5/3) silt loam; common, fine, distinct, light brownish-gray (10YR 6/2) and yellowish-brown (10YR 5/6) mottles; massive; friable; common, fine, dark-brown (7.5YR 3/2) iron-manganese concretions; very strongly acid.

The A horizon is 6 to 20 inches thick and ranges from dark grayish brown to dark brown or brown. Mottles in the A12 horizon range from light brownish gray to grayish brown.

The B horizon ranges from brown, mottled with grayish brown to light gray, to light gray, mottled with yellowish brown. It has weak structure or is massive, and it is strongly acid to very strongly acid.

Belknap soils are near Sharon and Bonnie soils, and they have natural drainage similar to that of Wakeland and Dupo soils. They are not so well drained as Sharon soils, but they are better drained than Bonnie soils. Belknap soils are more acid in the solum than Wakeland soils, and they contain less clay in the lower part of the B horizon than Dupo soils.

Belknap silt loam (382).—This soil is nearly level in most places, but some areas adjacent to hillsides or on narrow bottom lands in hilly areas are gently sloping.

Included with this soil in mapping were small areas, where drainageways enter bottom lands, in which slopes are as much as 10 percent. Also included were small areas of soils having surface layers or other layers that are sandy, gravelly, or stony.

Areas of this Belknap soil that are not limited for use because of flooding are well suited to most commonly grown crops. Management group IIw-2; woodland suitability group 2o4; recreation group 10.

Berks Series

The Berks series consists of moderately steep to very steep, well-drained soils that are moderately deep to bedrock. These soils formed in mixed loamy material and sandstone flags or stones. They are on uplands throughout

Hardin and Pope Counties and the northern part of Massac County.

In a representative profile the surface layer is about one inch of very dark grayish-brown stony loam. The subsurface layer is 2 inches of dark-brown very stony loam. The subsoil, about 17 inches thick, is dark yellowish-brown very stony loam. The underlying material is about 8 inches of strong-brown very stony loam. Sandstone bedrock is at a depth of about 28 inches.

Berks soils are low in content of organic matter. They have moderate to moderately rapid permeability and low available water capacity. Runoff is rapid to very rapid.

Berks soils are in an intricate pattern with Muskingum soils and Wellston soils. They are mapped only as undifferentiated units with Muskingum soils and as complexes with Wellston soils.

Representative profile of Berks stony loam in an area of Muskingum and Berks soils, 30 to 60 percent slopes, in a wooded area of Massac County, 200 feet west of a drainage way entering from the south in the SE $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 7, T. 14 S., R. 4 E.:

O1— $\frac{1}{2}$ inch to 0, very dark grayish-brown (10YR 3/2) decayed leaves, roots, and stems; friable; many roots; abrupt, smooth boundary.

A1—0 to 1 inches, very dark grayish-brown (10YR 3/2) stony loam; brown (10YR 5/3) dry; moderate, fine, granular structure; friable; many roots; about 35 percent sandstone fragments; medium acid; abrupt, smooth boundary.

A2—1 to 3 inches, dark-brown (10YR 4/3) very stony loam; pale brown (10YR 6/3) dry; weak, fine, granular structure; friable; many roots; about 50 percent sandstone fragments; medium acid; abrupt, smooth boundary.

B—3 to 20 inches, dark yellowish-brown (10YR 4/4) very stony loam; weak, fine, subangular blocky structure; friable; many roots; about 66 percent sandstone fragments; very strongly acid; gradual, smooth boundary.

C—20 to 28 inches, strong-brown (7.5YR 5/6) very stony sandy loam; massive; friable; common roots; about 75 percent sandstone fragments; very strongly acid.

R—28 inches, sandstone bedrock.

Depth to bedrock ranges from 20 to 40 inches. The bedrock is generally sandstone but in places is siltstone or shale. The total volume of coarse fragments in the soil (pebbles, cobblestones, flagstones, and stones) ranges from 35 to 75 percent. In places an individual horizon, however, is less than 35 percent coarse fragments.

The A1 and A2 horizons range from stony or flaggy silt loam to very stony loam. The B horizon ranges from very stony loam to very stony clay loam and is yellowish brown to yellowish red.

Berks soils are near and are similar to Muskingum and Wellston soils. They are also similar to Clarksville and Baxter soils. Berks soils contain more coarse fragments than Muskingum soils and have less clay in the B horizon than Wellston soils. They contain sandstone or shale fragments, but Clarksville and Baxter soils contain chert.

Bonnie Series

The Bonnie series consists of deep, nearly level, poorly drained soils on bottom lands. These soils formed in silty sediment more than 50 inches thick. They are along streams in all three counties.

In a representative profile the surface layer is about 5 inches of very dark grayish-brown silt loam. The subsoil is friable silt loam about 24 inches thick. It is gray in the upper 9 inches and light gray and light brownish gray in the lower 15 inches. It contains yellowish-brown, dark

yellowish-brown, and black iron and manganese concretions. The underlying material, to a depth of about 61 inches, is gray and grayish-brown silt loam.

Bonnie soils are low in content of organic matter. They have slow permeability and high available water capacity.

Crops on these soils respond moderately well to lime and fertilizer applied according to soil tests. The soils are subject to flooding in winter and spring, and the seasonal water table is at or near the surface.

Representative profile of Bonnie silt loam, in a cultivated field in Massac County, 45 feet south of east-west fence line and 50 feet west of northeast corner of the SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 20, T. 14 S., R. 4 E.:

A1—0 to 5 inches, very dark grayish-brown (10YR 3/2) and dark grayish-brown (10YR 4/2) silt loam; grayish brown (10YR 5/2) and light brownish gray (10YR 6/2) dry, dark brown (10YR 4/3) crushed; weak, fine and very fine, granular structure; friable; common, very fine, black (N 2/0) and yellowish-brown (10YR 5/6 and 5/8) iron-manganese concretions; strongly acid; abrupt, smooth boundary.

B1g—5 to 14 inches, gray (10YR 6/1) silt loam; common, fine, faint, light-gray (10YR 7/2) mottles; massive; friable; few, very fine, short pores; many, very fine, yellowish-brown (10YR 5/6 and 5/8) and black (N 2/0) and few, fine, dark yellowish-brown (10YR 3/4) iron-manganese concretions; yellowish-brown (10YR 5/6 and 5/8) root channels, some filled with pale-brown (10YR 6/3) silt loam; very strongly acid; clear, smooth boundary.

B2g—14 to 29 inches, light-gray (10YR 7/1) and light brownish-gray (2.5YR 6/2) silt loam; massive; friable; many, very fine to medium, black (N 2/0), dark yellowish-brown (10YR 3/4), and yellowish-brown (10YR 5/8) iron-manganese concretions; very strongly acid; clear, smooth boundary.

C—29 to 61 inches, gray (5Y 5/1) and grayish-brown (2.5Y 5/2) silt loam; massive; friable; many, very fine to medium, black (N 2/0), dark yellowish-brown (10YR 3/4), and yellowish-brown (10YR 5/8) iron-manganese concretions; very strongly acid.

The A horizon is 1 to 8 inches thick and ranges from dark grayish brown to brown. In uncultivated areas it is generally mottled with light gray to pale brown.

The B horizon ranges from light gray to light brownish gray and commonly has yellowish-brown mottles. It has granular or subangular blocky structure or is massive. Reaction is strongly acid or very strongly acid.

Bonnie soils are near Belknap and Sharon soils and have natural drainage similar to that of Cape and Petrolia soils. They are more poorly drained than Belknap or Sharon soils. Bonnie soils contain less clay in the solum than Cape soils, and they have less clay and are more acid in the solum than Petrolia soils.

Bonnie silt loam (108).—This soil commonly has slopes of less than 1 percent, but in places slopes are as much as 2 percent. In places areas are in depressions. The profile of this soil is similar to the one described as representative for the series, but in about 25 percent of the acreage a compact layer, 10 to 20 inches thick, is at a depth of 15 to 20 inches. This layer is firm and brittle.

Included with this soil in mapping were areas in the ancient Ohio River channel between Mermet and Brownfield that have silty clay loam layers beginning at a depth of 24 to 36 inches. Also included were a few areas that have silty clay loam overwash. In the eastern part of Hardin County areas of soils that are slightly acid or neutral were included.

This Bonnie soil is suited to most uses, but seasonal wetness is a concern of management. Flooding (fig. 12)



Figure 12.—Flooded area of Bonnie silt loam. This soil is subject to flooding in winter and in spring.

occurs in winter and spring. Management group IIIw-2; woodland suitability group 2w5; recreation group 11.

Bonnie silt loam, wet (W108).—This soil is nearly level and much of the acreage is in depressions. The water table is at the surface most of the time in winter and spring. In places areas are under water part of the time. A few areas are flooded most of the year.

The soil remains wet and waterlogged too late in the season to allow seedbed preparation. It is used mainly for trees, but some areas are suitable for pasture. Areas of this soil that can be adequately drained and protected from flooding can be used for crops. Management group Vw-1; woodland suitability group 3w6; recreation group 14.

Brandon Series

The Brandon series consists of gently sloping to steep, well-drained soils. These soils formed in loess and underlying Coastal Plain gravel. They are in Massac County and the southern part of Pope County.

In a representative profile the surface layer is about 2 inches of very dark grayish-brown silt loam. The subsurface layer is about 5 inches of light yellowish-brown silt loam. Below this, the subsoil extends to a depth of about 75 inches. The upper 17 inches is dark-brown silty clay loam. The next 26 inches is dark-brown very gravelly clay loam, and the lower 25 inches is red and dark-red very gravelly clay loam to clay.

Brandon soils are low in content of organic matter. They have moderate permeability and moderate available water capacity. Runoff is medium to rapid.

Brandon soils are in an intricate pattern with Saffell soils in Massac and Pope Counties. They are mapped only as undifferentiated units of Brandon and Saffell soils.

Representative profile of Brandon silt loam, along ridgetop in a wooded area of Brandon and Saffell soils, 12 to 30 percent slopes, in Massac County, 95 feet south of gravel road to south bank of bulldozer cut in the SW $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 35, T. 15 S., R. 6 E.:

- A1—0 to 2 inches, very dark grayish-brown (10YR 3/2) silt loam; light brownish gray (10YR 6/2) dry; weak, fine, granular structure; friable; strongly acid; abrupt, smooth boundary.
- A2—2 to 7 inches, light yellowish-brown (10YR 6/4) silt loam; few, fine, faint, dark yellowish-brown (10YR 4/4) and yellowish-brown (10YR 5/4) mottles; weak, fine, subangular blocky structure; friable; very strongly acid; clear, smooth boundary.
- B21t—7 to 14 inches, dark-brown (7.5YR 4/4) silty clay loam; moderate, fine and medium, subangular blocky structure; friable; patchy, thin, yellowish-red (5YR 4/6) clay films; very strongly acid; clear, smooth boundary.
- B22t—14 to 24 inches, dark-brown (7.5YR 4/4) light silty clay loam; about 5 percent in the lower part; weak, fine, prismatic structure parting to moderate, medium to very fine, subangular blocky; firm; thin yellowish-red (5YR 4/6) clay films; strongly acid; gradual, smooth boundary.
- IIB23t—24 to 32 inches, dark-brown (7.5YR 4/4) very gravelly light clay loam (about 70 percent gravel); moderate, fine, subangular blocky structure; friable; few, thin, yellowish-red (5YR 4/6) clay films; light-gray (10YR 7/2) silica coats; strongly acid; gradual, smooth boundary.
- IIB31t—32 to 50 inches, dark-brown (7.5YR 4/4) very gravelly clay loam (about 80 percent gravel); weak, fine, angular blocky structure; friable; few, thin, yellow-

ish-red (5YR 4/6) clay films; strongly acid; gradual, smooth boundary.

IIB32t—50 to 75 inches, red and dark-red (10YR 4/6 and 3/8) very gravelly clay loam to clay (about 80 percent gravel); moderate, fine, angular blocky structure; firm; very strongly acid.

The solum ranges from about 50 inches to more than 72 inches in thickness, but generally is more than 60 inches thick. The loess mantle ranges from 20 to 40 inches in thickness. In places, mainly in the lower part, the mantle is 1 to 15 percent scattered pebbles.

In cultivated areas the A1 and A2 horizons are mixed. The resultant Ap horizon ranges from brown to dark yellowish brown.

The lower part of the B horizon is 35 to more than 80 percent gravel, and the content of sand is variable. This horizon ranges from red to yellowish brown. The B horizon in Coastal Plain material is 4 to 6 feet thick and ranges from very gravelly clay loam to very gravelly clay. The total thickness of the gravel bed ranges from 2 to more than 20 feet, and it overlies Coastal Plain sand, silt, and clay.

In this survey area these soils generally have a thicker solum than is recognized in the range for the Brandon series, but this difference does not greatly alter the usefulness and behavior of these soils.

Brandon soils are near Saffell and Lax soils and have a profile similar to those of Wellston and Beasley soils. They have less gravel in the A horizon and the upper part of the B horizon than Saffell soils. They lack the fragipan of Lax soils, and they contain gravel in the lower part of the B horizon instead of the sandstone or shale fragments that are in Wellston and Beasley soils.

Brandon and Saffell soils, 1 to 4 percent slopes (956B).—These soils occur together without regularity of pattern on low terraces. Areas are narrow and irregular in shape and 5 to 15 acres in size. In places areas are all Brandon soils, in other places all are Saffell soils, and in other places both soils are mapped together. The profile of each soil is similar to that described as representative for its respective series, except that the lower part of the subsoil lacks red gravelly clay or gravelly clay loam layers. In about 40 percent of the areas the soils are very gravelly or very sandy and lack any silty clay loam or gravelly clay loam layers in the upper part of the subsoil. In places the soil has a very firm or hard iron-cemented gravelly layer 6 to 20 inches thick at a depth of 30 to 40 inches. In a few areas the soils contain no gravel to a depth of more than 20 inches. About one-fifth of the acreage has slopes of less than 2 percent.

The soils in this unit are suited to most uses. In places areas are used as a limited source of gravel. Management group IIIs-1; woodland suitability group 3s2; recreation group 1.

Brandon and Saffell soils, 4 to 12 percent slopes, eroded (956C2).—These soils occur together without regularity of pattern on terraces and rolling uplands. Areas are narrow, 50 to 200 feet wide, and are mostly 2 to 10 acres in size. The profile of each of these soils is similar to that described as representative for its respective series, except that the lower part of the subsoil is mainly gravel and lacks red gravelly clay or gravelly clay loam layers. In about one-third of the areas the soils are very gravelly and lack a silty clay loam or gravelly clay loam layer in the upper part of the subsoil. In about one-third of the areas slope is more than 7 percent. These steeper soils are severely eroded in about half of the areas in which they occur, and in these areas the surface layer ranges from silty clay loam to very gravelly loam.

The soils in this unit are suited to most uses, but the very gravelly areas have limited use because of low avail-

able water capacity and fertility. Some areas are used as a source of gravel. Management group IIIs-1; woodland suitability group 3s2; recreation group 1.

Brandon and Saffell soils, 12 to 30 percent slopes (956F).—These soils each have the profile described as representative for their respective series. About one-tenth of the areas have slopes of 12 to 18 percent and the rest are steeper. Brandon soils commonly are on the upper 25 to 35 percent of slopes, and Saffell soils are on the lower 65 to 75 percent. The pattern of occurrence is not regular, and some areas are all Brandon or all Saffell soil. Saffell soils are dominant, and in places are on ridgetops as well as hillsides.

Included with these soils in mapping are small areas of severely eroded soils. In these areas the silt loam surface and subsurface layers have been removed, and the present surface layer is generally gravelly silty clay loam. Also included in mapping were areas where slopes are more than 30 percent. Small areas of Hosmer silt loam, 12 to 18 percent slopes, and Lax silt loam, 12 to 18 percent slopes, were included within large areas of these soils.

Runoff is rapid, and the hazard of erosion is severe if the timber is removed.

Most areas of the soils in this unit are wooded. These soils have limited potential for pasture, but they are suited to trees and wildlife habitat. Management group VIIIs-1; woodland suitability group 3r2; recreation group 5.

Burnside Series

The Burnside series consists of deep, nearly level, moderately well drained and well drained soils on bottom lands. These soils formed in silty sediment that contains gravel and sandstone fragments at a depth of more than 15 inches. They are mainly on the narrow bottom lands associated with hilly upland areas.

In a representative profile the surface layer is 12 inches of dark-brown silt loam. The subsoil is dark-brown, friable silt loam about 15 inches thick. The underlying material is about 43 inches thick. The upper 9 inches is dark-brown gravelly silt loam, and the lower 34 inches is mixed brown and pale-brown gravelly loam that contains sandstone and shale cobbles. Shale bedrock is at a depth of about 70 inches.

Burnside soils are low in content of organic matter. They have moderate permeability and moderate available water capacity.

Crops on these soils respond moderately well to lime and fertilizer applied according to soil tests. These soils are subject to flash floods during heavy storms.

Representative profile of Burnside silt loam, in a pasture in Pope County, 130 feet east of concrete ford, 50 feet north of centerline of road in the SE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 13, T. 11 S., R. 6 E.:

Ap—0 to 7 inches, dark-brown (10YR 4/3) silt loam; pale brown (10YR 6/3) dry; weak, medium, granular structure; friable; slightly acid; abrupt, smooth boundary.

A1—7 to 12 inches, dark-brown (10YR 4/3) silt loam; moderate, medium, granular structure; friable; medium acid; clear, smooth boundary.

B1—12 to 17 inches, dark-brown (10YR 4/3) silt loam; common, fine to medium, faint, pale-brown (10YR 6/3) mottles; weak, medium and coarse, subangular

blocky structure; friable; very strongly acid; clear, smooth boundary.

B2—17 to 27 inches, dark-brown (10YR 4/3) silt loam that contains scattered gravel; few, fine and medium, faint, pale-brown (10YR 6/3) mottles; weak, fine and medium, blocky structure; friable; very strongly acid; gradual, wavy boundary.

IIC1—27 to 36 inches, dark-brown (10YR 4/3) gravelly silt loam; massive; friable; very strongly acid; gradual, wavy boundary.

IIC2—36 to 70 inches, mixed brown and pale-brown (10YR 4/3, 5/3, 6/3) gravelly loam; structureless; loose; sandstone cobbles and shale flagstones; strongly acid.

IIIC3—70 inches, shale bedrock.

Sandstone or shale bedrock is at a depth of 40 to 80 inches or more. Grayish mottles are below a depth of 20 inches in places.

The silty upper horizons range from 15 to 40 inches in thickness. The B horizon is strongly acid or very strongly acid. The IIC layer is 35 to 80 percent gravel, cobbles, or sandstone flagstones.

Burnside soils are near and are similar in drainage to Sharon and Haymond soils. They contain more coarse fragments than Sharon and Haymond soils and are more acid in the solum than Haymond soils.

Burnside silt loam (427).—In areas of this soil that are on wide bottom lands slope is generally less than 2 percent. Where areas are on narrow bottom lands that are less than about 200 feet wide, slope is as much as 4 percent in places. In places on narrow bottom lands, the silt loam upper layers are less than 15 inches thick. In some of the areas on narrow bottom lands the surface is commonly stony. Also, small areas that have a stony surface are within larger areas.

Included with this soil in mapping were areas of somewhat poorly drained soils that contain stony layers. Also included were several areas in the eastern and southern parts of Hardin County where the soils are medium acid or slightly acid in reaction in at least part of the profile. In Massac County most areas of this soil contain Coastal Plain gravel instead of stones and fragments of sandstone and shale.

This Burnside soil is suited to many uses, but occasional flooding, stoniness, or narrowness of sites affects use and management. Management group IIs-1; woodland suitability group 1o4; recreation group 9.

Cape Series

The Cape series consists of deep, nearly level, poorly drained soils that formed in sediment of silty clay loam over silty clay. These soils are mainly on bottom lands of the Cache River, Bay Creek, and Ohio River.

In a representative profile the surface layer is about 5 inches of dark grayish-brown silty clay loam. The subsoil is about 36 inches thick. It has strong-brown mottles. The upper 18 inches is light brownish-gray, firm silty clay loam, and the lower 18 inches is light brownish-gray silty clay. The underlying material, to a depth of about 60 inches, is gray silty clay that has mottles of strong brown.

Cape soils are low in content of organic matter. They have slow to very slow permeability and high available water capacity.

Crops in these soils respond moderately well to lime and fertilizer applied according to soil tests. These soils

are subject to ponding and flooding in winter and spring. They have a seasonal water table at or near the surface.

Representative profile of Cape silty clay loam, in a wooded area of Massac County, 620 feet south of quarter line and 150 feet west of center line of blacktop road in the SW $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 22, T. 14 S., R. 4 E.:

A1—0 to 5 inches, dark grayish-brown (10YR 4/2) silty clay loam; light brownish gray (10YR 6/2) dry; few, fine, distinct, strong-brown (7.5YR 5/6) mottles; moderate, very fine, angular blocky structure parting to weak, very fine and fine, granular; firm; few, very fine, dark-brown (7.5YR 3/2) iron-manganese concretions; slightly acid; clear, smooth boundary.

B1g—5 to 14 inches, light brownish-gray (10YR 6/2) silty clay loam; few, fine, distinct, strong-brown (7.5YR 5/6) mottles; moderate, medium, prismatic structure parting to moderate, medium and fine, subangular blocky; firm; thin, continuous, grayish-brown (2.5Y 5/2) clay films in root channels; common, very fine, dark-brown (7.5YR 3/2 and 4/4) iron-manganese concretions; strongly acid; clear, smooth boundary.

B21g—14 to 23 inches, light brownish-gray (10YR 6/2) silty clay loam; common, fine, distinct, strong-brown (7.5YR 5/6 and 5/8) mottles; weak, medium, prismatic structure parting to weak, medium and fine, subangular blocky; firm; common, medium, black (N 2/0) and yellowish-red (5YR 4/8) iron-manganese concretions; some root channels filled with grayish-brown (2.5Y 5/2) silty clay loam; strongly acid; clear, smooth boundary.

B22g—23 to 41 inches, light brownish-gray (10YR 6/2) silty clay; common, fine, distinct, strong-brown (7.5YR 5/6 and 5/8) mottles; weak, medium, prismatic structure parting to weak, medium and fine, subangular blocky; firm; thin, continuous, gray (5Y 6/1) clay films on ped faces and thin, dark-gray (10YR 4/1) clay films in pores and root channels; common, fine, black (N 2/0) iron-manganese concretions; strongly acid; gradual, smooth boundary.

Cg—41 to 60 inches, gray (10YR 6/1) silty clay; few, medium, distinct, strong-brown (7.5YR 5/6 and 5/8) mottles; massive; firm; few, thin, olive-gray (5Y 5/2) clay films; common, fine, black (N 2/0) and very dark grayish-brown (10YR 3/2) iron-manganese concretions; medium acid.

The silty clay loam material in the upper part of the profile ranges from 20 to 40 inches in thickness.

The B horizon ranges from light gray to olive brown. Mottles range from few to many and from strong brown to olive yellow. The B horizon is strongly acid or very strongly acid.

The C horizon is silty clay or clay to a depth of at least 50 inches.

Cape soils are near and are similar to Karnak, Darwin, Petrolia, and Hurst soils. They are not so fine textured in the upper part of the profile as Karnak and Darwin soils. They are finer textured in the lower part of the profile and more acid than Petrolia soils. They are more poorly drained than Hurst soils.

Cape silty clay loam (422).—This soil is nearly level and, in places, is in depressions. On the Cache River-Bay Creek bottom lands, this soil is in large, oblong areas 20 to more than 200 acres in size. On the Ohio River bottom lands, it is in long, narrow, low areas that are 100 to 400 feet wide and are near sloughs or drainageways. This soil has the profile described as representative for the series.

Included with this soil in mapping were areas where the silty clay loam layers are more than 40 inches thick and other areas where they are less than 20 inches thick. Also included were areas where the subsoil is medium acid or slightly acid. In places, in areas north and east of Mermet in Massac County, the surface layer is mixed with reddish-brown, burned muck.

This Cape soil is suited to corn and soybeans, but wetness and flooding in spring are concerns in most areas. The lower part of the subsoil and the underlying material are sticky and plastic and are difficult to work with construction machinery. Management group IIIw-3; woodland suitability group 2w5; recreation group 12.

Cape silty clay loam, wet (W422).—This soil is nearly level. Most areas are in long, narrow sloughs, but a few areas are broad and oblong. The water table is at or near the surface much of the year, and some areas are under water most of the time in winter and spring. A few places are flooded most of the year.

Included with this soil in mapping were areas where the soil is strongly acid silty clay loam sediment more than 40 inches thick. In these areas, silty clay sediment commonly is at a depth of 50 to 60 inches.

This Cape soil has limited potential for most crops. It remains wet and waterlogged too late in the season to allow seedbed preparation. Most areas are wooded, but in places areas are used for pasture. Management group Vw-1; woodland suitability group 3w6; recreation group 14.

Cape silt loam, overwash (422+).—This soil is nearly level. It is in a few, broad areas of 10 to more than 100 acres in size and in long, narrow areas along drainage-ways or sloughs. Slopes generally are less than 1 percent. The surface layer is silt loam and is 8 to 20 inches thick. The profile of this soil is similar to that described as representative for the series, except for the overwash silt loam surface layer.

This soil is suited to corn and soybeans, but wetness and flooding in spring are limitations in most areas. The subsoil and underlying material are sticky and plastic, and they are difficult to work when using construction machinery. Management group IIIw-3; woodland suitability group 2w5; recreation group 12.

Clarksville Series

The Clarksville series consists of steep to very steep, well-drained soils on uplands. These soils formed in silty and clayey material mixed with chert. They are in an area near Hicks Dome in Hardin County.

In a representative profile the surface layer is about 1 inch of very dark brown cherty silt loam. The subsurface layer is about 15 inches thick. It is dark grayish-brown and brown cherty silt loam in the upper 4 inches and yellowish-brown very cherty silt loam in the lower 11 inches. Below this the subsoil extends to a depth of 60 inches or more. The upper 10 inches is yellowish-brown very cherty silt loam and yellowish-red silty clay loam to silty clay. The next 10 inches is yellowish-red silty clay and reddish-brown silt loam in the interstices of fractured cherty rock. The lower 24 inches is yellowish-red and strong-brown silty clay between layers of soft and hard chert.

Clarksville soils are low in content of organic matter. They have moderate to moderately rapid permeability and low to very low available water capacity. Runoff is rapid to very rapid.

Nearly all areas of these soils are wooded.

Representative profile of Clarksville cherty silt loam, 30 to 60 percent slopes, in a wooded area of Hardin County, 120 feet northwest of road to bottom land, 75

feet upslope, and 85 feet north of fence at the edge of the woods in the NW $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 25, T. 11 S., R. 7 E.:

- O2— $\frac{1}{2}$ inch to 0, very dark brown (10YR 2/2) organic and silty material; densely matted roots; strongly acid; abrupt, smooth boundary.
- A1—0 to 1 inch, very dark brown (10YR 2/2) cherty silt loam; weak, medium, crumb structure; friable; very strongly acid; abrupt, smooth boundary.
- A21—1 to 5 inches, mixed dark grayish-brown (10YR 4/2) (60 percent) and brown (10YR 5/3) (40 percent) cherty silt loam; massive; friable; few fine pores; very strongly acid; clear, smooth boundary.
- A22—5 to 10 inches, yellowish-brown (10YR 5/4) very cherty silt loam; weak, very fine, subangular blocky structure apparent in interstices between chert; friable; root or worm channels coated with grayish brown (10YR 5/2); common fine pores; very strongly acid; clear, smooth boundary.
- A23—10 to 16 inches, yellowish-brown (10YR 5/4) very cherty silt loam; very pale brown (10YR 7/3) dry; weak, very fine to fine, subangular blocky structure in interstices between chert fragments; friable; few dark-brown (7.5YR 4/4) coatings of silty clay on chert fragments; interior of chert fragments yellowish red (5YR 4/8); very strongly acid; clear, wavy boundary.
- IIA&B—16 to 26 inches, yellowish-brown (10YR 5/4) very cherty silt loam and yellowish-red (5YR 4/8) silty clay loam to silty clay; light gray to white (10YR 7/2 to 8/2) matrix when dry; moderate, fine to very fine, angular blocky structure in few places where rock interstices are large enough to allow structure; very firm; silty part friable when crushed; strong-brown (7.5YR 5/6) and yellowish-red (5YR 5/6) clay films when dry; very strongly acid; gradual boundary.
- IIB21t—26 to 36 inches, yellowish-red (5YR 5/6) silty clay and reddish-brown (5YR 5/4) silt loam; very pale brown (10YR 7/3 to 7/4) dry in matrix; common fine, distinct, pinkish-gray (7.5YR 6/2) mottles in interstices of fractured cherty rock; medium to strong, fine to very fine, angular blocky structure in interstices large enough to allow structure; very firm; continuous reddish-brown (2.5YR 4/4) to dark red (2.5YR 3/6) clay films; yellowish-red (5YR 4/6 and 5/6) clay films when dry; strongly acid; gradual boundary.
- IIB22t—36 to 60 inches, alternate soft and hard chert layers; yellowish-red (5YR 5/6) and strong-brown (7.5YR 5/6) silty clay in fracture planes; yellowish red (5YR 5/6) and reddish yellow (7.5YR 7/6) dry in matrix; structure not determinable; very firm; reddish-brown (2.5YR 4/4) clay films on chert fragments; reddish-brown (2.5YR 4/4) clay films when dry; strongly acid.

The solum ranges from 60 to 100 inches or more in thickness.

The A horizon is 20 percent or more chert, and the B horizon is 35 to 90 percent chert. Chert fragments range from $\frac{1}{4}$ to 8 inches in diameter.

Clarksville soils formed in similar materials to those in Baxter and Bedford soils. They contain less clay and more chert in the lower part of the B horizon than Baxter soils. Clarksville soils are more cherty in the solum than Bedford soils, and unlike Bedford soils they lack a fragipan.

Clarksville cherty silt loam, 20 to 30 percent slopes (471F).—This soil is in long, irregularly shaped areas 5 to 100 acres in size. Slopes are 200 to 400 feet in length. This soil is variable in chert content and in depth to bedrock.

Included with this soil in mapping were small areas of Grantsburg, Bedford, and Baxter soils within the larger areas of this soil. Also, included were areas where slopes are less than 20 percent and small areas of severely eroded soil.

Runoff is rapid, and the hazard of erosion is very severe where trees are removed.

Nearly all areas of this Clarksville soil are wooded. This soil is better suited to trees and wildlife habitat than to other uses. Management group VII_s-1; woodland suitability group 3r2; recreation group 6.

Clarksville cherty silt loam, 30 to 60 percent slopes (471G).—This soil is in long, irregularly shaped areas 20 to 60 acres in size. Slopes are 200 to 400 feet long. Chert content and depth to bedrock are variable. This soil has the profile described as representative for the series.

Included with this soil in mapping were small areas of Bedford and Baxter soils within the larger areas of this soil.

Runoff is very rapid, and the hazard of erosion is very severe where trees are removed.

All areas of this Clarksville soil are wooded. This soil is better suited to trees and to wildlife habitat than to other uses. Management group VII_s-1; woodland suitability group 3r3; recreation group 6.

Darwin Series

The Darwin series consists of deep, nearly level, poorly drained and very poorly drained soils on bottom lands. These soils formed in silty clay sediment more than 50 inches thick. They are mostly along the Cache River and on the New Columbia-Bear Creek bottom lands in Massac County.

In a representative profile the surface layer is about 8 inches of very dark gray silty clay. The subsoil is 54 inches of firm silty clay. The upper 11 inches is very dark gray and has yellowish-brown and olive mottles, and the next 21 inches is dark gray and has olive mottles. Below this the subsoil also has olive mottles and is gray in the upper 9 inches and dark gray in the lower 13 inches. Mottles are olive gray. The underlying material, to a depth of 68 inches, is light olive-gray and pale-olive silt loam. From a depth of 68 to 72 inches, it is dark-gray light olive-gray, and pale-olive silty clay to clay.

Darwin soils are moderate in content of organic matter. They have very slow permeability and moderate to high available water capacity.

Crops on these soils vary in their response to applications of lime and fertilizer. These soils are subject to flooding in winter and spring, and the seasonal water table is at or near the surface.

Representative profile of Darwin silty clay, in a cultivated area of Massac County, 235 feet north of east-west fenceline and 550 feet west of ditchbank along north-south fenceline in the NE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 18, T. 14 S., R. 3 E.:

Ap—0 to 5 inches, very dark gray (10YR 3/1) silty clay; dark gray to gray (10YR 4/1 to 5/1) dry, very dark grayish brown (2.5YR 3/2) crushed; moderate, very fine, angular blocky structure; black (10YR 2/1) faces of peds; friable; common, very fine, black (N 2/0) iron-manganese concretions; mildly alkaline; abrupt, smooth boundary.

A1—5 to 8 inches, very dark gray (2.5Y 3/1) and very dark grayish-brown (2.5Y 3/2) silty clay; common, fine, prominent, yellowish-brown (10YR 5/6 and 5/8) mottles; very weak, very fine and fine, angular blocky structure; firm (plowsole); common, very fine, black (N 2/0) iron and manganese concretions; slightly acid; abrupt, smooth boundary.

B21g—8 to 19 inches, very dark gray (5Y 3/1) silty clay; few, fine, prominent, yellowish-brown (10YR 5/6) mottles in matrix and few, fine, prominent, olive (5Y 5/4) mottles on ped surfaces; strong, medium, prismatic structure parting to strong, very fine and fine, angular blocky; firm; discontinuous, thin, dark-gray (5Y 4/1) clay films; common, very fine and fine, yellowish-brown (10YR 5/6) iron-manganese concretions; neutral; clear, smooth boundary.

B22g—19 to 28 inches, dark-gray (5Y 4/1) silty clay; few, fine, distinct, olive (5Y 5/4) mottles; strong, medium, prismatic structure parting to strong, very fine and fine, angular blocky; firm; discontinuous, medium, dark-gray (N 4/0) clay films; common, very fine, strong-brown (7.5YR 5/6) and black (N 2/0) iron-manganese concretions; neutral; clear, smooth boundary.

B23g—28 to 40 inches, dark-gray (5Y 4/1) silty clay; few, fine, distinct, olive (5Y 5/4) mottles; strong, fine, prismatic structure parting to moderate, very fine, angular blocky; firm, sticky when wet; discontinuous, medium, dark-gray (N 4/0) clay films; common, very fine, yellowish-brown (10YR 5/8) iron-manganese concretions; mildly alkaline; clear, smooth boundary.

B31g—40 to 49 inches, gray (5Y 5/1) silty clay; few, fine, faint, olive (5Y 5/4) mottles; weak, very fine, prismatic structure parting to weak, very fine, angular blocky; firm, sticky when wet; patchy, medium, dark-gray (5Y 4/1) clay films; common, very fine, yellowish-brown (10YR 5/6 and 5/8) iron-manganese concretions; mildly alkaline; clear, smooth boundary.

B32g—49 to 62 inches, dark-gray (5Y 4/1) silty clay; common, fine, faint, olive-gray (5Y 5/2) mottles; weak, very fine, angular blocky structure; firm, sticky; few, fine, yellowish-brown (10YR 5/8) iron-manganese concretions; many small shells; mildly alkaline; abrupt, smooth boundary.

C1—62 to 68 inches, light olive-gray (5Y 6/2) and pale-olive (5Y 6/3) silt loam; many, medium, prominent, yellowish-brown (10YR 5/8) and strong-brown (7.5YR 5/8) mottles; massive; friable; worm channels coated with gray (5Y 5/1); many small shells; moderately alkaline; abrupt, smooth boundary.

C2—68 to 72 inches, dark-gray (2.5Y 4/1), light olive-gray (5Y 6/2), and pale-olive (5Y 6/3) silty clay to clay; many, medium, prominent, yellowish-brown (10YR 5/8) mottles and gray (5Y 5/1) channels in the light olive-gray and pale-olive (5Y 6/2 and 6/3) parts of the matrix; massive; firm, sticky; many small shells; moderately alkaline.

The Ap and A1 horizons combined range from 8 to 20 inches in thickness. The A horizon ranges from very dark grayish-brown to black silty clay loam to silty clay.

The B horizon is silty clay or clay. The middle and lower parts of the B horizon are lighter gray than the A horizon. Mottles in the B horizon range from few to many and from brown to olive. The B horizon is generally slightly acid or neutral, but it ranges from medium acid to mildly alkaline. Coarser textured material is stratified below a depth of 50 inches in places.

Darwin soils formed in similar materials as, and have a profile similar to, Karnak, Cape, and Petrolia soils. They have a thicker, dark-colored A horizon than Karnak soils and have a darker, finer textured A horizon than Cape and Petrolia soils.

Darwin silty clay (71).—Most of this nearly level soil is in a few large, rounded areas 20 to more than 100 acres in size. This soil has the profile described as representative for the series.

Included with this soil in mapping were a few areas where the dark-colored surface layer is only 8 to 10 inches thick. Also included were two areas that were partly covered by light-colored silt loam overwash 10 to 20 inches thick. One of these areas is one-half mile east of Boaz

in Massac County, and the other is one mile north of Rosiclare in Hardin County.

Wetness and flooding in spring are limitations in most areas. Favorable tilth is difficult to maintain, and timeliness in the use of farm machinery is an important concern of management. The sticky, plastic silty clay is difficult to work when using earthmoving machinery.

This Darwin soil is suited to crops if the surface is drained and protected from flooding. Management group IIIw-3; woodland suitability group 3w6; recreation group 13.

Darwin silty clay loam (525).—This nearly level soil is mainly in a few rounded or oblong areas 10 to more than 100 acres in size. The profile is similar to that described as representative for the series, except that the upper 10 to 20 inches is silty clay loam.

Wetness and flooding in spring are limitations to use in most areas. Favorable tilth is easier to maintain in this soil than it is in Darwin silty clay, and timeliness in the use of farm machinery is less critical. The underlying sticky, plastic silty clay is difficult to work when using earthmoving machinery.

This Darwin soil is suited to crops if the surface is drained and protected from flooding. Management group IIIw-3; woodland suitability group 3w6; recreation group 13.

Dupo Series

The Dupo series consists of deep, nearly level, somewhat poorly drained soils. They formed in silty sediment more than 20 inches thick that is underlain by darker colored clayey sediment. These soils are mainly on bottom lands along the Cache River and the New Columbia-Bear Creek area in Massac County.

In a representative profile the surface layer is about 11 inches of mostly yellowish-brown silt loam. Below this is brown, dark grayish-brown, and very dark gray silt loam, about 16 inches thick, that has yellowish-brown mottles. The next layer is black light silty clay about 10 inches thick. The next 8 inches is very dark gray light silty clay, and below this, to a depth of about 61 inches, is gray heavy silty clay loam that has yellowish-brown mottles.

Dupo soils are low in content of organic matter. They have moderately slow to slow permeability and high available water capacity.

Crops on these soils respond well to lime and fertilizer applied according to soil tests. These soils are subject to flooding in winter and spring, and the seasonal water table is within a depth of 3 feet of the surface.

Representative profile of Dupo silt loam, in a cultivated area of Massac County, 365 feet north and 155 feet west of the southeast corner of the SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 5., T. 15 S., R. 4 E.:

Ap—0 to 5 inches, yellowish-brown (10YR 5/4) and dark yellowish-brown (10YR 4/4) silt loam; few, fine, faint, pale-brown (10YR 6/3) and yellowish-brown (10YR 5/6, 5/8) mottles; moderate, medium, granular structure; friable; dark yellowish-brown (10YR 4/4) worm casts; common, very fine, black (N 2/0) iron-manganese concretions; medium acid; clear, smooth boundary.

A12—5 to 11 inches, yellowish-brown (10YR 5/4) silt loam; few, fine, faint, pale-brown (10YR 6/3), yellowish-brown (10YR 5/6 and 5/8), and light-gray (10YR

7/2) mottles; weak, fine and medium, granular structure; friable; very dark grayish-brown (10YR 3/2) and brown (10YR 4/3) worm casts; slightly acid; clear, smooth boundary.

C1—11 to 17 inches, brown (10YR 4/3) silt loam; common, medium, distinct, brownish-yellow (10YR 6/6) mottles; massive; friable; common, fine, distinct, strong-brown (7.5YR 5/6 and 5/8) iron stains and mottles; dark grayish-brown (10YR 4/2) and brown (10YR 4/3) worm casts; common, very fine, black (N 2/0) iron-manganese concretions; slightly acid; abrupt smooth boundary.

C2—17 to 23 inches, dark grayish-brown (10YR 4/2) silt loam; common, fine, distinct, yellowish-brown (10YR 5/4, 5/6, 5/8) mottles; very weak, medium granular structure; friable; worm casts and worm channels filled with very dark gray (10YR 3/1) silt loam; common, fine, black (N 2/0) iron-manganese concretions; slightly acid; abrupt, smooth boundary.

A1b—23 to 27 inches, very dark gray (10YR 3/1) heavy silt loam; few, fine, distinct, yellowish-brown (10YR 5/6 and 5/8) mottles; weak, medium, prismatic structure parting to weak, very fine, prismatic; friable; common, very fine, black (N 2/0) and strong-brown (7.5YR 5/8) iron-manganese concretions; very few, thin, very dark gray (10YR 3/1) coats on ped surfaces and in root and worm channels; neutral; clear, smooth boundary.

IIA12b—27 to 37 inches, black (10YR 2/1) light silty clay; moderate, medium and coarse, prismatic structure parting to very weak, medium and fine, subangular blocky; few very dark gray (2.5Y 3/1) coats on ped surfaces; very dark brown (10YR 2/2) worm channels; common, very fine, black (N 2/0) and strong-brown (7.5YR 5/6 and 5/8) iron-manganese concretions and stains; mildly alkaline; clear, smooth boundary.

IIA13b—37 to 45 inches, very dark gray (10YR 3/1) light silty clay; few, fine, distinct, strong-brown (7.5YR 5/6) and brown (10YR 5/3) mottles; moderate, medium, prismatic structure parting to weak, fine, prismatic structure; friable; discontinuous, thin, very dark gray (5Y 3/1) coats on ped surfaces and in channels; brown (10YR 5/3) worm casts; common, very fine, black (N 2/0) and strong-brown (7.5YR 5/8) iron-manganese concretions; mildly alkaline; clear, smooth boundary.

IIB2bg—45 to 61 inches, gray (2.5Y 5/1) heavy silt clay loam; many, fine, prominent, yellowish-brown (10YR 5/6 and 5/8) mottles; weak, medium, prismatic structure parting to weak, fine, prismatic; friable; discontinuous, thin, dark-gray (5Y 4/1) coats on ped surfaces; continuous very dark gray (2.5Y 3/1) coats in root and worm channels; common, fine, strong-brown (7.5YR 5/8) iron-manganese concretions; mildly alkaline; clear, smooth boundary.

The lighter colored silt loam upper horizons range from dark grayish brown or yellowish brown to gray and are 20 to 40 inches thick.

The underlying darker colored, finer textured horizons range from black to very dark grayish-brown heavy silty clay loam to clay. Reaction is generally slightly acid to neutral but ranges from medium acid to mildly alkaline.

Dupo soils are near and have natural drainage similar to Belknap and Wakeland soils. They contain a dark-colored, buried B horizon that is lacking in Belknap and Wakeland soils. Also, Dupo soils are less acid in the B horizon than Belknap soils.

Dupo silt loam (180).—This soil is nearly level and has slopes of 2 percent or less. It is generally between areas of medium-textured soils, such as Belknap silt loam or Bonnie silt loam, and areas of fine-textured soils, such as Darwin silty clay or Karnak silty clay. Where this soil is near the finer textured soils, the silt loam upper layers are less than 20 inches thick in places.

Included with this soil in mapping were areas where the silt loam upper layers are grayer than those of this

soil and areas where the soil material is less mottled. Also included were a few areas where the silt loam upper layers are slightly acid or neutral.

This Dupo soil is suited to most commonly grown crops. Most areas are subject to flooding in spring. Management group IIw-2; woodland suitability group 2o4; recreation group 10.

Emma Series

The Emma series consists of deep, nearly level to strongly sloping, moderately well drained soils on bottom lands along the Ohio River. These soils formed in silty clay loam sediment that is more than 50 inches thick.

In a representative profile the surface layer is about 8 inches of dark-brown silty clay loam. The subsoil is firm and very firm silty clay loam about 54 inches thick. The upper 13 inches is mostly dark yellowish brown and has strong-brown mottles. The lower 41 inches is dark brown and has strong-brown, light brownish-gray, and light-gray mottles. The underlying material is dark-brown silty clay loam.

Emma soils are low in content of organic matter. They have moderately slow permeability and high available water capacity.

Crops on these soils generally have low response to lime and fertilizer applied according to soil tests. Some areas are subject to flooding during severe floods.

Representative profile of Emma silty clay loam, 0 to 2 percent slopes, in a cultivated area of Massac County, 100 feet north of fence on west side of road, 40 feet east of centerline of road in the SW $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. T. 15 S., R. 4 E.:

Ap—0 to 5 inches, yellowish-brown (10YR 5/4) and dark brown (10YR 5/3) dry; moderate, medium, granular structure; firm; mildly alkaline; abrupt, smooth boundary.

B1—8 to 12 inches, dark yellowish-brown (10YR 4/4) (60 percent) and dark-brown (10YR 4/3) (40 percent) silty clay loam; weak, medium and coarse, subangular blocky structure; firm; dark grayish-brown (10YR 4/2) worm casts; few, fine, black (N 2/0) iron-manganese concretions; strongly acid; clear, smooth boundary.

B21—12 to 21 inches, dark yellowish-brown (10YR 4/4) silty clay loam; few, fine, distinct, strong-brown (7.5YR 4/6 and 5/8) mottles; weak to moderate, fine and medium, subangular blocky structure; firm; continuous, thin, brown (10YR 5/3) clay films; few, fine, black (N 2/0) iron-manganese concretions; very strongly acid; clear, smooth boundary.

B22—21 to 27 inches, dark-brown (7.5YR 4/4) silty clay loam; few, fine, faint, strong-brown (7.5YR 5/6 and 5/8) mottles; weak, fine, prismatic structure parting to moderate, fine and medium, subangular blocky; firm; continuous, thin, brown (10YR 5/3) clay films; few, fine, black (N 2/0) iron-manganese concretions; very strongly acid; gradual, smooth boundary.

B23—27 to 43 inches, dark-brown (7.5YR 4/4) silty clay loam; few, fine, distinct, light brownish-gray (10YR 6/2) and light-gray (10YR 7/2) mottles; weak, medium, prismatic structure parting to moderate, fine and medium, subangular blocky; very firm; patchy, thin, light brownish-gray (10YR 6/2) clay films; few, fine, black (N 2/0) iron-manganese concretions; very strongly acid; clear, smooth boundary.

B24—43 to 56 inches, dark-brown (7.5YR 4/4) silty clay loam; moderate, fine, subangular blocky structure; firm; patchy, thin, light brownish-gray (10YR 6/2) clay films; few, fine, black (N 2/0) iron-manganese

concretions; very strongly acid; gradual, smooth boundary.

B3—56 to 62 inches, dark-brown (7.5YR 4/4) silty clay loam; weak, fine and very fine, subangular blocky structure; firm; patchy, thin, grayish-brown (10YR 5/2) to pale-brown (10YR 6/3) clay films and few, thin, dark yellowish-brown (10YR 4/4) clay films; very strongly acid; gradual, smooth boundary.

C1—62 to 88 inches, dark-brown (7.5YR 4/4) silty clay loam; massive; firm; very strongly acid; gradual, smooth boundary.

The A horizon ranges from dark grayish-brown to dark-brown heavy silt loam to heavy silty clay loam. It ranges from 4 to 9 inches in thickness.

The B horizon has weak or moderate structure. It ranges from dark brown to yellowish brown and from strongly acid to extremely acid. Few to many mottles are in the B23 horizon.

Emma soils are near Hurst and Armiesburg soils. They formed in materials similar to, and have natural drainage similar to, Sciotoville soils. They are not so poorly drained as Hurst soils. They are more poorly drained and more acid in the solum than Armiesburg soils. Emma soils lack the silt loam A horizon and the fragipan that are characteristic of Sciotoville soils.

Emma silty clay loam, 0 to 2 percent slopes (469A).—Areas of this soil are mainly on the tops of ridges between old stream channels. Areas are 100 to 300 feet wide and 300 to 2,500 feet long. This soil has the profile described as representative for the series.

Included with this soil in mapping were a few areas in the bottoms of old stream channels where the soil contains many pale-brown mottles in the subsoil, which indicates a wetter than normal condition. Also included, in places, were areas of well-drained soils on ridgetops. In these areas the soils contain no brownish-gray mottles in the subsoil, and the subsoil is strongly acid.

This Emma soil has no major limitations to use, but many areas are subject to flooding during severe floods.

This Emma soil is well suited to most commonly grown crops. Management group I-1; woodland suitability group 2o1; recreation group 2.

Emma silty clay loam, 2 to 7 percent slopes (469B).—This gently sloping soil is on ridgetops and on sides of old stream channels. Areas are 100 to 150 feet wide and 300 to 1,500 feet long. Slope is 2 to 4 percent in about half the areas, and 4 to 7 percent in the other half. The profile of this soil is similar to that described as representative for the series, except that some areas are eroded and about 15 percent have lost most or all of the original dark-brown surface layer.

Included with this soil in mapping were areas of nearly level soils on bottoms of old stream channels. In many of these areas the soil contains pale-brown or brownish-gray mottles in the subsoil that indicate somewhat poor drainage.

Runoff is medium, and the hazard of erosion is moderate. Areas along stream channels are subject to annual flooding.

This Emma soil is suited to crops, but winter crops or pasture are subject to damage from flooding in low areas. Management group IIe-1; woodland suitability group 2o1; recreation group 2.

Emma silty clay loam, 7 to 18 percent slopes, eroded (469D2).—Areas of this soil are on long, narrow sides of drainageways and sloughs. Slopes are generally less than 100 feet wide. Slope is 7 to 12 percent in about half the areas and more than 12 percent in the other half. The

profile of this soil is similar to that described as representative for the series, except that most or all the original dark-brown surface layer has been removed by erosion, and the present surface layer is dark yellowish brown.

Included with this soil in mapping were areas where slope is more than 18 percent.

Runoff is rapid, and the hazard of erosion is moderate. This soil is subject to flooding.

This Emma soil is suited to crops, but winter crops or pasture are subject to damage from flooding. Management group IIIe-1; woodland suitability group 2o1; recreation group 3.

Ginat Series

The Ginat series consists of deep, nearly level, poorly drained soils on terraces or "second bottoms" associated with the Ohio River and the Bay Creek-Cache River channel. These soils formed in silt loam and silty clay loam sediment.

In a representative profile the surface layer is about 6 inches of brown silt loam. The subsurface layer is about 13 inches of pale-brown and light-gray silt loam. The subsoil is silty clay loam about 46 inches thick. The upper 15 inches is light brownish gray, and it has yellowish-brown, brown, and gray mottles. The next 15 inches is a fragipan that is grayish brown and has dark yellowish-brown, light olive-brown, and light-gray mottles. The lower 16 inches is grayish brown and brown and has light-gray, dark yellowish-brown, and grayish-brown mottles. The underlying material, to a depth of about 71 inches, is dark yellowish-brown silt loam that has yellowish-brown and light brownish-gray mottles.

Ginat soils are low in content of organic matter. They have slow to very slow permeability and high available water capacity.

Crops on these soils respond moderately well to lime and fertilizer applied according to soil tests. The seasonal water table is at or near the surface.

Representative profile of Ginat silt loam, in a cultivated field in Pope County, 300 feet north and 120 feet east of the southwest corner of the NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 3, T. 14 S., R. 5 E.:

- Ap—0 to 6 inches, brown (10YR 5/3) silt loam; light gray (10YR 7/2) dry; moderate, medium and coarse, granular structure; friable; common, fine and very fine, black (N 2/0), strong-brown (7.5YR 5/8), and dark-brown (7.5YR 3/2) iron-manganese concretions; very strongly acid; clear, smooth boundary.
- A21—6 to 11 inches, pale-brown (10YR 6/3) silt loam; few, fine, faint, light-gray (10YR 7/1) mottles; massive (plowsole); firm to friable; many, fine and very fine, black (N 2/0), dark-brown (7.5YR 3/2), and brown (7.5YR 4/4) iron-manganese concretions; vesicular; very strongly acid; clear, smooth boundary.
- A22—11 to 19 inches, light-gray (10YR 7/2) silt loam; common, medium, faint, yellowish-brown (10YR 5/4) and few, fine, faint, pale-brown (10YR 6/3) mottles; massive; friable; many, fine and very fine, black (N 2/0), strong-brown (7.5YR 5/8), and dark-brown (7.5YR 3/2) iron-manganese concretions; vesicular; very strongly acid; clear, smooth boundary.
- B1g—19 to 24 inches, light brownish-gray (10YR 6/2) light silty clay loam; few, fine, faint, yellowish-brown (10YR 5/8) and brown (10YR 5/3) mottles; massive; friable to firm; many, fine, black (N 2/0) and strong-brown (7.5YR 5/8) iron-manganese con-

cretions; vesicular; very strongly acid; clear, smooth boundary.

- B21tg—24 to 34 inches, light brownish-gray (2.5Y 6/2) silty clay loam; common, fine, faint, light-gray (2.5Y 7/2) mottles; very weak, medium, prismatic structure parting to very weak, medium, subangular blocky; firm; few, fine, yellowish-red (5YR 5/6) and many, fine, black (N 2/0), brown (7.5YR 4/4), and strong-brown (7.5YR 5/8) iron-manganese concretions; very strongly acid; clear, smooth boundary.
- Bx1g—34 to 43 inches, grayish-brown (2.5Y 5/2) heavy silty clay loam; few, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; very weak, medium, prismatic structure parting to moderate, fine and medium, subangular blocky; very firm, brittle; few, thin, grayish-brown (2.5Y 5/2) clay films; patchy, thin, light brownish-bray (10YR 6/2) silica coats; common, fine, black (N 2/0) and strong-brown (7.5YR 5/6) iron-manganese concretions; very strongly acid; clear, smooth boundary.
- Bx2g—43 to 49 inches, grayish-brown (2.5Y 5/2) heavy silty clay loam; common, fine, distinct, light olive-brown (2.5Y 5/6) and dark yellowish-brown (10YR 4/4) and few, fine, faint, light-gray (10YR 7/2) mottles; moderate, fine, subangular blocky structure; very firm, brittle; few, thin, grayish-brown (2.5Y 5/2) clay films; very strongly acid; clear, smooth boundary.
- B22tg—49 to 55 inches, grayish-brown (10YR 5/2) silty clay loam; common, fine, faint, light-gray (10YR 7/2) and few, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, fine subangular blocky structure; firm; few, thin, grayish-brown (10YR 5/2) clay films; few, fine, black (N 2/0) iron-manganese concretions; very strongly acid; clear, smooth boundary.
- B3—55 to 65 inches, brown (7.5YR 4/4) light silty clay loam; many, fine, distinct and common, medium, distinct, grayish-brown (10YR 5/2) mottles; very weak, coarse, subangular blocky structure; firm; patchy, thin, gray (10YR 6/1) and brown (7.5YR 5/2) clay films; patchy, thin, black (10YR 2/1) iron-manganese films on ped surfaces; very strongly acid; clear, smooth boundary.
- C—65 to 71 inches, dark yellowish-brown (10YR 4/4) silt loam; few, fine, faint, yellowish-brown (10YR 5/6), common, medium, distinct, light brownish-gray (10YR 6/2), and few, very fine, distinct, black (10YR 2/1) mottles; massive; friable; few, thin, gray (10YR 6/1) clay films in root and worm channels and pores; strongly acid.

The Ap and A2 horizons combined range from 10 to 24 inches in thickness. The A2 horizon is commonly silt loam but ranges to light silty clay loam in a few places. The B horizon ranges from light silty clay loam to heavy silty clay loam. The underlying material ranges from silt loam to silty clay loam. Thin sandy layers are in places.

Ginat soils are near Racoon, Weinbach, Reesville, and McGary soils. They have a thinner A2 horizon than Racoon soils and have a fragipan that is not characteristic of Racoon soils. Ginat soils are more poorly drained than Weinbach soils and are more poorly drained and more acid in the lower part of the B and the C horizons than Reesville and McGary soils.

Ginat silt loam (460).—This nearly level soil is on terraces. Areas range from narrow and 5 to 20 acres in size to broad and more than 100 acres in size. Slopes are generally less than 1 percent, but they range to 3 percent in a few places.

Included with this soil in mapping were small areas of Racoon silt loam and Weinbach silt loam that were too small to map separately. Also included were areas of soils that are slightly acid to neutral in the lower part of the subsoil, a few areas where the subsoil is silty clay, and, in places, areas of soils that contain Coastal Plain gravel. About 800 acres of Ginat soil in several areas between

Brookport and Hamlettsburg have silty clay loam surface and subsurface layers. The Ginat soil in these areas is nearly level or depressional and generally remains wet and waterlogged later in spring than Ginat soil in other areas. It is extremely acid and very low in content of organic matter.

This Ginat soil is suited to crops, pasture, and trees. Management group IIIw-1; woodland suitability group 4w2; recreation group 8.

Grantsburg Series

The Grantsburg series consists of gently sloping to moderately steep, moderately well drained soils that are moderately deep to a very firm, dense layer called a fragipan. These soils formed in loess. They are on ridgetops and hillsides in the northern part of Pope and the western part of Hardin Counties.

In a representative profile the surface layer is about 7 inches of brown silt loam. The subsoil is about 54 inches thick. The upper 17 inches is mainly strong-brown heavy silt loam. The next 14 inches is part of the fragipan. It is mainly yellowish-brown, very firm silty clay loam that has strong-brown and light-gray mottles. The lower part of the subsoil, also part of the fragipan, is yellowish-brown, very firm silt loam about 23 inches thick. Mottles are strong brown, light gray, brownish yellow, and light brownish gray. The underlying material is yellowish-brown silt loam that has brownish-yellow and light brownish-gray mottles.

Grantsburg soils are low in content of organic matter. They have slow to very slow permeability and moderate available water capacity. They are subject to erosion. Runoff is medium to very rapid.

Crops on these soils respond well to lime and fertilizer applied according to soil tests, but rooting depth is somewhat limited by the fragipan.

Representative profile of Grantsburg silt loam, 4 to 7 percent slopes, eroded, in an area of Pope County, 990 feet east of iron stake in the northwest corner of sec. 4 between new and old roads and 106 feet south of section line in the NE $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 4, T. 13 S., R. 5 E.:

- Ap—0 to 7 inches, brown (10YR 5/3) silt loam; weak, fine, granular structure; friable; strongly acid; abrupt, smooth boundary.
- B1—7 to 12 inches, strong-brown (7.5YR 5/6) heavy silt loam; weak, medium, subangular blocky structure; friable; many roots; strongly acid; clear, smooth boundary.
- B21t—12 to 17 inches, strong-brown (7.5YR 5/6) heavy silt loam; weak, fine, subangular blocky structure; firm; many roots; strongly acid; gradual, smooth boundary.
- B22t—17 to 20 inches, strong-brown (7.5YR 5/6) heavy silt loam; moderate, medium, subangular blocky structure; firm; thin, discontinuous, brown (7.5YR 5/4) clay films on vertical faces only; few iron-manganese concretions; common roots; very strongly acid; gradual, smooth boundary.
- B23t—20 to 24 inches, yellowish-brown (10YR 5/4) silt loam; weak, medium, subangular blocky structure; friable; few roots; very strongly acid; abrupt, smooth boundary.
- B and Ax—24 to 27 inches, brown (10YR 5/3) ped interiors, light-gray (10YR 7/1) silt-coated ped exteriors, silty clay loam; moderate, fine, subangular blocky structure; firm, compact, somewhat brittle; few iron-

manganese concretions; few roots; water seeps from surface of horizon when horizon above is saturated; very strongly acid; abrupt, smooth boundary.

- Bx1—27 to 38 inches, yellowish-brown (10YR 5/4) silty clay loam; common, medium, distinct, strong-brown (7.5YR 5/8) and light-gray (10YR 7/1) mottles; moderate, medium, subangular blocky structure; very firm, brittle; discontinuous, thin, dark-brown (7.5YR 4/4) clay films; some white (10YR 8/1) grainy silt on ped surfaces; few roots; few iron-manganese concretions; very strongly acid; clear, smooth boundary.
- Bx2—38 to 52 inches, yellowish-brown (10YR 5/4) silt loam; common, medium, distinct, strong-brown (7.5YR 5/8) and light-gray (10YR 7/1) mottles; weak, coarse, subangular blocky structure; very firm; patchy, thin, dark-brown (7.5YR 4/4) clay films; few roots; root channels filled with light-gray (10YR 7/1) silt; few iron-manganese concretions; very strongly acid; clear, smooth boundary.
- Bx3—52 to 61 inches, yellowish-brown (10YR 5/4) silt loam; common, medium, faint, brownish-yellow (10YR 6/8) and light brownish-gray (10YR 6/2) mottles; weak, coarse, blocky structure; very firm, compact, brittle; few iron-manganese concretions; strongly acid; gradual, smooth boundary.
- C—61 to 71 inches, yellowish-brown (10YR 5/4) silt loam; common, medium, faint, brownish-yellow (10YR 6/8) and light brownish-gray (10YR 6/2) mottles; massive; friable; medium acid.

Depth to the fragipan ranges from about 24 to 30 inches in areas of uneroded soil and 10 to 18 inches in areas of severely eroded soil. The total thickness of the loess over sandstone or shale bedrock ranges from about 50 to 100 inches.

An A2 horizon is in uneroded soil and ranges from 5 to 10 inches in thickness. Color ranges from brown to yellowish brown.

The B horizon is yellowish brown, dark yellowish brown, strong brown, or dark brown. The Bx horizon generally has mottles ranging from light gray to light brownish gray along with brownish-yellow, brown, or strong-brown mottles. In places the mottles are few in number or are absent. The B horizon is light silty clay loam or heavy silt loam. The horizon designated B and Ax ranges from 2 or 3 inches in thickness. It generally is prominent or distinct, but, in some places, it is faint.

Grantsburg soils have a profile similar to that of Hosmer, Zanesville, Bedford, and Lax soils, all of which have a fragipan. Grantsburg soils have a stronger and thicker fragipan than Hosmer soils. They formed entirely in loess, but Zanesville, Bedford, and Lax soils formed in loess in the upper part and in material weathered from sandstone, shale, and cherty or gravelly materials in the lower part of the subsoil.

Grantsburg silt loam, 2 to 4 percent slopes (301B).—

Areas of this soil are mostly on ridgetops. They are oblong in shape and as much as 500 feet wide or are long and irregular in shape and 100 to 200 feet wide. The profile of this soil is similar to that described as representative for the series, except that the combined thickness of the silt loam surface and subsurface layers is generally 7 to 15 inches, and the depth to the fragipan layer ranges from 27 to 30 inches.

Included with this soil in mapping were areas where slope is less than 2 percent. Also included were small areas of somewhat poorly drained soils similar to Robbs soils that are generally at the heads of drainageways.

Runoff is medium, and the hazard of erosion is slight to moderate. The available water capacity is moderate.

This Grantsburg soil is well suited to most uses. Management group IIe-2; woodland suitability group 3d2; recreation group 2.

Grantsburg silt loam, 4 to 7 percent slopes, eroded (301C2).—Areas of this extensive soil are mostly on ridgetops. They are long and irregular in shape and generally

are 200 to 400 feet wide, but range from 100 to 600 feet wide. This soil is also in oblong areas on foot slopes that range from 2 to 10 acres in size. It has the profile described as representative for the series.

Included with this soil in mapping were areas where this soil is only slightly eroded and the combined thickness of the silt loam surface and subsurface layers is 7 to 15 inches. These areas make up about 7 percent of the total acreage of this soil. Also included were a few areas where the soil is severely eroded and has a surface layer mostly of silty clay loam subsoil material. Additional inclusions were small areas of somewhat poorly drained soils, similar in appearance to Robbs soils, that are mainly at the heads of drainageways.

Runoff is medium, and the hazard of erosion is moderate.

This Grantsburg soil is suited to most commonly grown crops. Management group IIIe-2; woodland suitability group 3d2; recreation group 2.

Grantsburg silt loam, 7 to 12 percent slopes, eroded (301D2).—This soil is mainly in long, narrow areas around the rims of ridgetops or in oblong areas, 5 to 15 acres in size, along drainageways. The profile of this soil is similar to that described as representative for the series, but the surface layer is 3 to 7 inches thick. The depth to the fragipan ranges from 18 to 30 inches. In wooded areas this soil is generally less eroded, the silt loam surface layer is thicker, and the depth to the fragipan is 24 to 30 inches.

Included with this soil in mapping, in places, were small areas of Zanesville silt loam, 7 to 12 percent slopes, eroded.

Runoff is rapid, and the hazard of further erosion is severe.

This Grantsburg soil is moderately suited to most commonly grown crops. Management group IIIe-2; woodland suitability group 3d2; recreation group 3.

Grantsburg soils, 7 to 12 percent slopes, severely eroded (301D3).—These extensive soils are in long, narrow areas around the rims of ridgetops or in oblong areas, 2 to 20 acres in size, along drainageways. The profile of these soils is similar to that described as representative for the series, but most or all of the original surface layer has been removed by erosion, and the present plow layer is mainly silty clay loam or heavy silt loam subsoil material. The depth to the fragipan generally ranges from 12 to 18 inches.

Included with these soils in mapping, in the larger areas, were small areas of Zanesville soils, 7 to 12 percent slopes, severely eroded. Also included were a few, small areas of severely gullied soils.

Runoff is rapid, and the hazard of further erosion is severe. Erosion has seriously reduced the effective water storage area above the fragipan.

These Grantsburg soils are suited to pasture or trees but are poorly suited to crops. Management group IVe-2; woodland suitability group 3d2; recreation group 3.

Grantsburg silt loam, 12 to 18 percent slopes, eroded (301E2).—This soil is mostly along drainageways or around the heads of drainageways in irregular areas 5 to 20 acres in size. Slopes range from 100 to 200 feet in length. The profile of this soil is similar to that described as representative for the series, but the surface layer ranges from 3 to 7 inches in thickness. In places in cultivated areas, sub-

soil material is incorporated into the plow layer. The depth to the fragipan ranges from 18 to 28 inches. In areas that are wooded, the soil is generally less eroded, the surface layer is thicker, and the depth to the fragipan is 24 to 30 inches.

Included with this soil in mapping were small areas of Zanesville silt loam, 12 to 18 percent slopes, eroded, and Bedford silt loam, 12 to 18 percent slopes, eroded.

Runoff is rapid, and the hazard of further erosion is very severe.

This Grantsburg soil is suited to pasture or trees but is poorly suited to crops. Management group IV-2; woodland suitability group 3d2; recreation group 4.

Grantsburg soils, 12 to 18 percent slopes, severely eroded (301E3).—These soils are mostly in oblong areas around drainageways or in long, narrow areas along side slopes. Slopes range from 75 to 200 feet in length. The profile of these soils is similar to that described as representative for the series, but most or all of the original surface layer has been removed by erosion. The present surface layer is mainly former subsoil material and is silty clay loam or heavy silt loam. The depth to the fragipan layer ranges from 10 to 18 inches.

Included with these soils in mapping were a few areas of Grantsburg soils that have slopes of more than 18 percent. Most of these steeper soils are only slightly or moderately eroded. Also included were areas of Zanesville soils, 12 to 18 percent slopes, severely eroded, and Bedford soils, 12 to 18 percent slopes, severely eroded. A few, small areas of severely gullied soils were also included.

Runoff is very rapid, and the hazard of further erosion is very severe. Erosion has seriously reduced the effective water storage area above the fragipan.

These Grantsburg soils are not suited to crops because of the erosion hazard. They are suited to pasture and trees. Management group VIe-2; woodland suitability group 3d2; recreation group 4.

Haymond Series

The Haymond series consists of deep, nearly level, well-drained soils on bottom lands along streams that are mainly near the Ohio River in Hardin County. These soils formed in silty sediment more than 50 inches thick.

In a representative profile the surface layer is about 4 inches of brown silt loam. The subsoil is dark yellowish-brown silt loam about 37 inches thick. It is mottled with yellowish brown in the lower part. The underlying material, to a depth of about 60 inches, is dark-brown silt loam mottled with strong brown and yellowish brown.

Haymond soils are low in content of organic matter. They have moderate permeability and very high available water capacity.

Crops on these soils respond well to fertilizer applied according to soil tests. The soils are subject to flash flooding of short duration.

Representative profile of Haymond silt loam, in a cultivated field in Hardin County, 125 feet west of field opening on gravel road in SE $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 4, T. 12 S., R. 8 E.:

- Ap—0 to 4 inches, brown (10YR 4/3) silt loam; pale brown (10YR 6/3) dry; weak, medium, granular structure; friable; slightly acid; abrupt, smooth boundary.
B21—4 to 14 inches, dark yellowish-brown (10YR 4/4) silt loam; very weak, medium, subangular blocky struc-

- ture; friable; dark-brown (10YR 3/3) worm casts; patchy dark-brown (10YR 3/3) coats on ped faces; slightly acid; clear, smooth boundary.
- B22—14 to 28 inches, dark yellowish-brown (10YR 4/4) silt loam; very weak, medium and coarse, subangular blocky structure; friable; many ped faces are dark brown (10YR 3/3); many very fine pores; neutral; gradual, smooth boundary.
- B3—28 to 41 inches, dark yellowish-brown (10YR 4/4) silt loam; few, fine, faint, yellowish-brown (10YR 5/4 and 5/6) mottles; weak, medium, granular structure; friable; dark yellowish-brown (10YR 3/4) ped faces; slightly acid; clear, smooth boundary.
- C1—41 to 47 inches, dark-brown (7.5YR 4/4) silt loam; common, fine, faint, yellowish-brown (10YR 5/4) and strong-brown (7.5YR 5/8) mottles; massive; friable; slightly acid; gradual, smooth boundary.
- C2—47 to 60 inches, dark-brown (7.5YR 4/4) silt loam; common, fine, faint, yellowish-brown (10YR 5/4) mottles; massive; friable; about 15 percent gravel; slightly acid.

The A horizon ranges from brown to dark grayish brown in color, and the B horizon ranges from brown to yellowish brown. In places light brownish-gray or pale-brown mottles are below a depth of 20 inches. The B horizon is generally slightly acid, but ranges from medium acid to neutral. In places the C horizon is stratified with loam or sandy loam or contains a few pebbles.

Haymond soils are near Wakeland soils and have a profile similar to that of Sharon soils. They are less acid throughout the profile than Sharon soils, and they are better drained than Wakeland soils.

Haymond silt loam (331).—This soil is nearly level in most areas, but slopes are as much as 4 percent in a few places.

Included with this soil in mapping were small areas of soils that have a sandy or gravelly surface layer or that have sandy or gravelly layers in the profile.

This soil has no major limitations to use; but, in places, areas are subject to flash flooding of short duration.

This Haymond soil is well suited to most commonly grown crops. Management group I-2; woodland suitability group 1o4; recreation group 9.

Hosmer Series

The Hosmer series consists of gently sloping to steep, moderately well drained soils that are moderately deep to a firm, dense layer called a fragipan. These soils formed in loess. They are on uplands in Massac and Hardin Counties and in the southern part of Pope County.

In a representative profile the surface layer is about 5 inches of brown silt loam. The subsurface layer is about 5 inches of dark yellowish-brown silt loam. The upper part of the subsoil is about 21 inches thick. The upper 6 inches of it is strong-brown, friable silt loam; the next 9 inches is dark-brown, friable light silty clay loam that has pale-brown and strong-brown mottles; and the lower 6 inches is dark-brown silt loam that has pale-brown mottles. The lower part of the subsoil consists of a fragipan about 26 inches thick. The upper 6 inches is dark-brown, firm light silty clay loam that has pale-brown mottles; the next 14 inches is dark-brown, firm silt loam that has pale-brown and yellowish-brown mottles; and the lower 6 inches is dark yellowish-brown silt loam that has pale-brown mottles. The underlying material, to a depth of about 72 inches, is dark-brown silt loam that has pale-brown mottles.

Hosmer soils are low in content of organic matter. They

have slow permeability and moderate available water capacity. They are subject to erosion. Runoff is medium to very rapid.

Crops in these soils respond well to lime and fertilizer applied according to soil tests. Rooting depth is somewhat limited by the fragipan.

Representative profile of Hosmer silt loam, 4 to 7 percent slopes, eroded, in a brushy pasture in Massac County, 820 feet east of road T-junction and 45 feet north of middle of gravel road in the SW $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 16, T. 15 S., R. 4 E.:

- Ap—0 to 5 inches, brown (10YR 4/3) silt loam; moderate, fine, granular structure; friable; strongly acid; clear, smooth boundary.
- A2—5 to 10 inches, dark yellowish-brown (10YR 4/4) silt loam; few, very fine, faint, yellowish-brown (10YR 5/6) mottles; very weak, medium, platy structure; friable; few, very fine, black (N 2/0) iron-manganese concretions; very strongly acid; clear, smooth boundary.
- B1—10 to 16 inches, strong-brown (7.5YR 5/6) silt loam; weak, medium, subangular blocky structure parting to weak, very fine, subangular blocky; friable; few dark-brown (7.5YR 4/4) coats on ped surfaces; few, very fine, black (N 2/0) iron-manganese concretions; very strongly acid; clear, smooth boundary.
- B2t—16 to 25 inches, dark-brown (7.5YR 4/4) light silty clay loam; few, fine, distinct, pale-brown (10YR 6/3) and few, fine, faint, strong-brown (7.5YR 5/6) mottles and short pale-brown (10YR 6/3) streaks; weak, fine, prismatic structure parting to moderate, medium and fine, subangular blocky; friable; few, very fine, black (N 2/0) iron-manganese concretions; very strongly acid; abrupt, smooth boundary.
- A'2—25 to 31 inches, dark-brown (7.5YR 4/4) silt loam; common, fine, distinct, very pale brown (10YR 7/3) mottles; weak, medium, prismatic structure parting to moderate, medium and fine, subangular blocky; firm and brittle; continuous light-gray (2.5Y 7/2) silica coats; few grayish-brown (10YR 5/2) ped surfaces; streaks of light-gray (10YR 7/2) silt loam; common, medium, strong-brown (7.5YR 5/8) and yellowish-red (5YR 5/8) iron stains; extremely acid; abrupt, smooth boundary.
- B'x1—31 to 37 inches, dark-brown (7.5YR 4/4) light silty clay loam; common, fine, distinct, very pale brown (10YR 7/3) mottles; moderate, medium, prismatic structure parting to very weak, fine, subangular blocky; firm and brittle; streaks of light-gray (10YR 7/2) silt loam; light-gray (2.5Y 7/2) silica coats on tops of peds; many, very fine, black (N 2/0) iron-manganese concretions; common, medium, strong-brown (7.5YR 5/8) and yellowish-red (5YR 5/8) iron stains; extremely acid; abrupt, smooth boundary.
- B'x2—37 to 51 inches, dark-brown (7.5YR 4/4) silt loam; few, fine, distinct, yellowish-brown (10YR 5/6 and 5/8) and common, fine, distinct, pale-brown (10YR 6/3) mottles; weak, medium, prismatic structure parting to very weak, medium, subangular blocky; firm and brittle; discontinuous dark-brown (7.5YR 4/4) coats on ped surfaces and in pores; dark-brown (7.5YR 4/4) silty clay loam balls; common very small pores; very pale brown (10YR 7/3) silica coats; streaks of light-gray (10YR 7/2) silt loam; very strongly acid; gradual, smooth boundary.
- B'x3—51 to 57 inches, dark yellowish-brown (10YR 4/4) silt loam; common, fine, distinct, pale-brown (10YR 6/3) mottles; massive; slightly brittle; patchy, thin, brown (7.5YR 4/4) clay films; patchy, thin, pale-brown (10YR 6/3) silica coats and streaks; common, fine, black and very dark grayish-brown (N 2/0 and 10YR 3/2) iron-manganese concretions and stains; medium acid; gradual, smooth boundary.
- C—57 to 72 inches, dark-brown (7.5YR 4/4) silt loam; common, medium, distinct, pale-brown (10YR 6/3) mottles; massive; friable; light-gray (10YR 7/2) patches

and streaks; very few, fine, black (N 2/0) iron-manganese concretions and stains; medium acid.

The depth to the fragipan ranges from 24 to 36 inches in uneroded soils and from 10 to 18 inches in severely eroded soils. The loess ranges from about 4 feet to more than 20 feet in thickness and is underlain by sandstone or shale bedrock or Coastal Plain gravel.

The B horizon is generally dark brown, but in places is dark yellowish brown or strong brown.

Hosmer soils have a profile similar to that of Grantsburg, Lax, Zanesville, and Bedford soils, all of which contain a fragipan. Their fragipan is not so thick and dense as that in Grantsburg soils. The B horizon in Hosmer soils formed in loess, but the lower part of the B horizon in Lax soils contains gravel, the lower part of the B horizon in Zanesville soils contains sandstone and shale fragments, and the lower part of the B horizon in Bedford soils contains cherty limestone.

Hosmer silt loam, 2 to 4 percent slopes (214B).—This gently rolling soil is on ridgetops, 100 to 400 feet wide, in the central part of Massac County. These areas are 5 to 40 acres in size. In other parts of the survey area, this soil is in smaller areas on ridgetops and is associated with strongly rolling soils.

Included with this soil in mapping were a few areas where slope is less than 2 percent and areas of eroded soils where the remaining silt loam surface layer is less than 7 inches thick. Also included were small areas of somewhat poorly drained soils of the Stoy series that were too small to map separately. These areas are mainly at the heads of drainageways.

Runoff is medium, and the hazard of erosion is moderate.

This Hosmer soil is well suited to most commonly grown crops. Management group IIe-2; woodland suitability group 2o1; recreation group 2.

Hosmer silt loam, 4 to 7 percent slopes, eroded (214C2).—This very extensive soil (fig. 13) is commonly

on ridgetops, but it is in many kinds of areas, especially in Massac County. It has the profile described as representative for the series. In places in cultivated areas, subsoil material is incorporated into the surface layer.

Included with this soil in mapping were areas of uneroded or only slightly eroded soils. Here the combined thickness of the surface and subsurface layers averages nearly 11 inches. These areas make up about 10 percent of the acreage of this soil. Also included, in a few places, were severely eroded soils that have a surface layer mainly of silty clay loam subsoil material. In the eastern part of Hardin County, where small areas of Hosmer soils are associated with extensive areas of Alford soils, the fragipan is not so firm and brittle as that of this soil and is only 6 to 20 inches thick.

Runoff is medium, and the hazard of water erosion is moderate.

This Hosmer soil is well suited to most commonly grown crops. Management group IIIe-2; woodland suitability group 2o1; recreation group 2.

Hosmer silt loam, 7 to 12 percent slopes, eroded (214D2).—Areas of this soil are mainly on ridgetops. This soil is also on the sides of drainageways in moderately rolling areas. Slopes generally are 50 to 150 feet long. The profile of this soil is similar to that described as representative for the series, but the combined thickness of the surface and subsurface layers is less than 7 inches. In most cultivated areas, these layers and generally some subsoil material are incorporated into the plow layer. In areas that are wooded, this soil is generally less eroded, and the combined thickness of the surface and subsurface layers ranges from 8 to 12 inches.

Included with this soil in mapping, in the eastern part of Hardin County, were small areas of Hosmer soils that are associated with extensive areas of Alford soils. The



Figure 13.—An area of Hosmer silt loam, 4 to 7 percent slopes, eroded.

fragipan of these Hosmer soils is less well developed, generally 6 to 20 inches thick, and only slightly firm and brittle. Also included, in Massac County, were areas where Coastal Plain gravel is exposed near the bottom of slopes.

Runoff is rapid, and the hazard of erosion is severe.

This Hosmer soil is suited to most commonly grown crops. Management group IIIe-2; woodland suitability group 2o1; recreation group 3.

Hosmer soils, 7 to 12 percent slopes, severely eroded (214D3).—These soils are mainly on the rims of ridgetops in strongly rolling areas and on the sides of drainageways in moderately rolling areas. Slopes generally are 50 to 200 feet long. The profile of these soils is similar to that described as representative for the series, but most or all of the surface and subsurface layers have been removed by erosion. The present plow layer is mainly subsoil material and is silty clay loam or heavy silt loam. Depth to the fragipan ranges from 12 to 18 inches.

Included with these soils in mapping, in the eastern part of Hardin County, were small areas of Hosmer soils that are associated with extensive areas of Alford soils. The fragipan of these Hosmer soils is less well developed, is 6 to 20 inches thick, and is only slightly firm and brittle. Also included, in Massac County, were areas where Coastal Plain gravel is exposed near the bottom of some slopes. A few areas of severely gullied soils were also included.

Runoff is rapid, and the hazard of further water erosion is very severe. Erosion has seriously reduced the effective water-storage area above the fragipan.

These Hosmer soils are suited to pasture or trees but are poorly suited to crops. Management group IVe-2; woodland suitability group 2o1; recreation group 3.

Hosmer silt loam, 12 to 18 percent slopes, eroded (214E2).—Areas of this soil are on the rims of ridgetops and the sides of drainageways. Areas are mostly irregular in shape and 5 to 20 acres in size. Slopes generally are 100 to 200 feet long. The profile of this soil is similar to that described as representative for the series, but the combined thickness of the surface and subsurface layers of this soil is generally only 3 to 7 inches. In places in cultivated areas, subsoil material is incorporated into the plow layer. Depth to the fragipan ranges from 20 to 30 inches. In many areas this soil is wooded, and in these areas it is generally less eroded. The combined thickness of the surface and subsurface layers ranges from 8 to 12 inches, and depth to the fragipan ranges from 24 to 30 inches.

Included with this soil in mapping were areas along drainageways where bedrock or gravelly layers are exposed near the bottoms of slopes. Also included were areas of Zanesville silt loam, 12 to 18 percent slopes, eroded, that are too small to map separately.

Runoff is rapid, and the hazard of erosion is very severe.

This Hosmer soil is suited to pasture or trees but is poorly suited to crops. Management group IVe-2; woodland suitability group 2r2; recreation group 4.

Hosmer soils, 12 to 18 percent slopes, severely eroded (214E3).—These soils are in irregularly shaped areas on the rims of ridgetops, on the sides of drainageways, and at the heads of drainageways. Areas are 5 to 40 acres in size. Slopes generally are 100 to 200 feet long.

The profile of these soils is similar to that described as representative for the series, but most or all of the surface and subsurface layers have been removed by erosion. The present surface layer is mainly subsoil material and is silty clay loam or heavy silt loam. Depth to the fragipan ranges from 10 to 17 inches.

Included with these soils in mapping, in the eastern part of Hardin County, were small areas of Hosmer soils that are associated with extensive areas of Alford soils. The fragipan of Hosmer soils in these areas is not so firm and brittle as it is in other areas and is 6 to 20 inches thick. Also included were areas of Zanesville soils, 12 to 18 percent slopes, severely eroded, that were too small to map separately. In places bedrock or gravelly layers are exposed on the lower parts of slopes along drainageways.

Runoff is very rapid, and the hazard of further erosion is very severe. Erosion has seriously reduced the effective water-storage area above the fragipan.

These Hosmer soils are not suited to crops because of the erosion hazard. They are suited to pasture or trees. Management group VIe-2; woodland suitability group 2r2; recreation group 4.

Hosmer silt loam, 18 to 30 percent slopes, eroded (214F2).—This soil is mostly in areas 3 to 15 acres in size. Slopes are 100 to 200 feet long. The profile of this soil is similar to that described as representative for the series, but the subsurface layer and the subsoil are generally slightly thinner. Depth to the fragipan ranges from 19 to 27 inches.

Included with this soil in mapping were areas of severely eroded soils. In these areas the surface layer is mainly subsoil material of silty clay loam or heavy silt loam, and the depth to the fragipan ranges from 10 to 17 inches. These areas make up nearly one-fourth of the acreage of this Hosmer soil. Also included were a few places where the soils are steeper than 30 percent. Small areas of Zanesville, Bedford, Brandon, or Lax soils that were too small to map separately were included in places in large areas. Bedrock or gravel is exposed on the lower parts of longer slopes in places.

Runoff is very rapid, and the hazard of erosion is very severe.

This Hosmer soil is not suited to crops, but it is suited to trees or pasture. Management group VIe-2; woodland suitability group 2r2; recreation group 5.

Hosmer-Lax silt loams, 12 to 18 percent slopes, eroded (953E2).—The soils in this complex are in irregularly shaped areas, generally less than 20 acres in size. Slopes are mostly less than 200 feet long. Hosmer silt loam is on the upper 50 to 70 percent of the slope, and Lax silt loam is on the lower part. Lax silt loam is gravelly in the lower part of the subsoil. The Hosmer and Lax soils have profiles similar to those described as representative for their respective series, except the surface layer is 3 to 7 inches thick.

Included with this complex in mapping were areas of these soils that are only slightly eroded. In these areas the combined thickness of the surface layer and subsurface layer is more than 7 inches. Such areas make up about 15 percent of the total acreage of this complex.

Runoff is rapid, and the hazard of further erosion is very severe.

The soils in this complex are poorly suited to crops. They are better suited to pasture or trees than to other

uses. Management group IVe-2; woodland suitability group 2r2; recreation group 4.

Hosmer-Lax complex, 12 to 18 percent slopes, severely eroded (953E3).—The soils in this complex are in irregularly shaped areas, generally less than 15 acres in size. Slopes are mostly less than 200 feet long. Hosmer silt loam is on the upper 50 to 70 percent of the slope, and Lax silt loam is on the lower part. Lax silt loam is gravelly in the lower part of the subsoil. The Hosmer and Lax soils have profiles similar to those described as representative for their respective series, but most or all of the surface and subsurface layers have been removed by erosion. The present surface layer is mainly subsoil material and is silty clay loam or heavy silt loam.

Included in places with this complex in mapping were areas on the lower slopes where the surface layer contains gravel.

Runoff is very rapid, and the hazard of further erosion is very severe. Erosion has reduced the effective water-storage area above the fragipan.

The soils in this complex are not suited to crops, but they are suited to pasture and trees. Management group VIe-2; woodland suitability group 2r2; recreation group 4.

Hosmer-Lax silt loams, 18 to 30 percent slopes, eroded (953F2).—The soils in this complex are in irregularly shaped areas, 5 to 50 acres in size. Slopes are generally 100 to 300 feet long. Hosmer silt loam is on the upper 40 to 70 percent of the slope, and Lax silt loam is on the lower part. Lax silt loam is gravelly in the lower part of the subsoil. The Hosmer and Lax soils have profiles similar to those described as representative for their respective series, except the combined thickness of the surface and subsurface layers is 3 to 7 inches.

Included with this complex in mapping were areas of severely eroded soils in which the surface layer is mainly silty clay loam subsoil material. These areas make up about 8 percent of the total acreage of this complex. Also included in mapping were areas where slope is more than 30 percent. These areas make up about 10 percent of the total acreage of this complex. Small areas of Brandon and Saffell soils, 12 to 30 percent slopes, were also included.

Runoff is very rapid, and the hazard of further erosion is very severe in areas where the trees have been removed.

The soils in this complex are suited to limited pasture, to trees, or to wildlife habitat. Most areas of these soils are wooded or have brushy vegetation. Management group VIe-2; woodland suitability group 2r2; recreation group 5.

Huntington Series

The Huntington series consists of deep, nearly level, well-drained soils on bottom lands adjacent to the Ohio River. These soils formed in silty sediment more than 50 inches thick.

In a representative profile the surface layer is about 14 inches of very dark grayish-brown and dark-brown silt loam. The subsoil is friable silt loam about 40 inches thick. The upper part is dark yellowish brown, and the lower part is brown. The underlying material is dark yellowish-brown silt loam stratified with fine sandy loam.

Huntington soils are moderate in content of organic matter. They have moderate permeability and very high available water capacity.

These soils are naturally highly productive, but are subject to annual flooding in winter and spring by the Ohio River.

Representative profile of Huntington silt loam in a cultivated field in Pope County, 40 feet north of centerline of field lane and 180 feet west of edge of Ohio River bank in the SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 21, T. 15 S., R. 7 E.:

- Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) silt loam; brown (10YR 5/3) dry and dark brown (10YR 3/3) crushed; moderate, medium, granular structure; friable; mildly alkaline; abrupt, smooth boundary.
- A1—8 to 14 inches, dark-brown (10YR 3/3) silt loam; weak, medium, granular structure; friable; very dark grayish-brown (10YR 3/2) ped surfaces; very dark grayish-brown (10YR 3/2) surfaces on root and worm channels; mildly alkaline; clear, smooth boundary.
- B21—14 to 21 inches, dark yellowish-brown (10YR 4/4) silt loam; weak, fine, subangular blocky structure; friable; very dark grayish-brown (10YR 3/2) ped surfaces; very dark grayish-brown (10YR 3/2) to dark grayish-brown (10YR 4/2) surfaces on root and worm channels; mildly alkaline; gradual, smooth boundary.
- B22—21 to 33 inches, dark yellowish-brown (10YR 4/4) silt loam; weak, medium, prismatic structure parting to weak, coarse, subangular blocky; friable; dark grayish-brown (10YR 4/2) ped surfaces; dark grayish-brown (10YR 4/2) surfaces on root and worm channels; mildly alkaline; gradual, smooth boundary.
- B23—33 to 44 inches, brown and dark yellowish-brown (10YR 4/3 and 4/4) silt loam; very weak, medium, prismatic structure parting to very weak, coarse, subangular blocky; friable; dark grayish-brown (10YR 4/2) ped surfaces; very few, very fine, black (N 2/0) iron-manganese concretions; dark grayish-brown (10YR 4/2) surfaces on root and worm channels; mildly alkaline; gradual, smooth boundary.
- B31—44 to 54 inches, brown (10YR 4/3) silt loam; weak, fine, subangular blocky structure; friable; dark grayish-brown (10YR 4/2) ped surfaces; dark grayish-brown (10YR 4/2) surfaces on root and worm channels; mildly alkaline; abrupt, smooth boundary.
- IIC—54 to 65 inches, dark yellowish-brown (10YR 4/4) silt loam, lenses of fine sandy loam at depths of 54 to 55 and 59 to 60 inches; weak, fine, subangular blocky structure in silt loam; friable; dark-brown (10YR 3/3) ped surfaces; mildly alkaline.

The A horizon ranges from 10 to 20 inches in thickness. The B horizon is slightly acid to mildly alkaline. The C horizon is silty clay loam, loam, and fine sandy loam in places.

Huntington soils are near Armiesburg soils and have a profile similar to that of Armiesburg and Haymond soils. They contain less clay in the solum than Armiesburg soils. Huntington soils have a darker colored A horizon than Haymond soils.

Huntington silt loam (600).—This soil is mainly along the Ohio River in areas about 200 to 800 feet wide between the river and broad areas of Armiesburg soils. In many places it is 5 to 20 feet lower than the main bottom land. It generally has slopes of 0 to 2 percent, but slopes are short and steep in places. The change to adjacent soils is seldom distinct, and as a result, this soil is quite variable.

Included with this soil in mapping were areas where the underlying material is silty clay loam or sandy loam at a depth of 20 to 40 inches and areas that have a surface overwash of fine sandy loam. Also included were areas of a soil that has a light-colored surface layer.

This Huntington soil is well suited to annual cultivated crops. It is subject to flooding in winter or spring, and it is seldom used for overwinter crops or pasture. Management group I-2; woodland suitability group 104; recreation group 9.

Hurst Series

The Hurst series consists of deep, nearly level, somewhat poorly drained soils on bottom lands associated with the Ohio River. These soils formed in silty clay loam sediment more than 50 inches thick.

In a representative profile the surface layer is about 6 inches of brown silty clay loam. The subsurface layer is about 4 inches of pale-brown silty clay loam that has gray and light brownish-gray mottles. The subsoil is mixed light brownish-gray or grayish-brown and brown, firm heavy silty clay loam and light silty clay about 47 inches thick. The underlying material, to a depth of about 72 inches, is mixed grayish-brown and brown silty clay loam.

Hurst soils are low in content of organic matter. They have slow permeability and high available water capacity.

Crops on these soils generally have low response to applications of lime and fertilizer. The seasonal water table is at a depth of less than 3 feet.

Representative profile of Hurst silty clay loam in a cultivated field in Massac County, 1,155 feet east of centerline of gravel road and 468 feet south of ditch in NE $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 22, T. 16 S., R. 6 E.:

Ap—0 to 6 inches, brown (10YR 4/3) silty clay loam; pale brown (10YR 6/3) dry; weak, very fine, granular structure; friable; slightly acid; abrupt, smooth boundary.

A2—6 to 10 inches, pale-brown (10YR 6/3) silty clay loam; few, fine, distinct, gray (10YR 6/1) and light brownish-gray (10YR 6/2) mottles; massive; compact, brittle (plowpan); many, very fine, black (N 2/0), dark-brown, and brown (7.5YR 3/2 and 5/4) iron-manganese concretions; very strongly acid; abrupt, smooth boundary.

B21t—10 to 22 inches, mixed light brownish-gray (10YR 6/2), brown, and strong-brown (7.5YR 5/4 and 5/6) heavy silty clay loam; weak, very fine, subangular blocky structure; firm; common very fine vesicular pores; many, very fine, black (N 2/0), brown (7.5YR 5/4), and dark-brown (7.5YR 3/2) iron-manganese concretions; discontinuous, thin, grayish-brown (10YR 5/2) clay films; very strongly acid; clear, smooth boundary.

B22t—22 to 35 inches, mixed gray (10YR 6/1), brown, and strong-brown (7.5YR 5/4 and 5/6) heavy silty clay loam; weak, fine, subangular blocky structure; firm; common very fine vesicular pores; many, very fine, black (N 2/0), brown (7.5YR 5/4), and dark-brown (7.5YR 3/2) iron-manganese concretions; discontinuous, thin, grayish-brown (10YR 5/2) clay films; very strongly acid; gradual, smooth boundary.

B23t—35 to 48 inches, grayish-brown (10YR 5/2) (60 percent) and brown (7.5YR 5/4) (40 percent) light silty clay; many, fine, faint, yellowish-brown (10YR 5/6 and 5/8) mottles; weak, fine, subangular blocky structure; firm; few, fine, black (N 2/0) iron-manganese concretions; very strongly acid; gradual, smooth boundary.

B3—48 to 57 inches, grayish-brown (10YR 5/2) (60 percent) and brown (7.5YR 5/4) (40 percent) heavy silty clay loam; weak, medium, subangular blocky structure; firm; common dark-red (2.5YR 3/6) and dark reddish-brown (2.5YR 2/4) iron stains; common, fine, black (N 2/0) and dark-brown (7.5YR 3/2) iron-

manganese concretions; strongly acid; gradual, smooth boundary.

C—57 to 72 inches, grayish-brown (10YR 5/2) (60 percent) and brown and strong-brown (7.5YR 5/4 and 5/6) (40 percent) silty clay loam; many, fine, faint, yellowish-brown (10YR 5/6 and 5/8) mottles; massive; firm; many, fine, black (N 2/0) and dark-brown (7.5YR 3/2) iron-manganese concretions; strongly acid.

The Ap and A1 horizons range from heavy silt loam to heavy silty clay loam. The B horizon has weak to moderate structure. It ranges from silty clay loam to light silty clay. Mottles are common to many and range from yellowish brown to strong brown in this horizon. The C horizon is stratified with silt loam or silty clay.

In Pope, Hardin, and Massac Counties, the A horizon has a higher percentage of clay than is typical for most Hurst soils in other survey areas. The percentage of clay in the B horizon is in the low end of the range defined for the series, and permeability is estimated to be slow rather than the specified very slow.

Hurst soils are near Emma soils, and they formed in material similar to that of McGary and Weinbach soils. They are more poorly drained than Emma soils. Hurst soils are more acid in the lower part of the B horizon and in the C horizon than McGary soils, and they contain more clay throughout the solum than Weinbach soils.

Hurst silty clay loam (693).—This soil is mainly nearly level and is on ridgetops of broad, low terraces 100 to more than 600 feet wide. It is also on the bottoms of old stream channels that are 100 to 200 feet wide. Slopes are generally 0 to 2 percent but are as much as 6 percent in places. In places this soil is pale brown in the upper part of the subsoil instead of mixed gray and brown as shown in the profile described as representative for the series.

Included with this soil in mapping were poorly drained areas where the surface layer is mixed gray and brown. Areas where there is a silt loam overwash 10 to 15 inches thick make up about 4 percent of the total acreage of this soil. Areas where the surface layer and subsoil range from strongly acid to mildly alkaline were also included.

In the channel bottom areas, flooding by the Ohio River is moderately frequent, and overflow from local drainage is a hazard. The higher areas of this soil are covered by water only during the most severe floods.

This Hurst soil is suited to intensive use for crops or to trees and pasture. Management group IIw-1; woodland suitability group 301; recreation group 7.

Karnak Series

The Karnak series consists of deep, nearly level, poorly drained or very poorly drained soils in low areas of the Cache River-Bay Creek bottom lands, and in swales and old bayous of the Ohio River bottom lands. These soils formed in clayey sediment 50 or more inches thick.

In a representative profile the surface layer is about 5 inches of very dark grayish-brown silty clay. The subsoil is dark-gray, firm silty clay about 45 inches thick. Mottles in the subsoil are light olive brown and yellowish brown. The underlying material is gray silty clay loam. Mottles are yellowish brown and light olive brown.

Karnak soils are moderate in content of organic matter. They have slow to very slow permeability and moderate available water capacity.

Crops on these soils respond moderately well to lime and fertilizer applied according to soil tests. The seasonal water table is at or near the surface, and low areas are subject to annual flooding.

Representative profile of Karnak silty clay, in a cultivated field in Massac County, 230 feet north of east-west fence line and 45 feet west of north-south fence line in the SE $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 18, T. 14 S., R. 3 E.:

- Ap—0 to 5 inches, very dark grayish-brown (10YR 3/2) silty clay; light gray and light brownish gray (10YR 6/1 and 6/2) dry; weak, fine, granular structure; friable to firm; slightly acid; abrupt, smooth boundary.
- B1g—5 to 12 inches, dark-gray (5Y 4/1) silty clay; few, fine, faint, olive (5Y 5/4) mottles; weak, medium to fine, subangular blocky structure; firm; dark-gray (5Y 4/1) ped faces; yellowish-brown (10YR 5/6 and 5/8) root channels; slightly acid; clear, smooth boundary.
- B21g—12 to 20 inches, dark-gray (5Y 4/1) silty clay; common, fine, distinct, light olive-brown (2.5Y 5/6) mottles; weak, very fine and fine, prismatic structure parting to weak, medium and fine, subangular blocky; firm; patchy, thin, dark-gray (5Y 4/1) clay films on ped faces and in root channels; common, very fine, black (N 2/0) and yellowish-brown (10YR 5/8) iron-manganese concretions; slightly acid; clear, smooth boundary.
- B22g—20 to 33 inches, dark-gray (5Y 4/1) silty clay; common, fine, distinct, light olive-brown (2.5YR 5/6) and few, fine, prominent, yellowish-brown (10YR 5/6) mottles; moderate, medium, prismatic structure parting to weak, very fine, angular blocky; firm; patchy, thin, gray (N 5/0) clay films on ped faces and in root channels; common, very fine, yellowish-brown (10YR 5/8) iron-manganese concretions; slightly acid; clear, smooth boundary.
- B3g—33 to 50 inches, dark-gray (N 4/0) silty clay; few, fine, distinct, light olive-brown (2.5Y 5/6) and few, fine, prominent, yellowish-brown (10YR 5/6) mottles; weak, fine, prismatic structure parting to weak, fine, subangular blocky; firm; patchy, thin, gray (N 5/0) clay films; slightly acid; clear, smooth boundary.
- C—50 to 65 inches, gray (5Y 5/1) silty clay loam; many, fine, prominent, yellowish-brown (10YR 5/6 and 5/8), common, fine, distinct, light olive-brown (2.5Y 5/6) and few, fine, faint, light-gray (5Y 7/1) mottles; massive; firm; mildly alkaline.

Reaction is medium or slightly acid in the A and B horizons and ranges from medium acid to mildly alkaline in the C horizon.

The A horizon ranges from dark gray to grayish brown or, where it is less than 10 inches thick, from dark gray to very dark gray or very dark grayish brown. The B horizon ranges from silty clay to clay. Texture in the C horizon is coarser than silty clay loam in places.

Karnak soils are near and have a profile similar to that of Darwin, Petrolia, and Cape soils. They lack the thick, dark-colored A horizon of Darwin soils. Karnak soils have more clay throughout the solum than Petrolia soils, and they have more clay in the A horizon and the upper part of the B horizon than Cape soils.

Karnak silty clay (426).—This soil is nearly level or depressional. Slopes are seldom more than 1 percent. It is generally in large, rounded or oblong areas, but it also is in long, narrow, low drainageways on bottom lands along the Ohio River. It has the profile described as representative for the series.

Included with this soil in mapping was a 70-acre area west of Boaz near the Massac and Pulaski county line. In this area the soils are underlain by silt loam at a depth of 45 or 50 inches. They have better internal drainage and are more productive than nearby Karnak soils that are underlain by silty clay sediment. Also included were areas along Harris Creek in the northeastern part of Hardin County where the soils have a very dark gray surface layer 6 to 10 inches thick. These areas are a few feet higher in elevation than the adjacent medium-textured bottom lands and are seldom flooded. Included along

Main Ditch and north and east of Mermet, were areas where the material in the upper 6 to 10 inches is mixed with brown, burned muck.

This Karnak soil is wet late in spring, and most areas are subject to flooding. The sticky, plastic silty clay is difficult to work with construction machinery. If worked when wet, the surface layer becomes cloddy.

This Karnak soil is suited to most commonly grown crops if the surface is drained and the soil is protected from flooding. It has limited suitability for a construction site or as construction material. Management group IIIw-3; woodland suitability group 3w6; recreation group 13.

Karnak silty clay, wet (W426).—This soil is nearly level or depressional. The water table is at the surface. In places areas are under water most of the winter and spring, and in a few places areas are flooded most of the year.

Areas of this Karnak soil have limited use. They remain wet and waterlogged too late in the season to allow seedbed preparation. They are used principally for woodland, but some areas are suitable for pasture. If they can be drained and protected from flooding, they can be used for crops. Management group Vw-1; woodland suitability group 3w6; recreation group 14.

Karnak silt loam, overwash (426+).—This soil is nearly level. Slopes generally are less than 1 percent. The surface layer is dark grayish-brown to gray silt loam 8 to 20 inches thick. The profile of this soil is similar to that described as representative for the series, but it has a silt loam overwash layer.

This Karnak soil is wet in spring, and most areas are subject to flooding. Tilth is not a serious limitation in the plow layer, but the underlying, sticky, plastic silty clay is worked with difficulty when using construction machinery.

This soil is suited to most commonly grown crops. Management group IIIw-3; woodland suitability group 3w6; recreation group 13.

Karnak silty clay loam, ashy (426†).—This soil is nearly level. Slopes are less than 1 percent. It is in one area along Main Ditch, northeast of Mermet, in Massac County. The surface layer consists of 6 to 10 inches of reddish-brown, burned muck mixed with silty clay loam. The muck is the remains of a layer of muck or peat, as much as 2 feet thick, that burned many years ago. This soil is very strongly acid throughout. The profile is similar to that described as representative for the series, except for the texture of the surface layer and the very strongly acid reaction.

Wetness and flooding in spring are hazards. Tilth is not a serious limitation in the plow layer. The underlying, sticky, plastic silty clay, however, is worked with difficulty when using construction machinery.

This Karnak soil is suited to crops and generally produces higher yields than other Karnak soils. Management group IIIw-3; woodland suitability group 3w6; recreation group 13.

Lamont Series

The Lamont series consists of deep, nearly level to strongly sloping, well-drained soils mainly on terraces along Bay Creek, but also on high terraces and hillsides

near the Ohio River. These soils formed in loamy and sandy material.

In a representative profile the surface layer is about 6 inches of brown fine sandy loam. The subsurface layer is about 5 inches of dark yellowish-brown, friable fine sandy loam. The subsoil is dark yellowish-brown heavy fine sandy loam about 16 inches thick. The underlying material is strong-brown loamy fine sand.

Lamont soils are low in content of organic matter. They have moderately rapid permeability and low available water capacity.

Crops on these soils have low response to applications of lime and fertilizer because of droughtiness and low nutrient-holding capacity.

Representative profile of Lamont fine sandy loam, 7 to 12 percent slopes, eroded, in a cultivated field in Massac County, 140 feet west of north-south fence, and 165 feet north of east-west fence in the NE $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 19, T. 14 S., R. 4 E.:

- Ap—0 to 6 inches, brown (10YR 4/3) fine sandy loam; very weak, very fine, granular structure; friable; neutral; clear, smooth boundary.
- A2—6 to 11 inches, dark yellowish-brown (10YR 4/4) fine sandy loam; very weak, very coarse, platy structure; friable; slightly acid; clear, smooth boundary.
- B1—11 to 17 inches, dark yellowish-brown (10YR 4/4) (80 percent) and yellowish-brown (10YR 5/6) (20 percent) fine sandy loam; very weak, medium, prismatic structure; friable; few brown (7.5Y4 4/4) coats on peds and in root and worm channels; few fine and very fine pores; medium acid; clear, smooth boundary.
- B2t—17 to 27 inches, dark yellowish-brown (10YR 4/4) heavy fine sandy loam; weak, coarse, prismatic structure; friable; medium acid; abrupt, smooth boundary.
- C—27 to 60 inches, strong-brown (7.5YR 5/6) loamy fine sand; single grained; very friable; strongly acid.

The Ap horizon normally is brown, but in places it is dark yellowish brown. The B horizon is fine sandy loam or loam and contains thin layers of sandy clay loam in places. Reaction ranges from medium acid to strongly acid in the B and C horizons.

Lamont soils formed in similar materials and have natural drainage similar to that of Alvin soils. They have less clay in the B horizon than Alvin soils.

Lamont fine sandy loam, 2 to 7 percent slopes (175B).—This soil is on terraces. Slopes are 50 to 150 feet long. Areas are long and narrow and generally are less than 10 acres in size. Slopes are less than 4 percent in about 60 percent of the areas. In a few areas the soil is nearly level.

Included with this soil in mapping, in Pope and Massac Counties, were areas of a similar soil in which the subsoil is banded layers, 2 to 6 inches thick, of alternating sandy loam and fine sand. This included soil is generally more droughty than the Lamont soil. These areas make up about one-third of the total acreage of this soil.

Runoff is slow, and the hazard of erosion is slight.

This Lamont soil is suited to most farm uses and many nonfarm uses. Management group IIIs-1; woodland suitability group 3s2; recreation group 1.

Lamont fine sandy loam, 7 to 12 percent slopes, eroded (175D2).—This soil is on narrow stream terraces and in a few upland areas. Slopes are 50 to 100 feet long. The profile of this soil is similar to that described as representative for the series, but the thickness of the

combined surface and subsurface layers is less than 7 inches.

Included with this soil in mapping were areas where slopes are more than 12 percent. Also included, in Pope and Massac Counties, were areas of a soil in which the subsoil is banded layers, 2 to 6 inches thick, of alternating sandy loam and fine sand. This included soil is generally more droughty than the Lamont soil. These areas make up about 37 percent of the total acreage of this soil.

Runoff is slow to medium, and the hazard of erosion is moderate.

This Lamont soil is suited to most farm uses and many nonfarm uses. Management group IIIs-1; woodland suitability group 3s2; recreation group 3.

Lax Series

The Lax series consists of moderately steep and steep, moderately well drained soils that are moderately deep to a firm, dense fragipan. These soils formed in loess and underlying material influenced by Coastal Plain gravel. They are in Massac County and the southern part of Pope County.

In a representative profile the surface layer is about 5 inches of brown silt loam. The subsurface layer is about 3 inches of dark yellowish-brown silt loam. The subsoil is about 44 inches thick. The upper 12 inches is dark yellowish-brown and yellowish-brown silty clay loam. The lower 32 inches is a fragipan. The upper 12 inches of it is dark yellowish-brown, firm silty clay loam that has light-gray and brownish-yellow mottles. The lower 20 inches is dark-brown, firm gravelly silty clay loam and very gravelly loam that have light-gray mottles. The underlying material is red very gravelly clay loam that has yellowish-brown mottles.

Lax soils are low in content of organic matter. They have slow permeability and moderate available water capacity. They are subject to erosion. Runoff is rapid to very rapid.

Representative profile of Lax silt loam, 18 to 30 percent slopes, eroded, in an area of Massac County, 240 feet north of old gravel pit and 70 feet east of middle of Illinois Route 145 in the NW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 28, T. 14 S., R. 5 E.:

- O1—1 inch to 0, dark-brown (10YR 3/3) silt loam and undecomposed organic matter of roots, sticks, and leaves; weak, fine, crumb structure; friable; medium acid; abrupt, smooth boundary.
- A1—0 to 5 inches, brown (10YR 4/3) silt loam; weak, fine, granular structure; friable; very strongly acid; clear, smooth boundary.
- A2—5 to 8 inches, dark yellowish-brown (10YR 4/4) silt loam; moderate, medium, platy structure; friable; very strongly acid; clear, smooth boundary.
- B1—8 to 12 inches, dark yellowish-brown (10YR 4/4) light silty clay loam; moderate, medium, subangular blocky structure parting to weak, fine, subangular blocky; friable to firm; few brown (10YR 5/3) ped surfaces; very porous; very strongly acid; clear, smooth boundary.
- B21t—12 to 20 inches, yellowish-brown (10YR 5/6) and dark yellowish-brown (10YR 4/4) silty clay loam; moderate, medium, subangular blocky structure parting to weak, fine, subangular blocky; firm; continuous brown (7.5YR 4/4) coats on peds; few pebbles; very strongly acid; abrupt, smooth boundary.

- IIBx1**—20 to 32 inches, dark yellowish-brown (10YR 4/4) light silty clay loam (about 10 percent gravel); few, fine, distinct, light-gray (10YR 7/1) and brownish-yellow (10YR 6/6) mottles; weak, medium, subangular blocky structure; firm and brittle; patchy, thin, light-gray (10YR 7/1) silica coats on peds and in root channels and cracks; very strongly acid; clear, smooth boundary.
- IIBx2**—32 to 38 inches, dark-brown (7.5YR 4/4) gravelly light silty clay loam (about 50 percent gravel); common, medium, light-gray (10YR 6/1 and 7/1) mottles; moderate, medium, subangular blocky structure; very firm and brittle; patchy, thin, dark-brown (7.5YR 4/4) clay films and light-gray (10YR 6/1 and 7/1) silica coats; very strongly acid; gradual, smooth boundary.
- IIBx3**—38 to 52 inches, dark-brown (7.5YR 4/4) very gravelly loam (about 70 percent gravel); weak, medium, subangular blocky structure; firm and brittle; patchy, thin, dark reddish-brown and dark-brown (5YR 3/4 and 7.5YR 4/4) films on peds and dark-brown and dark yellowish-brown (7.5YR 4/4 and 10YR 4/4) films on pebbles; few, thin, light-gray (10YR 7/1) silica coats; very strongly acid; gradual, wavy boundary.
- IIC**—52 to 63 inches, red (10R 4/8) very gravelly clay loam (about 70 percent gravel); common, fine, prominent, yellowish-brown (10YR 5/8) mottles; massive; very firm; patchy, thin, dark-red (10R 3/6) and few, thin, yellowish-red (5YR 4/8) clay films; strongly acid.

The loess mantle is 20 to 40 inches thick. It commonly contains a few pebbles in the lower part.

The A1 or Ap horizon is dark grayish brown or brown.

The gravel content of the Coastal Plain material ranges from 35 to 50 percent in the IIBx2 horizon and from 35 to 70 percent in the IIBx3 and IIC horizons. The C horizon ranges from red to strong brown in color and has mottles of yellow and brown. Texture of this horizon ranges from very gravelly clay loam to very gravelly clay.

Lax soils are near and formed in materials similar to those of Brandon and Saffell soils. They have a fragipan that is not characteristic of Brandon and Saffell soils, and they have less gravel in the upper part of the B horizon than those soils. Lax soils are associated with and have an A horizon and an upper part of the B horizon similar to those of Hosmer soils. They have a fragipan that formed in material derived from Coastal Plain gravel, but Hosmer soils have a fragipan that formed in loess.

Lax silt loam, 12 to 18 percent slopes (628E).—This soil is in areas generally less than 20 acres in size that range in shape from oblong to long and narrow. The profile of this soil is similar to that described as representative for the series, except that more than half of the areas of this soil are wooded. The soil in these areas generally is only slightly eroded, and the combined thickness of the silt loam surface and subsurface layers is 8 to 12 inches. In areas that have been used for crops, the soil generally is eroded, and the present silt loam surface layer is 3 to 7 inches thick. The depth to the fragipan ranges from 24 to 30 inches in areas of uneroded soil and from 20 to 25 inches in areas of eroded soil.

Available water capacity is moderate in areas of uneroded soil. It is less in areas of eroded soil (low end of moderate) because of the reduced effective water-storage area above the fragipan. Runoff is rapid, and the hazard of erosion is very severe.

This Lax soil is suited to limited use for crops, but it is better suited to pasture or trees than to other uses. Management group IVE-2; woodland suitability group 2r2; recreation group 4.

Lax soils, 12 to 18 percent slopes, severely eroded (628E3).—These soils are in areas generally less than 10

acres in size that range from somewhat square to long and narrow in shape. The profile of these soils is similar to that described as representative for the series, but most or all of the surface and subsurface layers have been removed by erosion. The present surface layer is mainly subsoil material and is silty clay loam or heavy silt loam.

Erosion has reduced the effective water-storage area above the fragipan. Runoff is rapid, and the hazard of further erosion is severe.

These Lax soils are better suited to pasture or trees than to other uses. Most areas of these soils have been used for crops in the past but are now in pasture, brush, or trees. Management group VIe-2; woodland suitability group 2r2; recreation group 4.

Lax silt loam, 18 to 30 percent slopes, eroded (628F2).—This soil is in areas generally 5 to 30 acres in size that range in shape from oblong to long and narrow. It has the profile described as representative for the series.

Included with this soil in mapping were areas where soils are uneroded or only slightly eroded. They make up about 15 percent of the total acreage of this soil. Also included were areas where the soils are severely eroded and where the present surface layer is mostly silty clay loam subsoil material. These areas make up about 5 percent of the total acreage of this soil. Included in larger areas were small areas of Hosmer silt loam, 18 to 30 percent slopes, and Brandon and Sagell soils, 12 to 30 percent slopes.

Runoff is very rapid, and the hazard of water erosion is very severe if the trees have been removed.

This Lax soil is better suited to pasture or woodland than to other uses. Most areas are wooded. Management group VIe-2; woodland suitability group 2r2; recreation group 5.

Markland Series

The Markland series consists of deep, gently sloping to strongly sloping, moderately well drained and well-drained soils on a few small terraces along the Saline River and the Ohio River in Hardin County. These soils formed in clayey sediment.

In a representative profile the surface layer is about 6 inches of brown silt loam. The subsoil is dark yellowish-brown silty clay about 20 inches thick. Mottles in the subsoil are strong brown. The underlying material is strong-brown and yellowish-brown silty clay.

Markland soils are low in content of organic matter. They have slow permeability and moderate to high available water capacity. Runoff is medium to rapid.

Crops on these soils respond moderately well to lime and fertilizer applied according to soil tests.

Representative profile of Markland silty clay loam, 2 to 7 percent slopes, eroded, in an area of Pope County, 395 feet west and 105 feet south of northeast corner of the NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 4, T. 13 S., R. 7 E.:

Ap—0 to 6 inches, brown (10YR 4/3) silt loam; pale brown (10YR 6/3) dry; moderate, very fine, subangular blocky structure; friable; medium acid; abrupt, smooth boundary.

B21t—6 to 12 inches, dark yellowish-brown (10YR 4/4) silty clay; strong, medium, angular blocky structure;

- firm; discontinuous, thin, yellowish-brown (10YR 5/4) clay films; common, very fine, black (N 2/0) and yellowish-brown (10YR 5/8) iron-manganese concretions; strongly acid; clear, smooth boundary.
- B22t—12 to 26 inches, dark yellowish-brown (10YR 4/4) silty clay; common, fine, distinct, strong-brown (7.5YR 5/8) mottles; weak, medium, prismatic structure; very firm; continuous, thin, brown (7.5YR 4/4) clay films; common, very fine, yellowish-brown (10YR 5/8) iron-manganese concretions; few gray (2.5Y 6/1) streaks along root channels; neutral; gradual, smooth boundary.
- C1—26 to 40 inches, strong-brown (7.5YR 5/8) silty clay; massive; very firm; slightly effervescent; gradual, smooth boundary.
- C2—40 to 60 inches, yellowish-brown (10YR 5/8) silty clay; very thin and thinly stratified; firm; continuous, thin, gray (2.5Y 6/1) silty coatings on strata faces and in root channels; strongly effervescent.

The depth to carbonates ranges from about 20 to 45 inches. In places carbonates are exposed at the surface of severely eroded soils.

The A horizon ranges from 1 to 15 inches in thickness.

A silty clay loam B1 horizon is present in places. The lower part of the B horizon contains light brownish-gray mottles in places.

The C horizon is mainly silty clay but in places has thin strata of silty clay loam to sandy loam. The C horizon generally contains carbonate nodules.

Markland soils are near McGary, Sciotoville, and Wheeling soils. They formed in material similar to that of McGary soils but are better drained than these soils. Markland soils contain more clay and are less acid in the lower part of the B horizon and the C horizon than Sciotoville and Wheeling soils.

Markland silt loam, 2 to 7 percent slopes, eroded (467C2).—This soil is in irregularly shaped areas on sides of terraces. Areas generally are 10 acres or less in size. Slopes are mostly 50 to 150 feet long. This soil has the profile described as representative for the series. About one-third of the areas have slopes of less than 4 percent.

Included with this soil in mapping, in Hardin County, were a few areas of sloping soil that is similar to the somewhat poorly drained McGary soils.

Runoff is medium, and the hazard of erosion is moderate.

This Markland soil is only moderately well suited to most uses because of slope, slow permeability, and low productivity. Management group IIIe-1; woodland suitability group 2o1; recreation group 2.

Markland silt loam, 7 to 15 percent slopes, eroded (467D2).—This soil is in small areas on sides of narrow terraces. Slopes generally are 50 to 150 feet long. In slightly more than half the areas, slope is 7 to 12 percent. In the remaining areas slope is more than 12 percent.

Included with this soil in mapping were areas where the soil is severely eroded and the present surface layer consists mostly or entirely of silty clay or silty clay loam subsoil material. These areas make up about 13 percent of the total acreage of this soil. Also included were areas on short terrace breaks where slopes range from 15 to 30 percent.

Runoff is rapid, and the hazard of erosion is severe.

This Markland soil is suited to trees or pasture but has limited suitability for crops. Management group IVe-2; woodland suitability group 2o1; recreation group 3.

McGary Series

The McGary series consists of nearly level to gently sloping, deep, somewhat poorly drained soils on a few terrace areas near the Saline River and the Ohio River in Hardin County. These soils formed in clayey sediment.

In a representative profile the surface layer is about 3 inches of dark-gray silt loam. The subsurface layer is about 4 inches of grayish-brown silt loam. The subsoil is about 48 inches thick. The upper 6 inches is grayish-brown, firm silty clay loam that has yellowish-brown mottles. The next 20 inches is yellowish-brown, very firm silty clay that has gray mottles. The lower 22 inches is light brownish-gray, very firm silty clay that has gray, light-gray, yellowish-brown, and strong-brown mottles. The underlying material is yellowish-brown and gray silty clay.

McGary soils are low in content of organic matter. They have slow to very slow permeability and moderate to high available water capacity.

Crops on these soils respond moderately well to lime and fertilizer applied according to soil tests. The seasonal water table is within a depth of 3 feet.

Representative profile of McGary silt loam, 0 to 4 percent slopes, in a pasture in Hardin County, 85 feet west of gate on gravel lane and 130 feet south of gravel lane in the SW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 28, T. 12 S., R. 8 E.:

- A1—0 to 3 inches, dark-gray (10YR 4/1) silt loam; gray (10YR 6/1) dry; strong, medium, granular structure; friable; neutral; abrupt, smooth boundary.
- A2—3 to 7 inches, grayish-brown (10YR 5/2) heavy silt loam; many, fine, distinct, yellowish-brown (10YR 5/6 and 5/8) and common, fine, faint, very pale brown (10YR 7/3) mottles; very weak, thick, platy structure parting to weak, fine, subangular blocky; friable to firm; very strongly acid; clear, smooth boundary.
- B1—7 to 13 inches, grayish-brown (2.5YR 5/2) heavy silty clay loam; many, fine, yellowish-brown (10YR 5/6 and 5/8) mottles; moderate, medium, angular blocky structure; firm; patchy, thin, pale-brown (10YR 6/3) clay films; very strongly acid; clear, smooth boundary.
- B21t—13 to 21 inches, yellowish-brown (10YR 5/6) silty clay; common, fine, distinct, gray (10YR 6/1) mottles; weak, medium, prismatic structure parting to moderate, fine and medium, subangular blocky; very firm; discontinuous, thin, gray (10YR 5/1) clay films; extremely acid; clear, wavy boundary.
- B22t—21 to 33 inches, yellowish-brown (10YR 5/6) silty clay; common, fine, distinct, gray (10YR 6/1) mottles; moderate, medium, prismatic structure parting to moderate, medium, subangular and angular blocky; very firm; patchy, thin, gray (10YR 5/1) clay films; very strongly acid; clear, wavy boundary.
- B23gt—33 to 49 inches, light brownish-gray (2.5Y 6/2) silty clay; common, fine, distinct, gray (10YR 6/1) and yellowish-brown (10YR 5/6 and 5/8) mottles; weak, medium, subangular blocky structure parting to moderate, fine, subangular blocky; very firm; patchy, thin, gray (2.5Y 6/1) clay films; common, very fine and fine, black (N 2/0) and very dark grayish-brown (N 2/0 and 10YR 3/2) iron-manganese concretions; slightly acid; clear, wavy boundary.
- B3g—49 to 55 inches, light brownish-gray (2.5Y 6/2) silty clay; common, fine, distinct, light-gray (2.5Y 7/1) and strong-brown (7.5YR 5/6 and 5/8) mottles; weak, fine, subangular blocky structure; very firm; patchy, thin, light-gray (2.5Y 7/1) clay films; few,

very fine, black (N 2/0) iron-manganese concretions; slightly effervescent; clear, wavy boundary.

C1—55 to 64 inches, yellowish-brown (10YR 5/6) silty clay; massive; very firm; patchy, thin, gray (5Y 5/1) and few, thin, greenish-gray (5BG 6/1) clay films; few, very fine, black (N 2/0) iron-manganese concretions; few small pockets of clear flat crystals; strongly effervescent; abrupt, wavy boundary.

C2—64 to 72 inches, gray (5Y 5/1) silty clay to clay; common, fine, prominent, yellowish-brown (10YR 5/6 and 5/8) and few, fine, distinct, greenish-gray (5GY 5/1) mottles; massive; firm; pockets of clear flat crystals; few small lime nodules; slightly effervescent.

The A1 or Ap and A2 horizons combined range from 6 to 12 inches in thickness. The silty clay loam B1 horizon is lacking in some areas. The C horizon is generally silty clay, but has thin strata of silty clay loam or silt loam in places. The depth to carbonates ranges from about 30 to 50 inches, and the C horizon generally contains lime nodules.

McGary soils are near Markland soils and have natural drainage similar to that of Reesville and Weinbach soils. They are more poorly drained than Markland soils. McGary soils contain more clay in the B and C horizons than Reesville soils, and they contain more clay and are less acid in the lower part of the B horizon and in the C horizon than Weinbach soils.

McGary silt loam, 0 to 4 percent slopes (173B).—This soil is in irregularly shaped areas 10 acres or less in size. In about one-third of the areas, slope is less than 2 percent.

Included with this soil in mapping were areas where slopes are more than 4 percent. These areas make up about 10 percent of the total acreage of this soil. Also included were areas where the depth to moderately alkaline material is as much as 60 inches.

Runoff is slow to medium, and the hazard of water erosion generally is moderate. In areas where the slopes are less than 2 percent, however, the hazard of water erosion is slight. Wetness is a hazard in areas where soils are nearly level.

This McGary soil is suited to most commonly grown crops. Management group IIe-3; woodland suitability group 3o1; recreation group 7.

Muskingum Series

The Muskingum series consists of moderately steep to very steep, well-drained soils that are moderately deep to bedrock. These soils formed in silty or loamy material mixed with sandstone flagstones or stones. They are on uplands throughout Hardin, Pope, and the northern part of Massac Counties.

In a representative profile the surface layer is about 1 inch of very dark grayish-brown stony silt loam. The subsurface layer is about 2 inches of mixed dark grayish-brown and yellowish-brown stony silt loam. The subsoil is 31 inches thick. The upper 17 inches is mainly dark yellowish-brown stony silt loam, and the lower 14 inches is dark yellowish-brown gravelly loam. Sandstone bedrock is at a depth of about 34 inches.

Muskingum soils are low in content of organic matter. They have moderate permeability and low available water capacity. Surface stones and outcrops are common.

In this survey area Muskingum soils are in an intricate pattern with Berks soils and are mapped only as an undifferentiated unit with those soils.

Representative profile of Muskingum stony silt loam in Pope County in a wooded area of Muskingum and Berks soils, 30 to 60 percent slopes, 170 feet north of gravel road from point 95 feet east of culvert that is 0.1 mile east of T-road in the NE $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 7, T. 11 S., R. 7 E.:

O1— $\frac{1}{2}$ inch to 0, very dark brown (10YR 2/2) organic matter, partly decomposed leaves, silt, and matted roots.

A1—0 to 1 inch, very dark grayish-brown (10YR 3/2) stony silt loam; moderate, fine and medium, granular structure; friable; about 20 percent stones and gravel; medium acid; clear, wavy boundary.

A2—1 to 3 inches, mixed dark grayish-brown (10YR 4/2) and yellowish-brown (10YR 5/4) stony silt loam; very weak, very fine, subangular blocky structure parting to weak, fine and medium, granular; friable; about 20 percent stones and gravel; very strongly acid; clear, smooth boundary.

B1—3 to 7 inches, yellowish-brown (10YR 5/4) stony silt loam; few, medium, dark grayish-brown (10YR 4/2) areas; weak, fine, subangular blocky structure parting to weak, very fine, subangular blocky; friable; about 20 percent stones and gravel; very strongly acid; clear, wavy boundary.

B21—7 to 13 inches, dark yellowish-brown (10YR 4/4) stony silt loam; moderate, fine, subangular blocky structure; friable; yellowish-brown (10YR 5/4) ped surfaces; about 33 percent stones and gravel; porous; very strongly acid; clear, wavy boundary.

B22—13 to 20 inches, dark yellowish-brown (10YR 4/4) stony silt loam; strong, fine and very fine, subangular blocky structure between pebbles; friable; yellowish-brown (10YR 5/4) ped surfaces; very strongly acid; gradual, wavy boundary.

IB23—20 to 34 inches, dark yellowish-brown (10YR 4/4) gravelly loam; strong, medium, subangular blocky structure parting to strong, fine, subangular blocky; firm; very strongly acid.

R—34 inches; sandstone bedrock.

The soil averages 20 to 35 percent coarse fragments that consist of pebbles, cobblestones, flagstones, and stones. Individual horizons are less than 20 or more than 35 percent coarse fragments. The upper part of the solum is stony silt loam or stony loam. The depth to bedrock ranges from 18 to 36 inches.

Muskingum soils are closely associated with Berks and Wellston soils. They contain fewer stones than Berks soils. Muskingum soils have less clay in the B horizon than Wellston soils and are not so deep to bedrock as those soils.

Muskingum and Berks soils, 15 to 30 percent slopes (955F).—Areas of these soils are on hillsides and range from 10 to more than 100 acres in size. Slopes range from 200 to more than 500 feet in length. The soils occur together without regularity of pattern. The amount and distribution of each soil within areas varies widely. Individual areas are all Muskingum soils, all Berks soils, or a combination of both.

Included with these soils in mapping were small areas of Wellston and Zanesville soils. Also included were areas of Sandstone rock land. In many areas limestone outcrops and bands of soil that formed in material weathered from limestone were included.

The soils in this unit are used mainly for trees and wildlife habitat. Nearly all areas are wooded. Management group VIIe-1; woodland suitability group 3r2; recreation group 6.

Muskingum and Berks soils, 30 to 60 percent slopes (955G).—These soils are very steep and are on hillsides. Areas range from 10 to more than 100 acres in size. Slopes are 200 to more than 500 feet long. These soils have the profile described as representative for their re-

spective series. They occur together without regularity of pattern. The amount and distribution of each soil within areas varies widely. Individual areas are all Muskingum soils, all Berks soils, or a combination of both.

Included with these soils in mapping were areas of Wellston soils and many areas where small amounts of Sandstone rock land are present. Also included, in places, were limestone outcrops and bands of soil that formed in material weathered from limestone. Included within the larger areas were areas where single slopes are less than 30 percent or more than 60 percent.

The soils in this unit are used mainly for trees or for special wildlife habitat. Nearly all of the areas are wooded. Management group VIIIs-1; woodland suitability group 3r3; recreation group 6.

Petrolia Series

The Petrolia series consists of deep, nearly level, poorly drained soils in the bottoms of sloughs and old bayous on bottom lands along the Ohio River. These soils formed in silty clay loam sediment more than 50 inches thick.

In a representative profile the surface layer consists of about 7 inches of dark grayish-brown silty clay loam. The subsoil, to a depth of about 42 inches, is dark grayish-brown, firm silty clay loam that has grayish-brown and gray mottles. Below this, to a depth of about 62 inches, is gray silty clay loam and light silty clay that has brown, dark yellowish-brown, and yellowish-brown mottles.

Petrolia soils are moderate in content of organic matter. They have moderately slow permeability and high available water capacity.

Crops on these soils respond moderately well to fertilizer applied according to soil tests. The seasonal water table is at or near the surface, and annual flooding is likely to occur in low areas.

Representative profile of Petrolia silty clay loam, in a cultivated field in Massac County, 85 feet west of uncleared brush at field-lane crossing and 30 feet north of the center of the watercourse in the SE $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 35, T. 16 S., R. 6 E.:

- Ap—0 to 7 inches, very dark grayish-brown and dark grayish-brown (10YR 3/2 and 4/2) silty clay loam; dark brown (10YR 3/3) crushed and grayish brown to pale brown (10YR 5/2 to 6/3) dry; weak, medium, granular and weak, very fine, subangular blocky structure; firm; moderately alkaline; clear, smooth boundary.
- B1—7 to 13 inches, dark grayish-brown (10YR 4/2) silty clay loam; weak, medium, subangular blocky structure; firm; common, fine, brown (7.5YR 4/4) iron concretions and patchy yellowish-red (5Y 4/6) iron stains; neutral; clear, smooth boundary.
- B21g—13 to 26 inches, dark grayish-brown (2.5Y 4/2) silty clay loam; few, fine, faint, grayish-brown (10YR 5/2) mottles; moderate, fine and medium, subangular blocky structure; firm; few, medium, distinct, very dark grayish-brown and dark yellowish-brown (10YR 3/2 and 4/4) iron stains; discontinuous, thin, grayish-brown (10YR 5/2) clay films; common, fine, black (N 2/0) iron-manganese concretions; neutral; clear, smooth boundary.
- B22g—26 to 42 inches, dark grayish-brown (2.5Y 4/2) silty clay loam; few, fine, faint, gray (10YR 5/1 and 6/1) mottles; weak, medium, subangular blocky structure parting to moderate, fine, subangular blocky; firm;

discontinuous, thin, grayish-brown (10YR 5/2) clay films; common very dark grayish-brown and dark yellowish-brown (10YR 3/2 and 4/4) iron stains; common, fine and very fine, very dark grayish-brown and dark yellowish-brown (10YR 3/2 and 4/4) iron concretions; neutral; clear, smooth boundary.

B23g—42 to 53 inches, gray (10YR 5/1) silty clay loam; many, fine, faint, brown and dark yellowish-brown (10YR 4/3 and 4/4) mottles; moderate, fine, subangular blocky structure; firm; continuous, thin, dark grayish-brown (10YR 4/2 and 2.5Y 4/2) clay films; many, fine and medium, black (N 2/0) and dark-brown (7.5YR 3/2) iron-manganese stains; neutral; clear, smooth boundary.

B3g—53 to 62 inches, gray (10YR 5/1) light silty clay; common, fine, distinct, yellowish-brown (10YR 5/6 and 5/8) mottles; weak, medium, subangular blocky structure; firm; continuous, thin, gray (N 5/0) clay films in root channels; common, fine, black (N 2/0) and very dark grayish-brown (10YR 3/2) iron-manganese concretions; neutral.

The A1 or Ap horizon is normally dark gray to light brownish gray, but it is very dark gray or very dark grayish brown. It is less than 10 inches thick in places.

The B horizon is normally lighter colored than the A horizon, but it ranges from dark gray to light brownish gray. Reaction in this horizon ranges from medium acid to neutral. The texture is silty clay loam to a depth of at least 50 inches, but in places strata of loam to silty clay are below this depth.

Petrolia soils are near Karnak, Cape, and Hurst soils. They contain less clay in the solum than Karnak soils and are less acid throughout than Cape soils. Petrolia soils are more poorly drained and less acid in the solum than Hurst soils.

Petrolia silty clay loam (288).—This soil is nearly level or depressional. Most of the acreage is in long, low areas or in sloughs 100 to 300 feet wide. It has the profile described as representative for the series.

Included with this soil in mapping were areas near the Ohio River where the soil is less poorly drained and the dominant color of the upper 10 to 20 inches in brown or dark brown. Also included were areas farther back from the river where the soil is strongly acid in reaction.

Wetness and spring flooding are hazards in most areas.

This Petrolia soil is well suited to annual farm crops, but overwinter crops or pasture are seldom grown. Management group IIw-3; woodland suitability group 2w5; recreation group 12.

Petrolia silty clay loam, wet (W288).—Areas of this soil are mostly in long, low, depressional sloughs. The water table is at or near the surface, and many areas are under water most of the winter and spring. Some areas are flooded most of the year.

Included with this soil in mapping were a few areas that are strongly acid in reaction.

This soil has limited use. It remains wet and waterlogged too late in the season to allow seedbed preparation for crops or pasture. Most areas are wooded. In places, the soils are too wet for most kinds of trees. Management group Vw-1; woodland suitability group 3w6; recreation group 14.

Raccoon Series

The Raccoon series consists of deep, nearly level, poorly drained soils on terraces and high bottom lands of the Ohio River and in the New Columbia-Bear Creek area in Massac County and the southern part of Pope County.

These soils formed in silt loam and silty clay loam sediment.

In a representative profile the surface layer is about 6 inches of grayish-brown silt loam. The subsurface layer is about 24 inches of light-gray silt loam that has brown and yellowish-brown mottles. The subsoil is firm silty clay loam about 27 inches thick. The upper 12 inches is gray and has brown mottles, and the lower 15 inches is grayish brown and has dark yellowish-brown mottles. The underlying material, to a depth of about 70 inches, is grayish-brown silty clay loam that has yellowish-brown mottles.

Racoon soils are low in content of organic matter. They have slow permeability and high available water capacity.

Crops on these soils have moderate response to lime and fertilizer applied according to soil tests. The seasonal water table is at or near the surface. In places these soils are subject to ponding or flooding.

Representative profile of Racoon silt loam in an idle field in Massac County, 200 feet east of centerline of dirt lane and 140 feet south of centerline of blacktop road in the NE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 18, T. 16 S., R. 6 E.:

Ap—0 to 6 inches, grayish-brown (10YR 5/2) silt loam; light gray (10YR 7/2) dry; weak, fine, granular structure; friable; many, very fine, black (N 2/0), very dark grayish-brown (10YR 3/2), and dark yellowish-brown (10YR 4/4) iron-manganese concretions; very strongly acid; clear, smooth boundary.

A21—6 to 14 inches, light-gray (10YR 7/2) silt loam; common, fine, faint, brown (10YR 5/3) mottles; weak, very fine, platy structure; friable; many, very fine, black (N 2/0), very dark grayish-brown (10YR 3/2), and dark yellowish-brown (10YR 4/4) iron-manganese concretions; very strongly acid; clear, smooth boundary.

A22—14 to 30 inches, light-gray (10YR 7/2) silt loam; common, fine, faint, yellowish-brown (10YR 5/4) mottles; very weak, medium, platy structure; friable; many, very fine, black (N 2/0), very dark grayish-brown (10YR 3/2), dark yellowish-brown (10YR 4/4), and yellowish-brown (10YR 5/6) iron-manganese concretions; very strongly acid; clear, smooth boundary.

B21tg—30 to 42 inches, gray (10YR 5/1) silty clay loam; common, fine, faint, brown (10YR 5/3) mottles; weak, medium, subangular blocky structure; firm; common very fine pores; common, thin, grayish-brown (2.5Y 5/2) clay films in root and worm channels; many, very fine, black (N 2/0), dark yellowish-brown (10YR 4/4), and yellowish-brown (10YR 5/6) iron-manganese concretions; very strongly acid; clear, smooth boundary.

B22tg—42 to 57 inches, grayish-brown (2.5Y 5/2) silty clay loam; common, fine, distinct, dark yellowish-brown (10YR 4/4) and strong-brown (7.5YR 5/6) mottles; weak, medium, subangular blocky structure; firm; few, thin, grayish-brown (2.5Y 5/2) clay films; many, very fine, black (N 2/0), dark yellowish-brown (10YR 4/4), and yellowish-brown (10YR 5/6) iron-manganese concretions; very strongly acid; gradual, smooth boundary.

C—57 to 70 inches, grayish-brown (10YR 5/2) silty clay loam; common, fine, distinct, yellowish-brown (10YR 5/6) mottles; massive; firm; many, very fine, black (N 2/0), dark yellowish-brown (10YR 4/4), and yellowish-brown (10YR 5/6) iron-manganese concretions; common, fine, black (N 2/0), strong-brown (7.5YR 5/8), and yellowish-red (5YR 5/8) iron-manganese stains; medium acid.

The Ap and A2 horizons combined range from 24 to 36 inches in thickness. The A2 horizon ranges from grayish brown to gray, and it commonly is mottled.

The B horizon ranges from grayish-brown to gray and is light to heavy silty clay loam. It has weak to moderate structure. Reaction in this horizon is strongly acid or very strongly acid.

Racoon soils have natural drainage similar to that of Ginat, Weir, and Bonnie soils, and they are near Ginat and Bonnie soils. They have a thicker A2 horizon than Ginat and Weir soils. Racoon soils contain more clay in the lower part of the B horizon than Bonnie soils.

Racoon silt loam (109).—This soil is nearly level and is on terraces and high bottom lands. A few areas are on uplands. Slopes are less than 2 percent. Some areas are in depressions. Areas are irregular in shape and are 5 to 300 acres in size.

Included with this soil in mapping were small areas of Ginat silt loam and Bonnie silt loam. Also included were areas of a similar soil that has a silty clay subsoil.

This soil is wet in winter and spring but in a few lower areas is wet most of the year. Areas of this soil associated with Ginat silt loam generally are not subject to flooding, but many areas associated with Bonnie silt loam are on bottom lands and are subject to overflow.

This Racoon soil is used for crops, but some areas are wooded. It is suited to most crops commonly grown if water is not allowed to stand on the surface. Management group IIIw-1; woodland suitability group 4w2; recreation group 8.

Reesville Series

The Reesville series consists of deep, nearly level to gently sloping, somewhat poorly drained soils on low terraces near the Saline and Ohio Rivers and on the Cache River-Bay Creek lowlands. These soils formed in silt loam and silty clay loam sediment.

In a representative profile the surface layer is about 7 inches of dark-brown silt loam. The subsurface layer is about 5 inches of brown silt loam that has light-gray and light brownish-gray mottles. The subsoil is about 21 inches thick. The upper part is mainly grayish brown, firm silty clay loam that has yellowish-brown mottles, and the lower part is brown heavy silt loam that has yellowish-brown mottles. The underlying material, to a depth of about 58 inches, is mottled, grayish-brown and yellowish-brown silt loam. Below this, to a depth of about 69 inches, it is mottled, brown, yellowish-brown, and pale-brown silt loam.

Reesville soils are low in content of organic matter. They have moderate to moderately slow permeability and high available water capacity.

Crops on these soils respond moderately well to lime and fertilizer applied according to soil tests. The seasonal water table is at a depth of 3 feet or less.

Representative profile of Reesville silt loam in a cultivated field in Massac County, 430 feet north and 300 feet west of the southeast corner of sec. 32, T. 14 S., R. 4 E.:

Ap—0 to 7 inches, dark-brown (10YR 4/3) silt loam; pale brown (10YR 6/3) dry; moderate, fine, granular structure; friable; many roots; common, very fine, black (N 2/0) iron-manganese concretions; neutral; abrupt, smooth boundary.

A2—7 to 12 inches, brown (10YR 5/3) silt loam; few, fine, distinct, light-gray (10YR 7/1) and light brownish-gray (10YR 6/2) mottles; weak, medium, platy structure; friable; many roots; many, very fine, black (N 2/0) and dark-brown (10YR 3/3) iron-

manganese concretions; neutral; abrupt, smooth boundary.

B21tg—12 to 16 inches, yellowish-brown (10YR 5/4) silty clay loam; many, fine, faint, yellowish-brown (10YR 5/6 and 5/8) and few, fine, distinct, grayish-brown (10YR 5/2) mottles; moderate, medium, prismatic structure parting to weak, fine and medium, sub-angular blocky; firm; common roots; discontinuous, thin, brown (10YR 5/3) clay films; common, very fine, very dark grayish-brown (10YR 3/2) iron-manganese concretions; few pale-brown (10YR 6/3) silica coats; slightly acid; clear, smooth boundary.

B22tg—16 to 27 inches, grayish-brown (10YR 5/2) silty clay loam; many, fine, distinct, yellowish-brown (10YR 5/6 and 5/8) mottles; moderate, medium, prismatic structure parting to strong, fine and medium, sub-angular blocky; firm; common roots; continuous, thin, dark grayish-brown (10YR 4/2) clay films; few, fine, black (N 2/0) iron-manganese stains; common, very fine, black (N 2/0), very dark gray (10YR 3/1), and very dark grayish-brown (10YR 3/2) iron-manganese concretions; neutral; clear, smooth boundary.

B3—27 to 33 inches, brown (10YR 5/3) heavy silt loam; common, fine, faint, yellowish-brown (10YR 5/6) and few, fine, faint, yellowish-brown (10YR 5/8) mottles; weak, medium, prismatic structure; firm; few roots; common fine pores; patchy, thin, dark grayish-brown (10YR 4/2) clay films; common, very fine, very dark grayish-brown (10YR 3/2) iron-manganese concretions; moderately alkaline; clear, smooth boundary.

C1—33 to 40 inches, mottled grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/6 and 5/8) heavy silt loam; massive; friable; few roots; dark grayish-brown (10YR 4/2) clay films in root channels; common, very fine, very dark grayish-brown (10YR 3/2) and dark yellowish-brown (10YR 3/4) iron-manganese concretions; noneffervescent; moderately alkaline; clear, smooth boundary.

C2—40 to 58 inches, mottled grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/6 and 5/8) silt loam; massive; common, very fine, very dark grayish-brown (10YR 3/2) and dark yellowish-brown (10YR 3/4) iron-manganese concretions; strongly effervescent; gradual, smooth boundary.

C3—59 to 69 inches, mottled brown (10YR 5/3), yellowish-brown (10YR 5/4, 5/6, and 5/8), and pale-brown (10YR 6/3) silt loam; massive; friable; common, very fine, very dark grayish-brown (10YR 3/2) iron-manganese concretions; violently effervescent.

The B horizon ranges from dark yellowish brown to light brownish gray and has mottles ranging from light gray to yellowish brown. Reaction in the B21tg horizon ranges from very strongly acid to slightly acid.

In places the silt loam C horizon is slightly stratified with light silty clay loam or loam. Depth to the C horizon ranges from 24 to 50 inches.

Reesville soils are near and have natural drainage similar to McGary and Weinbach soils. They contain less clay in the B and C horizons than McGary soils, are less acid in the lower part of the B horizon and in the C horizon than Weinbach soils, and lack the fragipan that is characteristic of Weinbach soils.

Reesville silt loam (723).—This soil has slopes of 0 to 4 percent. About three-fourths of the areas are nearly level, oblong or irregular in shape, and 5 to 40 acres in size. Areas where this soil is gently sloping are on the convex tops and sides of terraces and generally are less than 10 acres in size. Slopes are 50 to 150 feet long.

Included with this soil in mapping were some small areas of poorly drained soils at the heads of drainageways within larger areas of this soil. Also included in a few places were soils that are strongly acid to a depth

of more than 4 feet. A few areas where slope is 4 to 7 percent were also included.

Runoff is slow, and the hazard of erosion is slight where this soil is sloping. Artificial drainage is beneficial in some areas.

This Reesville soil is well suited to most commonly grown crops. Management group IIw-1; woodland suitability group 2o1; recreation group 7.

Robbs Series

The Robbs series consists of nearly level to gently sloping, somewhat poorly drained soils that are moderately deep to a fragipan layer. These soils are mainly on uplands in the northern part of Pope County. They formed in loess.

In a representative profile the surface layer is about 4 inches of grayish-brown silt loam. The subsurface layer is about 4 inches of brown silt loam. The subsoil is 36 inches thick. The upper 14 inches is light yellowish-brown silty clay loam mottled with light gray. The next 7 inches is mixed yellowish-brown, light brownish-gray, and white silty clay loam. The lower 15 inches consists of a fragipan that is mixed yellowish-brown and light yellowish-brown, very firm silty clay loam in the upper part and firm heavy silt loam in the lower part. The underlying material, to a depth of about 65 inches, is yellowish-brown and light brownish-gray silt loam.

Robbs soils are low in content of organic matter. They have slow permeability and moderate available water capacity.

Crops on these soils respond moderately well to lime and fertilizer applied according to soil tests. The seasonal water table is at a depth of 3 feet or less.

Representative profile of Robbs silt loam, 1 to 4 percent slopes, on highway right-of-way in Pope County, 50 feet south of highway centerline and 190 feet east of field entrance in the SW $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 23, T. 12 S., R. 5 E.:

A1—0 to 4 inches, grayish-brown (10YR 5/2) silt loam; light gray (10YR 7/2) dry; moderate, medium, granular structure; friable; many roots; moderately alkaline; abrupt, smooth boundary.

A2—4 to 8 inches, brown (10YR 5/3) silt loam; weak, medium, platy structure; friable; many roots; mildly alkaline; clear, smooth boundary.

B1—8 to 16 inches, light yellowish-brown (10YR 6/4) light silty clay loam; common, fine, distinct, light-gray (10YR 7/2) and few, fine, distinct, yellowish-brown (10YR 5/6) mottles; weak, fine and medium, sub-angular blocky structure; friable; few roots; very strongly acid; clear, smooth boundary.

B21t—16 to 22 inches, light yellowish-brown (10YR 6/4) light silty clay loam; many, coarse, distinct, light-gray (10YR 7/2) and few, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, subangular blocky structure; firm; patchy, thin, light-gray (10YR 7/2) silica coats; few roots; very strongly acid; abrupt, smooth boundary.

B and A—22 to 29 inches, fine, mixed, yellowish-brown (10YR 5/4), light yellowish-brown (10YR 6/4), light brownish-gray (10YR 6/2), and white (10YR 8/2) silty clay loam; strong, fine and medium, subangular blocky structure; very firm, slightly brittle; patchy, thin, light brownish-gray (10YR 6/2) clay films; continuous, thick, light yellowish-brown (10YR 6/4) silica coats; common roots; very strongly acid; clear, smooth boundary.

- Bx1—29 to 39 inches, mixed yellowish-brown and light yellowish-brown (10YR 5/6 and 6/4) silty clay loam; few, medium, distinct, light-gray (10YR 7/2) mottles; moderate, medium, subangular blocky structure; very firm, brittle; few, thin, light brownish-gray (10YR 6/2) clay films; discontinuous streaks of light gray (10YR 7/2); few, fine, very dark grayish-brown (10YR 3/2) iron concretions; very strongly acid; gradual, smooth boundary.
- Bx2—39 to 44 inches, mixed yellowish-brown and light yellowish-brown (10YR 5/6 and 6/4) heavy silt loam; common, medium, distinct, light-gray (10YR 7/2) mottles and streaks; weak, medium and coarse, subangular blocky structure; firm, brittle; few, thin, light brownish-gray (10YR 6/2) clay films; few, fine, very dark grayish-brown (10YR 3/2) iron concretions; very strongly acid; clear, smooth boundary.
- C1—44 to 65 inches, yellowish-brown (10YR 5/4) silt loam; common, coarse, distinct, light brownish-gray (10YR 6/2) mottles and streaks; massive; friable; very strongly acid; gradual, wavy boundary.

The A2 horizon ranges from brown to light yellowish brown and in places is mottled with pale brown or light brownish gray. The depth to the Bx1 horizon ranges from 24 to 31 inches. The depth to the C horizon ranges from 42 to 48 inches.

Robbs soils are near Grantsburg soils, and they have a profile similar to that of Stoy soils. They are more poorly drained than Grantsburg soils. Robbs soils have a thicker, firmer fragipan at a shallower depth than Stoy soils.

Robbs silt loam, 1 to 4 percent slopes (335B).—This soil is commonly in areas that are essentially round and mainly less than 10 acres in size.

Included with this soil in mapping were areas where this soil is nearly level and where slopes are less than 1 percent. These areas make up about one-tenth the acreage of this soil. Also included were small areas of poorly drained soils, commonly at the heads of drainageways.

This Robbs soil is suited to most crops grown in the survey area. Management group IIe-3; woodland suitability group 3o1; recreation group 7.

Saffell Series

The Saffell series consists of deep gently sloping to steep, well-drained soils in Massac County and the southern part of Pope County. These soils formed in gravelly Coastal Plain material.

In a representative profile the surface layer is about 2 inches of very dark grayish-brown gravelly silt loam. The subsoil extends to a depth of 68 inches or more. The upper 8 inches is yellowish-brown very gravelly silt loam. The next 14 inches is dark-brown very gravelly clay loam. Below this is red very gravelly clay loam about 26 inches thick. The lower 18 inches is red and dark-red very gravelly clay.

Saffell soils are low in content of organic matter. They have moderate to rapid permeability and low available water capacity.

Most areas of these soils are wooded.

In Massac and Pope Counties, Saffell soils occur in an intricate pattern with Brandon soils and are mapped together as undifferentiated units of Brandon and Saffell soils.

Representative profile of Saffell gravelly silt loam, 12 to 30 percent slopes, in a wooded area of Massac County; 200 feet south of gravel road in north bank of bulldozer cut in the NW $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 35, T. 15 S., R. 6 E.:

- A1—0 to 2 inches, very dark grayish-brown (10YR 3/2) gravelly silt loam; grayish brown (10YR 5/2) dry; weak, fine, granular structure; friable; 50 percent gravel; medium acid; abrupt, smooth boundary.
- B1—2 to 10 inches, yellowish-brown (10YR 5/4) very gravelly silt loam; weak, fine, subangular blocky structure; friable; 80 percent gravel; medium acid; abrupt, smooth boundary.
- B21t—10 to 24 inches, dark brown (7.5YR 4/4) very gravelly clay loam; weak, fine, angular blocky structure; friable; 90 percent gravel; strongly acid; abrupt, smooth boundary.
- B22t—24 to 50 inches, red (10YR 4/6 and 4/8) very gravelly clay loam; weak, fine, angular blocky structure; firm, very sticky; continuous, thick, dark yellowish-brown (10YR 3/4) clay films; strongly acid; gradual, smooth boundary.
- B23t—50 to 68 inches, red and dark-red (10YR 4/6 and 3/8) very gravelly clay; moderate, fine, angular blocky structure; firm; discontinuous, medium, dark yellowish-brown (10YR 3/4) clay films; very strongly acid.

The solum ranges from 20 inches to more than 72 inches in thickness, but it generally is more than 60 inches thick. These soils are generally gravelly on the surface and throughout the A horizon, but in places they contain little or no gravel to a depth of as much as 20 inches.

The B horizon normally is more than 35 percent but less than 80 percent gravel. The content of sand and fine gravel, however, is variable. The gravel generally contains bands, 1 to 10 inches thick, cemented with iron oxides, but such bands are normally below a depth of 40 inches. The total thickness of the gravel bed ranges from about 2 to more than 20 feet and is underlain by Coastal Plain clay and sand that are exposed in places in eroded spots where the gravel layer is thin.

The solum of Saffell soils in Pope and Massac Counties generally is thicker than is recognized in the range for the Saffell series, but this difference does not greatly alter the usefulness and behavior of these soils.

Saffell soils are near and formed in materials similar to those of Brandon and Lax soils. They contain more gravel at or near the surface in most places than Brandon soils. They lack the fragipan that is characteristic of Lax soils.

Sandstone Rock Land

Sandstone rock land (9) is a land type consisting of very stony soils or areas of soils interspersed with many boulders, rock outcrops, and vertical bluffs. Exposed rock is dominant.

Areas range from long and narrow single sandstone bluffs to oblong areas that contain boulders and small rock outcrops or areas that contain many stones and flags. The intervening soil is 4 to 60 inches thick over bedrock. The surface layer ranges from silt loam to stony loam. The underlying layers range from silty clay loam to stony loam, but are silty clay in a few places where shale is present and crops out on the surface.

No representative profile can be described for Sandstone rock land, but a typical wooded area is in Pope County in NW $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 4, T. 11 S., R. 7 E.

Included with this unit in mapping were small areas of Berks, Grantsburg, Hosmer, Muskingum, Wellston, and Zanesville soils. These soils have slopes of 20 to 60 percent. Also included were areas where limestone outcrops and bluffs form a part of many slopes.

The included soils have moderate to moderately rapid permeability. Available water capacity ranges from high to very low because of the shallow depth of the soil or high proportion of stones in the soil.

Sandstone rock land generally is used only for wildlife habitat or recreation. The included soils are moderately well suited to well suited to trees. Management group VII_s-1; woodland suitability group 3r3; recreation group 6.

Sciotoville Series

The Sciotoville series consists of nearly level to moderately steep, moderately well drained soils that are moderately deep to a fragipan. These soils are on terraces of the Ohio River and the Bay Creek-Cache River lowlands. They formed in silty and loamy sediment.

In a representative profile the surface layer is about 8 inches of brown silt loam. The subsoil is about 44 inches thick. The upper 6 inches is yellowish-brown silt loam. The next 10 inches is dark yellowish-brown heavy silt loam that has pale-brown mottles. Below this is a fragipan, about 18 inches thick, of brown, very firm heavy silt loam that has gray, light-gray, and yellowish-brown mottles. The lower 10 inches of the subsoil is brown light clay loam that has light brownish-gray mottles. The underlying material, to a depth of about 72 inches, is dark yellowish-brown silty clay loam that has light brownish-gray mottles.

Sciotoville soils are low in content of organic matter. They have moderately slow permeability and high available water capacity. Runoff is slow to rapid.

Crops on these soils respond moderately well to lime and fertilizer applied according to soil tests. The rooting zone is restricted somewhat by the fragipan.

Representative profile of Sciotoville silt loam, 2 to 4 percent slopes, in an idle field in Massac County, 180 feet south of railroad track and 120 feet east of old lane in the SE $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 8, T. 16 S., R. 5 E.:

- Ap—0 to 8 inches, brown (10YR 4/3) silt loam; pale brown (10YR 6/3) dry; moderate, fine, granular structure; friable; many, very fine, very dark grayish-brown (10YR 3/2) iron-manganese concretions; strongly acid; abrupt, smooth boundary.
- B1—8 to 14 inches, yellowish-brown (10YR 5/6) silt loam; weak, fine, subangular blocky structure; friable; common, very fine, black (N 2/0) and very dark grayish-brown (10YR 3/2) iron-manganese concretions; very dark grayish-brown (10YR 3/2) films in root channels; very strongly acid; clear, smooth boundary.
- B2t—14 to 24 inches, dark yellowish-brown (10YR 4/4) heavy silt loam; few, fine, distinct, pale-brown (10YR 6/3) mottles; weak, medium, subangular blocky structure; friable; common, fine, black (N 2/0) and very dark grayish-brown (10YR 3/2) iron-manganese concretions; patchy, thin, yellowish-brown (10YR 5/4) clay films; very strongly acid; clear, smooth boundary.
- Bx1—24 to 32 inches, brown (7.5YR 4/4) heavy silt loam; few, fine, distinct, gray (10YR 6/1) and yellowish-brown (10YR 5/6) mottles; coarse prismatic structure; very firm, brittle; few, very fine, very dark grayish-brown (10YR 3/2) iron-manganese concretions; discontinuous, thin, light brownish-gray (10YR 6/2) silt coatings; very strongly acid; gradual, smooth boundary.
- Bx2—32 to 42 inches, brown (7.5YR 4/4) heavy silt loam; common, fine, distinct, light-gray (10YR 7/2) mottles; moderate, very coarse, prismatic structure; very firm, brittle; common, very fine, black (N 2/0) and very dark grayish-brown (10YR 3/2) iron-manganese concretions; continuous, thin, light-gray

- (10YR 7/2) silt coatings and patchy, thin, light brownish-gray (10YR 6/2) clay films; very strongly acid; gradual, smooth boundary.
- B3—42 to 52 inches, brown (7.5YR 4/4) light clay loam; common, medium, distinct, light brownish-gray (10YR 6/2) mottles; weak, medium, prismatic structure; firm; common, very fine, black (N 2/0) and very dark grayish-brown (10YR 3/2) iron-manganese concretions; few, thin, grayish-brown (10YR 5/2) clay films; very strongly acid; gradual, smooth boundary.
- C—52 to 72 inches, dark yellowish-brown (10YR 4/4) silty clay loam; common, fine, distinct, light brownish-gray (10YR 6/2) mottles; massive; firm; common, very fine, black (N 2/0) and very dark grayish-brown (10YR 3/2) iron-manganese concretions; very strongly acid.

In the B horizon texture ranges from heavy silt loam to silty clay loam. Color ranges from brown to yellowish brown. Reaction in the B and C horizons ranges from medium acid to very strongly acid.

The C horizon is silty clay loam or silt loam and is stratified in places with sandy sediment. The B and C horizons contain a noticeable amount of mica in places.

Sciotoville soils are associated with Ginat, Wheeling, and Weinbach soils. They are not so well drained as Wheeling soils, but they are better drained than Ginat and Weinbach soils.

Sciotoville silt loam, 0 to 2 percent slopes (462A).—This soil is in areas ranging in shape from essentially round to long and narrow. Areas are generally 10 to 50 acres in size. The profile of this soil is similar to that described as representative for the series, but the surface layer is 10 to 14 inches thick.

Included with this soil in mapping were small areas of poorly drained Ginat silt loam and somewhat poorly drained Weinbach silt loam.

Runoff is slow. This Sciotoville soil is well suited to most uses. Management group IIw-1; woodland suitability group 2o1; recreation group 2.

Sciotoville silt loam, 2 to 4 percent slopes (462B).—Areas of this soil are on the sides and convex tops of low terraces. They are irregular or long and narrow in shape and 5 to about 50 acres in size. This soil has the profile described as representative for the series.

Included with this soil in mapping were areas where the soil has a thin silt loam surface layer or where the surface layer has become eroded and now is only 3 to 7 inches thick. In places in these areas, subsoil material has been incorporated into the plow layer. These areas make up about 5 percent of the acreage of this soil. Also included were a few areas of soils near the Saline River in Hardin County that are calcareous in the lower part of the subsoil.

Runoff is medium, and the hazard of erosion is slight. The Sciotoville soil is well suited to most uses. Management group IIe-2; woodland suitability group 2o1; recreation group 2.

Sciotoville silt loam, 4 to 7 percent slopes, eroded (462C2).—Areas of this soil are mostly in drainageways and on long, narrow sides of terraces. Slopes are 50 to 200 feet long. The profile of this soil is similar to that described as representative for the series, but the silt loam surface layer is less than 7 inches thick. In most places some subsoil material has been incorporated into the plow layer.

Included with this soil in mapping were areas of only slightly eroded or uneroded soils that have a silt loam surface layer 8 to 14 inches thick. These areas make up

about 20 percent of the mapped acreage. Also included were areas where the soil is severely eroded and where the surface layer is silty clay loam or heavy silt loam. These areas make up about 5 percent of the acreage of this soil. A few small areas where the surface layer is sandy and a few areas, mainly near the Saline River in Hardin County where the lower part of the subsoil is calcareous, were included.

Runoff is medium, and the hazard of erosion is moderate. This Sciotoville soil is well suited to most uses. Management group IIe-2; woodland suitability group 2o1; recreation group 2.

Sciotoville silt loam, 7 to 12 percent slopes, eroded (462D2).—This soil is around drainageways and on the sides of low terraces. Areas generally are less than 10 acres in size. Slopes are 50 to 150 feet long. The profile of this soil is similar to that described as representative for the series, but the silt loam surface layer is less than 7 inches thick. In most places subsoil material has been incorporated into the plow layer.

Included with this soil in mapping were areas of slightly eroded soils that have a surface layer more than 7 inches thick. Also included were a few areas of somewhat poorly drained soils that have slopes of 7 to 12 percent and that are mostly at the heads of drainageways. A few areas near the Saline River in Hardin County where the lower part of the subsoil is calcareous were also included.

Runoff is rapid, and the hazard of erosion is severe. This Sciotoville soil is suited to most uses. Management group IIIe-2; woodland suitability group 2o1; recreation group 3.

Sciotoville soils, 7 to 12 percent slopes, severely eroded (462D3).—Areas of these soils are along drainageways and on the sides of low terraces and are generally less than 10 acres in size. Slopes are 50 to 150 feet long. The profile of these soils is similar to that described as representative for the series, but most or all of the original silt loam surface layer has been removed by erosion. The present plow layer is mainly subsoil material and is silty clay loam or heavy silt loam. The depth to the fragipan layer ranges from 18 to 30 inches.

Included with these soils in mapping were a few areas near the Saline River in Hardin County where the lower part of the subsoil is calcareous.

Runoff is rapid, and the hazard of further erosion is severe. Erosion has reduced the effective moisture-storage area above the fragipan.

These Sciotoville soils are well suited to pasture or trees, but they have limited suitability for crops. Management group IVe-2; woodland suitability group 2o1; recreation group 3.

Sciotoville silt loam, 12 to 18 percent slopes, eroded (462E2).—Areas of this soil are on sides of low terraces. Slopes are generally 50 to 150 feet long. The profile of this soil is similar to that described as representative for the series, but the silt loam surface layer is less than 7 inches thick.

Included with this soil in mapping were areas where the soil is slightly eroded and where the surface layer is more than 7 inches thick. Also included in a few places, were areas where short slopes are more than 18 percent.

Runoff is rapid, and the hazard of further erosion is severe.

This Sciotoville soil is well suited to pasture or trees, but its suitability for crops is limited. Management group IVe-2; woodland suitability group 2r2; recreation group 4.

Sharon Series

The Sharon series consists of deep, nearly level, well-drained and moderately well drained soils on bottom lands along streams throughout the three counties. These soils formed in silty sediment more than 50 inches thick.

In a representative profile the surface layer is about 12 inches of dark-brown and brown silt loam. The subsoil is friable silt loam about 21 inches thick. The upper 7 inches is mixed brown and yellowish brown, and the next 9 inches is strong brown. The lower 5 inches of the subsoil is dark yellowish brown and has pale-brown and light-gray mottles. The underlying material, to a depth of about 41 inches, is dark yellowish-brown silt loam that has pale-brown and light-gray mottles. Below this, to a depth of about 61 inches, the underlying material is light-gray silt loam that has yellowish-brown mottles.

Sharon soils are low in content of organic matter. They have moderate permeability and very high available water capacity.

Crops on these soils respond well to lime and fertilizer applied according to soil tests. In places these soils are subject to flash flooding during heavy storms.

Representative profile of Sharon silt loam in a pasture in Hardin County, 125 feet south of edge of bridge, 60 feet east of centerline of road in the NW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 18, T. 11 S., R. 8 E.:

- Ap—0 to 7 inches, dark-brown (10YR 3/3) silt loam; brown (10YR 5/3) dry; weak, medium, granular structure; friable; medium acid; abrupt, smooth boundary.
- A1—7 to 12 inches, brown (10YR 4/3) silt loam; weak, medium, granular structure; friable; strongly acid; clear, smooth boundary.
- B1—12 to 19 inches, mixed brown and yellowish-brown (10YR 4/3 and 5/4) silt loam; weak, fine, subangular blocky and weak, medium, granular structure (material mixed by earthworms); friable; very strongly acid; clear, smooth boundary.
- B2—19 to 28 inches, strong-brown (7.5YR 5/6) silt loam; weak, fine and medium, subangular blocky structure; friable; patchy, thin, brown (10YR 4/3) coats on ped faces; very strongly acid; gradual, smooth boundary.
- B3—28 to 33 inches, dark yellowish-brown (10YR 4/4) silt loam; common, fine, distinct, pale-brown (10YR 6/3) and few, fine, distinct, light-gray (10YR 7/2) mottles; very weak, medium, subangular blocky structure; friable; very strongly acid; clear, smooth boundary.
- C1—33 to 41 inches, dark yellowish-brown (10YR 4/4) silt loam; common, fine, distinct, pale-brown and light-gray (10YR 6/3 and 7/2) mottles; massive; friable; very strongly acid; clear, smooth boundary.
- C2—41 to 61 inches, light-gray (10YR 7/2) silt loam; many, coarse, distinct, yellowish-brown (10YR 5/6) mottles; few sandstone pebbles; massive; friable; very strongly acid.

Texture is silt loam to a depth of at least 50 inches, but in places below this depth are strata of gravelly, stony, sandy, or clayey material.

The A horizon is generally dark brown, dark grayish brown, or brown. The B horizon ranges from dark grayish brown to strong brown or yellowish brown. Light brownish-gray to brown mottles are common below a depth of about

20 inches. Reaction in the B horizon ranges from strongly acid to extremely acid.

Sharon soils are near Belknap and Burnside soils and have a profile similar to that of Haymond soils. They are better drained than Belknap soils. Sharon soils are more acid in the solum than Haymond soils, and they lack the gravelly or stony layers that are characteristic of Burnside soils.

Sharon silt loam (72).—Areas of this soil are in narrow drainageways, on large bottom lands, and in some sinkholes. This soil commonly is nearly level, but slope ranges from 0 to 4 percent. In a few fan-shaped areas, slopes are as much as 7 percent.

Included with this soil in mapping were small areas of sandy soil. Also included, in places, were areas where thin layers of sandy, gravelly, or stony material are present.

This Sharon soil has no major hazards, but in places it is subject to flash floods of short duration. It is well suited to all commonly grown crops. Management group I-2; woodland suitability group 104; recreation group 9.

Stoy Series

The Stoy series consists of nearly level to moderately sloping, somewhat poorly drained soils that are deep or moderately deep to a fragipan layer. Most of these soils are on uplands in the southern part of Massac County, but small areas are in Pope and Hardin Counties. They formed in loess.

In a representative profile the surface layer is about 7 inches of dark-brown and brown silt loam. The subsurface layer is about 6 inches of yellowish-brown silt loam that has pale-brown mottles. The subsoil is 36 inches thick. The upper 4 inches is pale-brown and yellowish-brown, friable heavy silt loam. The next 12 inches is brown light silty clay loam that has grayish-brown and yellowish-brown mottles. Below this is 9 inches of light brownish-gray, firm silty clay loam. The next 11 inches consist of a fragipan that is light brownish-gray, firm silty clay loam. Mottles in the fragipan are pale brown. The underlying material, to a depth of about 62 inches, is dark yellowish-brown silt loam that has light brownish-gray and pale-brown mottles.

Stoy soils are low in content of organic matter. They have slow permeability and high available water capacity. Runoff is slow to medium.

Crops on these soils respond moderately well to lime and fertilizer applied according to soil tests. In places the rooting zone is somewhat restricted by the fragipan layer. A seasonal water table is at a depth of 3 feet or less.

Representative profile of Stoy silt loam, 2 to 4 percent slopes, in a cultivated field in Massac County, 95 feet east of centerline of blacktop road and 755 feet south of northwest corner of the SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 34, T. 15 S., R. 5 E.:

Ap—0 to 7 inches, dark-brown (10YR 3/3) (60 percent) and brown (10YR 4/3) (40 percent) silt loam; brown (10YR 5/3) dry and dark brown (10YR 3/3) crushed; weak, fine and very fine, granular structure; friable; common roots; common, very fine, black (N 2/0) iron-manganese concretions; slightly acid; abrupt, smooth boundary.

A21—7 to 9 inches, mixed brown (10YR 4/3) and yellowish-brown (10YR 5/4) silt loam; massive; hard and brittle (plowsole); few roots; common, very fine, black (N 2/0) iron-manganese concretions; slightly acid; abrupt, smooth boundary.

A22—9 to 13 inches, yellowish-brown (10YR 5/6) silt loam; common, fine, faint, yellowish-brown and pale-brown (10YR 5/4 and 6/3) mottles; very weak, very coarse, platy structure parting to very weak, very fine, subangular blocky; friable; many roots; very fine, common, short pores; few, very fine, black (N 2/0) iron-manganese concretions; very strongly acid; clear, smooth boundary.

B1—13 to 17 inches, pale-brown and yellowish-brown (10YR 6/3 and 5/4) heavy silt loam; weak, fine and very fine, subangular blocky structure; friable; few roots; very fine, common, short pores; patchy, thin, light-gray (10YR 7/2) silica coats; few, fine, black (N 2/0) iron-manganese concretions; very strongly acid; clear, smooth boundary.

B21t—17 to 20 inches, brown (10YR 5/3) light silty clay loam; common, fine, grayish-brown (10YR 5/2) mottles; weak, fine and very fine, subangular blocky structure; friable; few roots; continuous, thin, light-gray (10YR 7/2) silica coats on ped faces and in root channels and pores; many, fine, strong-brown (7.5YR 5/6) iron-manganese concretions; very strongly acid; clear, smooth boundary.

B22t—20 to 29 inches, brown (10YR 5/3) light silty clay loam; common, fine, faint, grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/4) mottles; strong, fine and medium, prismatic structure parting to moderate, fine subangular blocky; firm; few roots; continuous, thick, pale-brown (10YR 6/3) and few, thick, grayish-brown (10YR 5/2) clay films; discontinuous, medium, light-gray (10YR 7/2) silica coats; common, fine and very fine, strong-brown (7.5YR 5/6) iron-manganese concretions; very strongly acid; clear, wavy boundary.

B23t—29 to 38 inches, light brownish-gray (10YR 6/2) silty clay loam; common, fine, faint, grayish-brown (10YR 5/2) mottles; weak, medium, prismatic structure parting to weak, fine and medium, subangular blocky; firm; very fine small pores; continuous, thick, pale-brown (10YR 6/3) clay films; common, fine, light-gray (10YR 7/2) silica coats; many, very fine, yellowish-brown (10YR 5/8) iron-manganese concretions; areas surrounding concretions are yellowish brown (10YR 5/8); very strongly acid; clear, smooth boundary.

Bx1—38 to 49 inches, light brownish-gray (10YR 6/2) silty clay loam; common, fine, faint, pale-brown (10YR 6/3) mottles; weak, fine and medium, subangular blocky structure; firm, brittle; patchy, thick, pale-brown (10YR 6/3) clay films; patchy, thin, light-gray (10YR 7/2) silica coats; common, very fine and fine, strong-brown (7.5YR 5/8) iron-manganese concretions; yellowish brown (10YR 5/8) in areas surrounding concretions; very strongly acid; clear, smooth boundary.

C—49 to 62 inches, dark yellowish-brown (10YR 4/4) heavy silt loam; common, fine and medium, distinct, light brownish-gray (10YR 6/2) and few, fine, faint, pale-brown (10YR 6/3) mottles; massive; friable; very fine pores; discontinuous, thick, dark reddish-brown (5YR 3/4) clay films in pores and along cracks; very strongly acid.

The A2 horizon ranges from yellowish brown to light yellowish brown mixed with brown. Mottles are pale brown, yellowish brown, or light brownish gray. The B2 horizon ranges from brown to light brownish-gray silty clay loam or heavy silty clay loam. Mottles are grayish brown to yellowish brown. The fragipan is weakly developed and sometimes difficult to detect if moist.

Stoy soils are associated with Hosmer and Weir soils, and they have a profile similar to that of Robbs soils. They are not so well drained as Hosmer soils and are not so poorly

drained as Weir soils. They have a thinner fragipan at a greater depth than that in Robbs soils.

Stoy silt loam, 0 to 2 percent slopes (164A).—This soil is nearly level and is in irregularly shaped areas as much as 40 acres in size. The profile of this soil is similar to that described as representative for the series, but the subsurface layer is 3 to 6 inches thicker.

Included with this soil in mapping were small areas of poorly drained Weir silt loam in small depressions and at the heads of drainageways.

This Stoy soil is suited to most uses, but wetness and slow permeability are limitations for a few uses. Management group IIw-1; woodland suitability group 3o1; recreation group 7.

Stoy silt loam, 2 to 4 percent slopes (164B).—Areas of this soil are in gently undulating terrain or are in gently rolling terrain along drainageways in irregularly shaped areas as much as 40 acres in size. This soil has the profile described as representative for the series.

Included with this soil in mapping were small areas of poorly drained Weir silt loam in depressions and at the heads of drainageways. Also included were a few areas of eroded soils in which the combined silt loam surface and subsurface layers are less than 7 inches thick.

Runoff is medium, and the hazard of water erosion is slight.

This Stoy soil is suited to most uses, but wetness and slow permeability are limitations. Management group IIe-3; woodland suitability group 3o1; recreation group 7.

Stoy silt loam, 4 to 7 percent slopes, eroded (164C2).—This soil is in irregularly shaped areas as much as 10 acres in size, mainly along and at the heads of drainageways. The profile of this soil is similar to that described as representative for the series, but the combined thickness of the silt loam surface and subsurface layers is only 3 to 7 inches, and in most places subsoil material has been incorporated into the plow layer.

Included with this soil in mapping were areas where the soil is severely eroded and the plow layer consists mostly of silty clay loam subsoil material. These areas make up about 15 percent of the mapped acreage. Also included were areas where the soil is uneroded or slightly eroded or where the silt loam surface layer is more than 7 inches thick. These areas make up 10 percent of the acreage of this soil.

Runoff is medium, and the hazard of erosion is moderate. This Stoy soil is suited to most uses. Management group IIIe-2; woodland suitability group 3o1; recreation group 7.

Wakeland Series

The Wakeland series consists of deep, nearly level, somewhat poorly drained soils on bottom lands along streams in Hardin County, mainly near the Ohio River. These soils formed in silty sediment more than 50 inches thick.

In a representative profile the surface layer is about 6 inches of brown silt loam. The subsoil is friable silt loam about 32 inches thick. Color in the upper 11 inches is mixed brown, pale brown, and grayish brown. The lower

21 inches of the subsoil is light brownish gray and has very pale brown, yellowish-brown, and gray mottles. The underlying material, to a depth of about 68 inches, is light brownish-gray and gray silt loam.

Wakeland soils are low in content of organic matter. They have moderate permeability and high or very high available water capacity.

Crops on these soils respond well to fertilizer applied according to soil tests. The need for lime is variable. The soils are subject to flooding in spring. The seasonal water table is at a depth of 3 feet or less.

Representative profile of Wakeland silt loam in pasture in Hardin County, 100 feet east of field entrance at road in the NW $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 33, T. 11 S., R. 10 E.:

- Ap—0 to 6 inches, brown (10YR 5/3) silt loam; light gray (10YR 7/2) dry; common, fine, faint, very pale brown (10YR 7/4) mottles; moderate, medium, granular structure; friable; moderately alkaline; abrupt, smooth boundary.
- B1—6 to 17 inches, finely mixed brown, pale-brown, and grayish-brown (10YR 5/3, 6/3, and 5/2) silt loam; weak, medium, granular structure; friable; neutral; gradual, smooth boundary.
- B2—17 to 34 inches, light brownish-gray (10YR 6/2) silt loam; moderate, medium, distinct, very pale brown (10YR 7/3) and common, fine, distinct, yellowish-brown (10YR 5/4) mottles; very weak, medium, subangular blocky structure parting to moderate, medium, granular; friable; very dark grayish-brown (10YR 3/2) iron stains; neutral; gradual, smooth boundary.
- B3g—34 to 38 inches, light brownish-gray (2.5Y 6/2) silt loam; common, medium, faint, gray (2.5Y 6/1) and common, fine, distinct, yellowish-brown (10YR 5/4) mottles; very weak, medium, subangular blocky structure parting to very weak, fine, subangular blocky or coarse granular; friable; black (10YR 2/1) iron-manganese stains and mottles; neutral; gradual, smooth boundary.
- C1g—38 to 60 inches, light brownish-gray (2.5Y 6/2) silt loam; moderate, medium, faint, gray (2.5Y 6/1) and common, fine, distinct, yellowish-brown (10YR 5/6) mottles; massive; friable; common, fine, distinct, dark-brown and black (10YR 3/3 and 2/1) iron-manganese stains; neutral; clear, smooth boundary.
- C2g—60 to 86 inches, gray (10YR 5/1) silt loam; massive; friable; neutral.

The A horizon ranges from brown to dark grayish brown in color and from 6 to 20 inches in thickness. In the B horizon, color of the silt loam ranges from brown to yellowish brown mottled with gray or grayish brown to grayish brown or light brownish gray mottled with gray, very pale brown, pale brown, or yellowish brown. Reaction in this horizon ranges from medium acid to neutral.

Wakeland soils are near Haymond soils and have a profile similar to that of Belknap soils. They are not so well drained as Haymond soils. Wakeland soils are less acid throughout the profile than Belknap soils.

Wakeland silt loam (333).—This soil is nearly level in most places, but in a few places slope is as much as 4 percent. Areas where this soil is more sloping are generally in narrow bottom lands or next to hillsides.

Included with this soil in mapping were a few small areas where the soil has a sandy or gravelly surface layer or contains sandy or gravelly layers.

This Wakeland soil is well suited to most uses, but it is subject to flooding in spring. Management group IIw-2; woodland suitability group 2o4; recreation group 10.

Weinbach Series

The Weinbach series consists of nearly level to moderately sloping, somewhat poorly drained soils that are deep to moderately deep to a fragipan layer. These soils are on terraces or second bottoms of the Ohio River and the Bay Creek-Cache River lowlands. They formed in silt loam and silty clay loam sediment.

In a representative profile the surface layer is about 7 inches of dark-brown silt loam. The subsurface layer is about 7 inches of yellowish-brown silt loam that has light-gray and brownish-yellow mottles. The subsoil is about 31 inches thick. The upper 22 inches is light brownish-gray, very firm silty clay loam that has strong-brown, light-gray, and yellowish-brown mottles. The lower 9 inches is a firm, slightly brittle fragipan of yellowish-brown heavy silt loam. It has light-gray mottles. The underlying material, to a depth of about 72 inches, is brown and dark yellowish-brown silt loam that has light brownish-gray, pale-brown, and yellowish-brown mottles.

Weinbach soils are low in content of organic matter. They have slow permeability and high available water capacity. Runoff is slow to medium.

Crops on these soils respond moderately well to lime and fertilizer applied according to soil tests. The seasonal water table is within a depth of 3 feet.

Representative profile of Weinbach silt loam, 0 to 2 percent slopes, in a brushy wildlife area of Massac County on the east side of Mermet Lake, 235 feet along access lane southwest from gravel road, 15 feet southeast of lane in SE $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 36, T. 14 S., R. 3 E.:

Ap—0 to 7 inches, dark-brown (10YR 4/3) silt loam; pale brown (10YR 6/3) dry, dark brown (10YR 4/3) crushed; moderate, medium, granular structure; friable; strongly acid; abrupt, smooth boundary.

A2—7 to 14 inches, yellowish-brown (10YR 5/4) silt loam; many, medium, distinct, light-gray (10YR 7/2) and few, fine, faint, brownish-yellow (10YR 6/6) mottles; weak, very thick, platy structure parting to weak, coarse, granular; friable; common, very fine, black (N 2/0) and very dark grayish-brown (10YR 3/2) iron-manganese concretions; very strongly acid; clear, smooth boundary.

B21t—14 to 25 inches, light brownish-gray (10YR 6/2) heavy silty clay loam; many, fine, distinct, strong-brown (7.5 YR 5/6) mottles; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky and weak, fine, angular blocky; very firm; continuous, thin, brown (10YR 5/3) clay films; common, very fine, dark-brown and strong-brown (7.5YR 3/2 and 5/6) iron concretions; extremely acid; clear, smooth boundary.

B22t—25 to 36 inches, light brownish-gray (10YR 6/2) silty clay loam; many, very fine, faint, light-gray (10YR 7/2) and many, fine, distinct yellowish-brown (10YR 5/6) mottles; weak, medium, prismatic structure parting to moderate, medium, subangular blocky and moderate, fine, angular blocky; very firm; discontinuous, thin, brown (10YR 5/3) clay films; many, fine, black (N 2/0), dark-brown (7.5YR 3/2), and strong-brown (7.5YR 5/6) iron-manganese concretions; extremely acid; clear, smooth boundary.

Bx1—36 to 45 inches, yellowish-brown (10YR 5/4) heavy silt loam; common, fine, light-gray (10YR 7/2) mottles and light brownish-gray (10YR 6/2) streaks; weak, firm and medium, subangular blocky structure; firm, slightly brittle; patchy, thin, light yellowish-brown (10YR 6/4) clay films; many, fine, dark-brown and

strong-brown (7.5YR 3/2 and 5/5) iron concretions; extremely acid; gradual, smooth boundary.

C1—45 to 59 inches, brown (7.5YR 4/4) silt loam; common, fine and medium, distinct, light brownish-gray and pale-brown (10YR 6/2 and 6/3) mottles; massive; firm to friable; common, fine, dark-brown (7.5YR 3/2) and black (N 2/0) iron-manganese concretions; slightly acid; gradual, wavy boundary.

C2—59 to 72 inches, dark yellowish-brown (10YR 4/4) silt loam containing silty clay loam lenses; common, fine, faint, yellowish-brown (10YR 5/6) mottles; massive; friable; common, very fine, dark-brown (7.5YR 3/2) iron-manganese concretions; medium acid.

The A horizon is generally silt loam, but in places it is light silty clay loam, especially in the lower part of the A2 horizon.

The B2 horizon ranges from light silty clay loam to heavy silty clay loam. The BX horizon ranges from heavy silt loam to light silty clay loam. Reaction in the B horizon is medium acid to extremely acid.

The C horizon is silty clay loam or silt loam and is stratified in places with sandy sediment. Mica flakes are common throughout the profile.

Weinbach soils are near Ginat and Sciotoville soils and have natural drainage similar to McGary and Reesville soils. They are not so poorly drained as Ginat soils and are more poorly drained than Sciotoville soils. Weinbach soils are more acid in the lower part of the B horizon and in the C horizon than McGary and Reesville soils, and they have a fragipan that is not characteristic of McGary or Reesville soils.

Weinbach silt loam, 0 to 2 percent slopes (461A).—

This soil is in areas ranging from essentially round to long and narrow in shape and from 10 to 100 acres in size. It has the profile described as representative for the series.

Included with this soil in mapping were a few small areas of sandy soil and areas of gravelly soil. Also included were areas, north and east of Boaz and west of Round Knob in Massac County, where the surface layer is dark colored.

This Weinbach soil is suited to most uses, but wetness and slow permeability are limitations. Management group IIw-1; woodland suitability group 3ol; recreation group 7.

Weinbach silt loam, 2 to 4 percent slopes (461B).—

Areas of this soil are on the convex tops and sides of low terraces. They are essentially round, irregularly shaped, or long and narrow.

Included with this soil in mapping were areas where the surface layer is thin or has been eroded. These areas make up 6 to 10 percent of the mapped acreage. Where such areas are cultivated, the plow layer is silty clay loam or heavy silt loam. Also included were a few small areas of sandy soil, areas where the soil contains gravel, and a few areas of a poorly drained, gently sloping soil similar to Ginat silt loam.

Runoff is medium, and the hazard of erosion is slight.

This Weinbach soil is suited to most uses, but wetness and slow permeability are limitations. Management group IIe-3; woodland suitability group 3ol; recreation group 7.

Weinbach silt loam, 4 to 7 percent slopes, eroded (461C2).—

Areas of this soil are mostly around drainage-ways and on long, narrow sides of terraces. The profile of this soil is similar to that described as representative for the series, but the combined thickness of the surface and subsurface layers is less than 7 inches. Also, in

most places some subsoil material has been incorporated into the plow layer of this soil.

Included with this soil in mapping were areas of only slightly eroded soils and areas of severely eroded soils. In about 20 percent of these areas the soil has a silt loam surface layer about 7 inches thick, and in about 17 percent of the areas it has a plow layer consisting mostly or entirely of silty clay loam subsoil material.

Runoff is medium, and the hazard of erosion is moderate.

This Weinbach soil is suited to most uses, but wetness and slow permeability are limitations. Management group IIIe-2; woodland suitability group 3o1; recreation group 7.

Weir Series

The Weir series consists of deep, nearly level, poorly drained soils on uplands. These soils formed in loess.

In a representative profile the surface layer is about 8 inches of grayish-brown silt loam that has strong-brown and yellowish-brown mottles. The subsurface layer is about 10 inches of light brownish-gray silt loam that has light-gray mottles. The subsoil is about 30 inches thick. The upper 7 inches is light-gray silty clay loam that has strong-brown mottles. The next 14 inches is gray heavy silty clay loam that has yellowish-brown mottles. The next 5 inches is light brownish-gray light silty clay loam, and the lower 4 inches is light olive-gray silt loam. The underlying material, to a depth of about 70 inches, is olive-brown silt loam. It has light olive-brown and light-gray mottles.

Weir soils are low in content of organic matter. They have slow permeability and high available water capacity.

Crops on these soils respond moderately well to lime and fertilizer applied according to soil tests. The seasonal water table is at or near the surface, and some areas are subject to surface ponding.

Representative profile of Weir silt loam in an idle field in Massac County, 105 feet south of middle of east-west blacktop road and 213 feet west of middle of north-south blacktop road in northeast corner sec. 27, T. 15 S., R. 4 E.:

Ap—0 to 8 inches, grayish-brown (10YR 5/2) silt loam; common, medium, distinct, strong-brown (7.5YR 4/6 and 5/8) and yellowish-brown (10YR 5/6 and 5/8) mottles or iron stains; weak, fine, granular structure; friable; very fine and fine, common, black (N 2/0) iron-manganese concretions; very strongly acid; abrupt, smooth boundary.

A2—8 to 18 inches, light brownish-gray (10YR 6/2) silt loam; few, fine, faint, light-gray (10YR 7/2) mottles and common, medium, distinct, strong-brown (7.5YR 5/6 and 5/8) iron stains or mottles; weak, fine, platy structure; friable; gray (10YR 6/1) worm casts; many, very fine and fine, black (N 2/0) and strong-brown (7.5YR 5/8) iron-manganese concretions; very strongly acid; clear, smooth boundary.

B1tg—18 to 25 inches, light-gray (10YR 7/1) and grayish-brown (10YR 5/2) silty clay loam; few, medium, distinct, strong-brown (7.5YR 5/6) mottles; weak, fine, subangular blocky structure; friable; many, fine and very fine, black (N 2/0) and strong-brown (7.5YR 5/8) iron-manganese concretions; very strongly acid; abrupt, irregular boundary.

B2tg—25 to 39 inches, gray (5Y 5/1) heavy silty clay loam; few, fine, prominent, yellowish-brown (10YR 5/6) mottles; weak, medium and coarse, prismatic structure parting to moderate, medium, subangular blocky; firm; gray (10YR 6/1) and light-gray (10YR 7/1) continuous coats on ped surfaces; many, fine and very fine, black (N 2/0) and strong-brown (7.5YR 5/8) iron-manganese concretions; very strongly acid; clear, smooth boundary.

B31g—39 to 44 inches, light brownish-gray (2.5Y 6/2) light silty clay loam; weak, medium, subangular blocky structure; firm to friable; gray (5Y 6/1) continuous coats on ped surfaces; many, fine, black (N 2/0) and strong-brown (7.5YR 5/8) iron-manganese concretions; very strongly acid; clear, smooth boundary.

B32g—44 to 48 inches, light olive-gray (5Y 6/2) silt loam; weak, fine, subangular blocky structure; friable; common, fine, prominent strong-brown (7.5YR 5/6 and 5/8) and yellowish-brown (10YR 5/6 and 5/8) iron-manganese stains; many, fine, black (N 2/0) iron-manganese concretions; very strongly acid; gradual, smooth boundary.

C—48 to 70 inches, olive-brown (2.5Y 4/4) silt loam; common, fine, faint, light olive-brown (2.5Y 5/6) and common, medium, distinct, light-gray (10YR 7/2) mottles; massive; friable; common, fine, black (N 2/0) iron-manganese concretions; very strongly acid.

The A1 or Ap horizon is dark grayish brown or grayish brown, and the A2 horizon ranges from grayish brown to light gray in color.

In the B horizon, color ranges from light gray or light olive gray to grayish brown. Texture is light silty clay loam to heavy silty clay loam. This horizon has few to many pale-brown to yellowish-brown mottles.

Weir soils are near Stoy soils, and they have a profile similar to that of Racoon and Ginat soils. They are more poorly drained than Stoy soils, and they have a thinner A2 horizon than Racoon soils. Weir soils formed in loess on uplands, but Ginat soils formed at least partly in alluvium on terraces.

Weir silt loam (165).—This soil commonly has slopes of less than 1 percent, but in places, slopes are as much as 3 percent. Ninety percent of the acreage of this soil is north and west of Metropolis in broad areas 5 to more than 100 acres in size and as much as one-fourth mile wide. The other 10 percent is widely distributed throughout the three counties in small areas generally less than 10 acres in size.

This Weir soil is suited to most uses. Poor drainage and slow permeability are limitations. Management group IIIw-1; woodland suitability group 4w2; recreation group 8.

Wellston Series

The Wellston series consists of deep, moderately steep to very steep, well-drained soils on uplands. These soils formed in loess and underlying material weathered from sandstone or shale bedrock. They are mainly on hill-sides throughout the three counties.

In a representative profile the surface layer is about 1 inch of very dark grayish-brown silt loam, and the subsurface layer is about 4 inches of dark yellowish-brown silt loam. The subsoil is about 33 inches thick. The upper 5 inches is brown, friable heavy silt loam, and the lower 28 inches is brown, friable light silty clay loam. The underlying material is dark yellowish-brown and yellowish-brown stony silt loam. Sandstone bedrock is at a depth of about 42 inches.

Wellston soils are low in content of organic matter.

They have moderate permeability and moderate available water capacity.

Most areas of these soils are wooded.

Representative profile of Wellston silt loam, 18 to 30 percent slopes, in a wooded area of Massac County, 100 feet north of edge of woods and 30 feet south of natural drainageway in the NW $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 7, T. 14 S., R. 4 E.:

A1—0 to 1 inch, very dark grayish-brown (10YR 3/2) silt loam mixed with decayed organic matter; dark brown (10YR 3/3) crushed and pale brown (10YR 6/3) dry; weak, fine, granular structure; friable; many roots; very strongly acid; abrupt, smooth boundary.

A2—1 to 5 inches, dark yellowish-brown (10YR 4/4) silt loam; yellowish brown (10YR 5/4) crushed and light yellowish brown (10YR 6/4) dry; very weak, medium, platy structure parting to weak, fine, granular; friable; many roots; very strongly acid; clear, smooth boundary.

B1—5 to 10 inches, brown (7.5YR 4/4) heavy silt loam; weak, fine, subangular blocky structure; friable; many roots; common fine pores; very strongly acid; clear, smooth boundary.

B21t—10 to 26 inches, brown (2.5YR 4/4) light silty clay loam; moderate, fine, prismatic structure parting to moderate, fine and very fine, subangular blocky; friable; common fine pores; patchy, thin, brown (7.5YR 4/4) clay films; few, thin, light yellowish-brown (10YR 6/4) silica coats; very strongly acid; clear, smooth boundary.

IIB22t—26 to 38 inches, brown (7.5YR 4/4) light silty clay loam; weak, medium, prismatic structure parting to weak, fine and very fine, subangular blocky; friable; patchy, thin, brown (7.5YR 4/4) clay films; 5 to 10 percent rock fragments; common very fine pores; black (N 2/0) iron-manganese stains along some ped faces; very strongly acid; clear, smooth boundary.

IIC—38 to 42 inches, dark yellowish-brown (10YR 4/4) and yellowish-brown (10YR 5/4) stony silt loam; massive; friable; patchy, thin, brown (7.5YR 4/4) clay films; 25 percent rock fragments; very strongly acid; clear, smooth boundary.

R—42 inches, sandstone bedrock.

Depth to bedrock ranges from 36 to 60 inches. The loess mantle is generally less than 30 inches thick and is absent in places. Where the loess is thin or absent, a stone line is generally at a depth of 6 to 15 inches. Coarse fragments make up less than 35 percent of any horizon. In places these fragments are absent in the loess, but they are generally incorporated into it. The material weathered from sandstone ranges from silty clay loam to stony silt loam, and that weathered from shale is silty clay or clay. Reaction is strongly acid or very strongly acid throughout the profile.

The B horizon ranges from yellowish brown to dark brown in color. The IIB22t horizon commonly has a few grayish mottles.

Wellston soils are associated with Berks, Muskingum, and Zanesville soils. They have more clay in the B horizon and are deeper to bedrock than Berks and Muskingum soils. Wellston soils lack the fragipan that is characteristic of Zanesville soils.

Wellston silt loam, 12 to 18 percent slopes (339E).—Areas of this soil are mostly on long narrow side slopes, on upper parts of slopes above steep stony soils, or near the heads of drainageway. Slopes commonly are 100 to 200 feet long.

Included with this soil in mapping, in the larger areas, were small areas of Muskingum and Zanesville soils and areas where slope is more than 18 percent. Also included, in places, were areas where slope is

less than 12 percent and areas of eroded soils on ridgetops that have been used for crops or pasture. The soils on ridgetops have slopes of 7 to 12 percent.

Runoff is rapid, and the hazard of erosion is very severe.

This Wellston soil is mostly wooded. It is well suited to trees and is moderately well suited to pasture. Management group VIe-3; woodland suitability group 2r2; recreation group 4.

Wellston soils, 12 to 18 percent slopes, severely eroded (339E3).—These soils are on the upper parts of slopes and around drainageways in areas generally less than 15 acres in size. These areas were once used for crops. Generally these were originally areas where the material weathered from sandstone or shale was deeper than normal for the series. Now, because of severe erosion, the material weathered from sandstone or shale is shallower and is at or near the surface in places. The present surface layer is silty clay loam or heavy silt loam and small areas of stony clay loam in places.

Runoff is rapid, and the hazard of further erosion is very severe.

This Wellston soil is suited to trees and wildlife habitat, but use for pasture is limited by surface stoniness and the hazard of erosion. Management Group VIIe-1; woodland suitability group 2r2; recreation group 4.

Wellston silt loam, 18 to 30 percent slopes (339F).—This soil has slopes that are 100 to 400 feet long. Areas are 5 to 50 acres in size. This soil has the profile described as representative for the series.

Included with this soil in mapping were areas of severely eroded soils. They make up about 2 percent of the acreage. Also included were areas of Berks, Muskingum, and Zanesville soils that were too small to map separately. Within the larger areas are places where slopes are less than 18 percent or more than 30 percent.

Runoff is rapid. The hazard of erosion is very severe if the trees are removed.

Nearly all of this Wellston soil is wooded. This soil is better suited to trees and wildlife habitat than to other uses. Management group VIIe-1; woodland suitability group 2r2; recreation group 5.

Wellston-Berks complex, 12 to 18 percent slopes (986E).—The soils in this complex have slopes that are generally 200 to 400 feet long. Areas are mainly 10 to 40 acres in size. About 65 to 80 percent of each area is Wellston soils, and about 20 to 35 percent is Berks soils. Berks soils are mostly on the lower parts of slopes and along small lateral drainageways. Wellston soils are in the rest of the areas. Depth to material weathered from sandstone or shale and the amount of stoniness are variable.

Included with this complex in mapping were small areas of Muskingum, Zanesville, Hosmer, and Grantsburg soils.

Runoff is rapid, and the hazard of erosion in cleared areas is very severe. The soils of this complex are suited to trees or to wildlife habitat. Use of the soils for pasture is limited by surface stoniness. Most areas of these soils are wooded. In a few areas that have been cleared for crops or pasture, the soil is eroded. Management group VIe-3; woodland suitability group 3r2; recreation group 4.

Wellston-Berks complex, 18 to 30 percent slopes (986F).—The soils in this complex have slopes that are generally 200 to 500 feet long. Areas are as much as 200 acres or more in size. Berks soils are mostly on the lower parts of slopes and along small lateral drainage-ways. These soils are also on the upper rims of slopes or in one or more bands across the slope. Wellston soils are generally in more than 60 percent of an area. Stoniness and depth to material weathered from sandstone or shale are variable.

Included with this complex in mapping were small areas of Muskingum, Zanesville, Grantsburg, and Hosmer soils. Also included were areas where slope is less than 18 percent and other areas where slope is more than 30 percent.

Nearly all areas of the soils in this complex are wooded. The soils are better suited to trees and wildlife habitat than to other uses. Management group VIIe-1; woodland suitability group 3r2; recreation group 6.

Wellston-Berks complex, 30 to 60 percent slopes (986G).—This complex is generally in long narrow areas less than 50 acres in size. Slopes are 100 to 400 feet long. A few areas are several hundred acres in size, and in these areas slopes are as much as 800 feet long. About 40 to 60 percent of each area is Wellston soil, and about 40 to 60 percent is Berks soils. Berks soils are on the upper rim of slopes, along the lower parts of hillsides, or in one or more bands across the slopes. Stoniness and depth to material weathered from sandstone or shale are variable.

Included with this complex in mapping were small areas of Muskingum and Zanesville soils. Also included were areas where slope is less than 30 percent and a few areas where slope is more than 60 percent.

The soils of this complex are wooded. They are suited only to woodland and special wildlife uses. Management group VIIe-1; woodland suitability group 3r3; recreation group 6.

Wheeling Series

The Wheeling series consists of nearly level to moderately steep, deep, well-drained soils on terraces of the Ohio River and the Bay Creek-Cache River lowlands. These soils formed in silty and loamy sediment.

In a representative profile the surface layer is about 5 inches of dark-brown silt loam. The subsurface layer is about 2 inches of yellowish-brown silt loam. The subsoil is about 42 inches thick. The upper 31 inches is mainly brown, friable clay loam, and the lower 11 inches in brown, friable sandy clay loam. The underlying material, to a depth of about 60 inches, is brown sandy loam.

Wheeling soils are low in content of organic matter. They have moderate permeability and high available water capacity.

Crops on these soils respond well to lime and fertilizer applied according to soil tests.

Representative profile of Wheeling silt loam, 4 to 7 percent slopes, eroded, in a wooded area of Massac County, 170 feet north of north end of bridge and 105 feet west of centerline of blacktop road in NE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 32, T. 14 S., R. 4 E.:

A1—0 to 5 inches, dark-brown (10YR 3/3) silt loam; very dark grayish brown (10YR 3/2) crushed, brown (10YR 5/3) dry; moderate, fine, granular structure; friable; many roots; strongly acid; abrupt, smooth boundary.

A2—5 to 7 inches, yellowish-brown (10YR 5/4) silt loam; weak, fine, granular structure; friable; many roots; medium acid; clear, smooth boundary.

B1—7 to 10 inches, yellowish-brown (10YR 5/4) heavy silt loam to loam; weak, fine, subangular blocky structure; friable; many roots; common very fine and fine pores; thin brown (7.5YR 4/4) clay films in root and worm channels; strongly acid; clear, smooth boundary.

B21t—10 to 23 inches, brown (7.5YR 4/4) clay loam; strong, fine and medium, prismatic structure parting to strong, fine and medium, angular blocky; friable; common roots; few, very fine, black (N 2/0) iron-manganese stains; very strongly acid; clear, smooth boundary.

B22t—23 to 30 inches, brown (7.5YR 4/4) clay loam; moderate, medium, prismatic structure parting to moderate, fine and medium, subangular blocky; friable; common roots; few very fine pores; continuous, thin, brown (7.5YR 4/4) clay films; few, very fine, black (N 2/0) iron-manganese stains; very strongly acid, clear, smooth boundary.

B23t—30 to 38 inches, brown (7.5YR 4/4) clay loam; weak, medium, prismatic structure parting to moderate, medium, subangular blocky; friable; few roots; few very fine pores; discontinuous, thin, brown (7.5YR 4/4) clay films; few, very fine, black (N 2/0) iron-manganese stains, few stains 1 to 2 inches in diameter; very strongly acid; clear, smooth boundary.

B3—38 to 49 inches, brown (7.5YR 4/4) sandy clay loam; few, fine, distinct, light yellowish-brown (10YR 6/4) mottles; weak, medium, prismatic structure parting to weak, medium, subangular blocky; friable; few roots; few very fine pores; patchy, thin, brown (7.5YR 4/4) clay films very strongly acid; clear, smooth boundary.

C—49 to 60 inches, brown (7.5YR 4/4) sandy loam; massive; friable; very strongly acid.

The B horizon ranges from yellowish brown to brown. The B21t horizon ranges from silty clay loam to sandy clay loam. Most areas have a noticeable amount of mica. Reaction in the B horizon ranges from medium acid to very strongly acid.

The C horizon is stratified with material ranging from sandy clay loam to loamy fine sand.

Wheeling soils are near Sciotoville, Markland, Alvin, and Lamont soils on terraces. They are better drained than Sciotoville soils and have no fragipan. They are more acid in the lower part of the B horizon than Markland soils and have less sand in the A and B horizons than Alvin and Lamont soils.

Wheeling silt loam, 0 to 2 percent slopes (463A).—This soil is in oblong or irregularly shaped areas that are generally less than 15 acres in size. The profile of this soil is similar to that described as representative for the series, but the combined thickness of the silt loam surface and subsurface layers generally is 10 to 16 inches.

Nearly all of this Wheeling soil is used for crops. The soil is well suited to most uses. Management group I-1; woodland suitability group 2o1; recreation group 1.

Wheeling silt loam, 2 to 4 percent slopes (463B).—This soil is in irregularly shaped areas on convex stream terraces or on long, narrow sides of terraces. Slopes generally are 50 to 150 feet long. The profile of this soil is similar to that described as representative for the series, but the combined thickness of the silt loam surface and subsurface layers is 8 to 14 inches.

Included with this soil in mapping were a few areas where the soil is eroded and the combined thickness of the surface layer and subsurface layer is less than 7 inches.

Runoff is medium, and the hazard of erosion is slight.

Nearly all areas of this Wheeling soil are used for crops. The soil is well suited to most uses. Management group IIe-1; woodland suitability group 2o1; recreation group 1.

Wheeling silt loam, 4 to 7 percent slopes, eroded (463C2).—This soil is mostly in narrow areas, generally less than 15 acres in size, that are along drainageways and sides of terraces. Slopes are 50 to 150 feet long. This soil has the profile described as representative for the series.

Included with this soil in mapping were areas where the soil is only slightly eroded and the silt loam surface layer is more than 7 inches thick. These areas make up about 20 percent of the acreage. Also included were a few areas of severely eroded soils where the present plow layer is mostly silty clay loam subsoil material.

Runoff is slow, and the hazard of erosion is moderate.

Nearly all of this Wheeling soil is used for crops. The soil is well suited to most uses. Management group IIe-1; woodland suitability group 2o1; recreation group 1.

Wheeling silt loam, 7 to 12 percent slopes, eroded (463D2).—This soil is mostly in narrow areas that are less than 10 acres in size and are on the sides of terraces. Slopes are 50 to 150 feet long. The profile of this soil is similar to that described as representative for the series, but the combined thickness of the silt loam surface layer and subsurface layer is less than 7 inches. In places subsoil material is incorporated into the plow layer.

Included with this soil in mapping were areas where the plow layer is entirely silty clay loam subsoil material. These areas make up about 30 percent of the acreage.

Runoff is medium, and the hazard of further erosion is severe.

This Wheeling soil is suited to all farm uses and most nonfarm uses. Management group IIIe-1; woodland suitability group 2o1; recreation group 3.

Wheeling silt loam, 12 to 25 percent slopes, eroded (463E2).—Areas of this soil are on sides of terraces. Slopes are generally 50 to 150 feet long. In about one-fourth of the areas slope is more than 18 percent. The profile of this soil is similar to that described as representative for the series, but the subsoil is slightly thinner.

Included with this soil in mapping were severely eroded soils where the present surface layer is mainly silty clay loam or heavy silt loam subsoil material. Also included were areas of severely eroded Sciotoville soils that have slopes of more than 12 percent. These areas make up about one-fifth of the acreage.

Runoff is rapid, and the hazard of further erosion is severe.

This Wheeling soil is not suited to crops. It is suited to pasture, trees, or wildlife habitat. Management group VIe-1; woodland suitability group 2r2; recreation group 4.

Zanesville Series

The Zanesville series consists of strongly sloping to steep, moderately well drained soils that are moderately deep to a fragipan. These soils are on ridgetops and sides of uplands in all three counties, but they are most common in the northern part of Pope County. They formed in loess and underlying material weathered from sandstone or shale bedrock. Stones are in many drainageways (fig. 14).

In a representative profile the surface layer is about 4 inches of dark yellowish-brown silt loam. The subsoil is about 44 inches thick. The upper 18 inches is mainly brown light silty clay loam. The next 26 inches is a fragipan that is brown, very firm to extremely firm loam in the upper 20 inches and yellowish-brown, extremely firm shaly silt loam in the lower 6 inches. The underlying material, to a depth of about 60 inches, is red very shaly silty clay. Shale bedrock is below this depth.

Zanesville soils are low in content of organic matter. They have slow permeability and moderate available water capacity. They are subject to erosion. Runoff is rapid to very rapid.

Crops on these soils respond moderately well to lime and fertilizer applied according to soil tests. Rooting depth is limited somewhat by the fragipan layer.

Representative profile of Zanesville silt loam, 7 to 12 percent slopes, eroded, in an abandoned brushy area of Hardin County, along drainageway 175 feet north of first concrete dam in road ditch east of stream; east side of drainageway where it becomes a broad area of eroded soil, in the NW $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 2, T. 11 S., R. 8 E.:

- Ap—0 to 4 inches, dark yellowish-brown (10YR 4/4) silt loam; moderate, fine, granular structure; friable; very strongly acid; clear, smooth boundary.
- B1—4 to 7 inches, brown (7.5YR 4/4) heavy silt loam; weak, fine, subangular blocky structure; friable; very strongly acid; clear, smooth boundary.
- B21t—7 to 16 inches, brown (7.5YR 4/4) light silt clay loam; moderate, medium, subangular blocky structure; friable; extremely acid; clear, wavy boundary.
- B22t—16 to 22 inches, brown and strong-brown (7.5YR 4/4 and 5/6) light silty clay loam; pale-brown (10YR 6/3) streaks and coatings; weak, medium, subangular blocky structure; firm; patchy, thin, brown (7.5YR 4/4) clay films; few stones, 3 to 8 inches in diameter; extremely acid; gradual, wavy boundary.
- Bx1—22 to 35 inches, brown (7.5YR 4/4) silt loam; common, fine, distinct, light yellowish-brown (10YR 6/4) mottles and very pale brown (10YR 7/3) streaks; very weak, coarse, prismatic structure parting to weak, medium, subangular blocky; very firm, very brittle; few, thin, dark-brown (7.5YR 3/2) clay films; common, fine, black (N 2/0) iron-manganese concretions; few stones; very strongly acid; gradual, wavy boundary.
- Bx2—35 to 42 inches, brown (7.5YR 4/4) silt loam; few, fine, faint, brownish-yellow (10YR 6/6) mottles; very weak, coarse, prismatic structure parting to weak, medium, subangular blocky; extremely firm and brittle; 15 percent stones; few, fine, black and very dark grayish-brown (N 2/0 and 10YR 3/2) iron-manganese concretions and stains; strongly acid; gradual, wavy boundary.
- IIBx3—42 to 48 inches, yellowish-brown (10YR 5/6) shaly silt loam; very weak, coarse, prismatic structure parting to weak, coarse, subangular blocky; extremely firm and brittle; about 25 percent shale



Figure 14.—Drainageway in an area of Zanesville soils.

fragments; few, thin, dark yellowish-brown (10YR 4/4) clay films; neutral; clear, wavy boundary.

IIC—48 to 60 inches, red (2.5YR 4/6) very shaly silty clay; common, fine, prominent, pale-brown (10YR 6/3) and olive (5Y 5/4) mottles; weak platy structure; firm; about 50 percent shale fragments; neutral.

R—60 inches, shale bedrock.

Depth to bedrock of sandstone or shale ranges from 40 to 72 inches. The loess is generally 30 to 58 inches thick where the soil is uneroded. Depth to the fragipan in areas of moderately eroded or slightly eroded soils ranges from about 19 to 27 inches. In severely eroded soils it ranges from 10 to 17 inches.

In places the B horizon contains a few light-gray to grayish-brown mottles above the fragipan. The texture of the material weathered from sandstone or shale ranges from loam to silty clay. It generally contains stony fragments, and this material ranges from yellowish brown or strong brown to red, gray, and yellowish red. Reaction in the B horizon ranges from strongly acid to extremely acid above the fragipan. The C horizon ranges from very shaly silty clay to stony loam.

Zanesville soils are near Wellston, Hosmer, and Grantsburg soils. They have a fragipan that is lacking in Wellston soils. They formed partly in material weathered from sandstone or shale, but Hosmer and Grantsburg soils formed entirely in loess.

Zanesville silt loam, 7 to 12 percent slopes, eroded (340D2).—This soil is mostly in long, narrow areas around the rims of ridgetops or in oblong areas, 5 to 15 acres in size, around drainageways. It has the profile described as representative for the series. In about 10 percent of the areas the soil is uneroded or only slightly eroded, and the surface layer is more than 7 inches thick.

Runoff is rapid, and the hazard of further erosion is severe.

Most areas of this Zanesville soil are wooded or in pasture. This soil is suited to most farm uses. Management group IIIe-2; woodland suitability group 3d2; recreation group 3.

Zanesville soils, 7 to 12 percent slopes, severely eroded (340D3).—These soils are mostly in long, narrow areas around the rims of ridgetops or in oblong areas, 5 to 15 acres in size, around drainageways. Slopes generally are 75 to 200 feet long. The profile of this soil is similar to that described as representative for the series, but most or all of the surface layer has been removed by erosion. The surface layer is now mainly silty clay loam or heavy silt loam subsoil material.

Depth to the fragipan ranges from 10 to 17 inches. Depth to material weathered from shale or sandstone varies somewhat and in places is at a depth of more than 48 inches.

Runoff is rapid, and the hazard of further erosion is severe. Erosion has seriously reduced the effective moisture-storage area above the fragipan.

These Zanesville soils are suited to pasture or trees, but they have limited suitability for crops. Management group IVe-2; woodland suitability group 3d2; recreation group 3.

Zanesville silt loam, 12 to 18 percent slopes, eroded (340E2).—This soil is mostly in long, irregularly shaped areas around drainageways and along the rims of ridgetops. Slopes are 100 to 300 feet long. Depth to the fragipan ranges from 19 to 27 inches. The depth to material weathered from shale or sandstone varies somewhat and in places is at a depth of more than 48 inches.

Included with this soil in mapping were areas of this soil that are wooded and where the soil generally is less eroded. In these areas the silt loam surface layer is 8 to 12 inches thick, and the fragipan generally is 2 to 6 inches deeper.

Runoff is rapid, and the hazard of erosion is very severe. Erosion has reduced the effective moisture-storage area above the fragipan.

This Zanesville soil is suited to pasture or trees, but it has limited suitability for crops. Management group IVe-2; woodland suitability group 3d2; recreation group 4.

Zanesville soils, 12 to 18 percent slopes, severely eroded (340E3).—These soils are mostly in long, irregularly shaped areas around drainageways and along the rims of ridgetops. Slopes are 100 to 400 feet long. The profile of these soils is similar to that described as representative for the series, but most or all of the surface layer has been removed by erosion. The present surface layer is mainly subsoil material and is silty clay loam or silt loam. Depth to the fragipan layer generally is 10 to 17 inches. The depth to material weathered from shale or sandstone varies somewhat and in places is at a depth of more than 48 inches. In a few places, however, the depth to solid bedrock is less than 48 inches.

Included with these soils in mapping were areas of severely eroded soils that have slopes of more than 18 percent. In a few places areas of severely gullied soils were included.

Runoff is rapid, and the hazard of further erosion is very severe. Erosion has seriously reduced the effective moisture-storage area above the fragipan.

These Zanesville soils are not suited to crops because of the hazard of erosion, but they can be used for pasture or trees. Management group VIe-2; woodland suitability group 3d2; recreation group 4.

Zanesville silt loam, 18 to 30 percent slopes, eroded (340F2).—Areas of this soil are mostly along sides of drainageways and are 5 to 20 acres in size. Slopes are 100 to 400 feet long. The profile of this soil is similar to that described as representative for the series, but in about one-third of the areas the soil is only slightly eroded and the silt loam surface layer is more than 7

inches thick. Depth to the fragipan ranges from 19 to 27 inches.

Included with this soil in mapping were small areas where the depth to weathered shale or sandstone is less than 30 inches and some areas where it is more. Also included were a few areas where stones or bedrock outcrops are at the surface.

Runoff is very rapid, and the hazard of erosion is very severe.

This Zanesville soil is suited to woodland or pasture. Management group VIe-2; woodland suitability group 3d2; recreation group 5.

Use and Management of the Soils

This section has six main parts. In the first the soils are placed in management groups, and the capability classification used by the Soil Conservation Service to show the relative suitability of the soils for crops is explained. This part also includes a table giving estimated yields under a high level of management. The use of soils for woodland is discussed in the second part and the kinds of wildlife and the use of soils for wildlife habitat in the third part. In the fourth part is a discussion on the use of soils for recreation. The fifth part consists of engineering data and interpretations, and the sixth part provides information on residential uses of soils.

General Management of Cropland

About 25 percent of the three counties is cultivated. Of this acreage, about 51 percent is in Massac County, 34 percent in Pope County, and 15 percent in Hardin County. Corn and soybeans are the main crops. Other important crops are wheat, grain sorghum, and grass-legume hay.

The main concerns of management in the survey area are controlling erosion, conserving moisture, overcoming the hazard of wetness and providing protection from flooding, and maintaining tilth and fertility.

Measures that help control erosion include terracing, contour farming, minimum tillage, planting cover crops, using grassed waterways, and returning crop residue to the soil. A combination of several measures generally is used.

Measures that help overcome wetness include the use of tile drains, shallow surface ditches, inlets to tile drains, drainage ditches, and diversions. Levees provide protection from flooding.

Conserving moisture generally means reducing evaporation, limiting runoff, increasing infiltration, and controlling weeds. Practices that help to conserve moisture include minimum tillage, use of crop residue, contour farming, stripcropping, and field windbreaks.

Among measures that help to maintain tilth and fertility are the application of chemical fertilizer, green manure, and barnyard manure, and the inclusion in the cropping system of cover crops, grasses, and legumes. Applications of lime are needed periodically, especially on most areas of upland and terrace soils. These, as well as the applications of chemical fertilizer, are made according to results of soils tests. Controlling erosion also helps to conserve fertility and maintain tilth.

Capability Grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations when used for field crops, the risk of damage when they are so used, and the way they 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 requiring 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 groups of soils for forest trees or for engineering.

In the capability system, all kinds of soils are grouped at three levels, the capability class, subclass, and the unit in this survey called "management groups." These groups are discussed in the following paragraphs.

CAPABILITY CLASSES, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use.

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

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

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

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife.

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife.

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, water supply, or to esthetic purposes. (None in this survey area)

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, II*e*. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained;

w shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in some parts of the United States, but not in this survey area, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife, or recreation.

MANAGEMENT GROUPS are soil groups within the subclasses. The soils in one group are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the management group is a convenient grouping for making many statements about management of soils. The groups are generally designated by adding an Arabic numeral to the subclass symbol, for example, II*w*-1 or III*e*-1. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the management group within each subclass.

In the following pages the management groups in the survey area are described and suggestions for use and management for all the soils of each group are given. Soils used for cultivated crops generally need lime and fertilizer. The amount and type to apply on a given soil should be determined by soil tests. The names of soil series represented are mentioned in the description of each management group, but this does not mean that all soils of a given series appear in the group. To find the names of all the soils in any given management group, refer to the "Guide to Mapping Units" at the back of this survey.

MANAGEMENT GROUP I-1

This group consists of soils of the Alvin, Emma, and Wheeling series. All of these are well drained and moderately well drained, nearly level soils on stream terraces. The Wheeling soil has a surface layer of silt loam and a subsoil of silty clay loam. The Emma soil has a surface layer of silty clay loam, and the Alvin soil has a surface layer of fine sandy loam.

Permeability is moderate or moderately slow, and available water capacity is high in soils of this group. Content of organic matter is low, and the soils are strongly acid to very strongly acid. These soils have no major limitations to use, but the Emma soil is subject to flooding during unusually severe floods.

The soils of this group are well suited to such commonly grown crops as corn, soybeans, wheat, grasses, and legumes. (fig. 15).

Crops on Wheeling and Alvin soils respond moderately well or well to applications of lime and fertilizer. Such response is only poor on the Emma soil. Root growth is



Figure 15.—Corn and soybeans on Emma silty clay loam, management group I-1. These are the main crops grown on this soil.

somewhat restricted by the sandy substratum in the Alvin soil. Crusts tend to form on the surface of the Wheeling soil. Returning crop residue to the soil and the periodic use of catch crops or grasses and legumes help to maintain organic-matter content and good tilth.

MANAGEMENT GROUP I-2

This group consists of soils of the Armiesburg, Haymond, Huntington, and Sharon series. These nearly level and gently sloping soils are moderately well drained and well drained and are in small and medium-sized creek bottoms. They generally have a surface layer and subsoil of silt loam, but Armiesburg soil is silty clay loam throughout.

Permeability is moderate, and available water capacity is very high in soils of this group. Content of organic matter is low to moderate. The Sharon soil is very strongly acid, and the Haymond soil ranges from medium acid to neutral in the subsoil. The Armiesburg and Huntington soils are mildly alkaline.

These soils have no major limitation to use, but they are subject to flooding.

The soils in this group are well suited to such commonly grown crops as corn, soybeans, wheat, grasses, and legumes. In places, narrow bottom lands or inaccessible areas are used for pasture or trees as are the adjacent uplands.

Crops respond well to applications of lime and fertilizer. Returning crop residue to the soil, keeping tillage to a minimum, and using green-manure catch crops or hay crops help to maintain tilth.

MANAGEMENT GROUP IIe-1

This group consists of soils of the Alvin, Alford, Emma, and Wheeling series. These soils are gently sloping or sloping, and they are well drained or moderately well drained. Most of the moderately sloping soils are eroded, but the gently sloping soils are generally only slightly eroded. All except Alford soils are on stream terraces. Alford soils are on uplands. Alford and Wheeling soils have a surface layer of silt loam and a subsoil of silty clay loam. The Emma soil has a surface layer of silty clay loam, and the Alvin soil has a surface layer and subsurface layer of fine sandy loam.

Permeability is moderate or moderately slow in soils of this group. Available water capacity is high, except for Alvin soil where it is moderate. Content of organic matter is low, and the soils are very strongly acid. Erosion is the main hazard. The Emma soil is subject to flooding during unusually severe Ohio River floods.

The soils of this group are well suited to such commonly grown crops as corn, soybeans, wheat, grasses, and legumes.

Crops on Alford and Wheeling soils respond well to applications of lime and fertilizer. Such response is only moderate on Alvin soil and poor on Emma soil. Root growth is somewhat restricted by the sandy substratum in the Alvin soil. Management is needed to control erosion. Crusts tend to form easily on the surface of soils in this group. Proper management of crop residue and use of animal manure help to maintain organic matter, improve tilth, and reduce soil loss. Less mechanical power

is needed on the gently sloping soils, and equipment is easier to operate. These soils need less intensive erosion-control measures than moderately sloping soils.

MANAGEMENT GROUP IIc-2

This group consists of soils of the Grantsburg, Hosmer, and Sciotoville series. These gently sloping soils are on uplands and are moderately well drained. They have a surface layer of silt loam and a subsoil of heavy silt loam or silty clay loam. The subsoil contains a fragipan in the lower part.

Permeability is very slow to moderately slow, and available water capacity is moderate or high in soils of this group. Content of organic matter is low, and the soils are very strongly acid. Erosion is the main hazard.

The soils of this group are well suited to such commonly grown crops as corn, soybeans, wheat, grasses, and legumes.

Root growth is restricted by the fragipan, but crops respond well or moderately well to applications of lime and fertilizer. Crusts tend to form easily on the surface of soils in this group. Management is needed to control erosion. Proper management of crop residue and use of animal manure help to maintain organic-matter content, improve tilth, and reduce soil loss.

MANAGEMENT GROUP IIc-3

This group consists of soils of the McGary, Robbs, Stoy, and Weinbach series. These soils have a surface layer of silt loam and a subsoil of silty clay loam. All have a fragipan except McGary soil, which has a very firm silty clay subsoil. Robbs and Stoy soils are on uplands. McGary and Weinbach soils are on stream terraces.

Permeability is slow to very slow, and available water capacity is moderate or high in soils of this group. Content of organic matter is low, and the soils are very strongly acid. The McGary soil is slightly acid to moderately alkaline in the lower part of the subsoil. Erosion is the main hazard.

The soils of this group are well suited to most of the crops commonly grown, such as corn, soybeans, wheat, grasses, and legumes. Plants subject to heaving, such as alfalfa, should be avoided on these somewhat poorly drained soils.

Crops respond moderately well or poorly to applications of lime and fertilizer. Plant roots are somewhat restricted by a weak fragipan in the Robbs, Stoy, and Weinbach soils, and by the alkaline lower part of the subsoil of the McGary soil. Crusts tend to form easily on the surface of these soils. Management is needed to control erosion. Proper management of crop residue and use of animal manure help to maintain organic-matter content, improve tilth, and reduce soil loss.

MANAGEMENT GROUP IIw-1

This group consists of soils of the Hurst, Reesville, Sciotoville, Stoy, and Weinbach series. These nearly level soils are on uplands and stream terraces. They are somewhat poorly drained, except for the Sciotoville soil, which is moderately well drained. All except the Hurst soil have a surface layer of silt loam and a subsoil of heavy silt loam or silty clay loam. The Hurst soil has a surface layer of silty clay loam and a subsoil of silty

clay. It is on low terraces that are subject to flooding during severe Ohio River floods.

Available water capacity is high in soils of this group. Permeability is slow in all soils except Sciotoville and Reesville. In these soils permeability is moderately slow. All are low in organic-matter content. Hurst, Stoy, and Sciotoville soils are very strongly acid in the subsoil. The Weinbach soil is extremely acid in the subsoil. The Reesville soil is slightly acid in the upper part of the subsoil and moderately alkaline in the lower part.

The soils of this group are well suited to most of the crops commonly grown in this area. Among these are corn, soybeans, wheat, grasses, and legumes. Plants easily damaged by heaving, such as alfalfa, should be avoided on these somewhat wet soils.

Crop response to applications of lime and fertilizer is medium or poor. Plant roots are somewhat restricted by a weak fragipan in Sciotoville, Stoy, and Weinbach soils and by the alkaline lower part of the subsoil in Reesville soil. Overwintering crops on the Hurst soil are sometimes damaged by flooding, especially in low areas and sloughs. Wetness is the main limitation affecting the use of these soils. Surface drainage is beneficial in most areas. Crusts tend to form easily on the surface. Proper management of crop residue and use of animal manure help to maintain organic-matter content and improve tilth. Using catch crops or grasses and legumes in the cropping system also helps to maintain tilth.

MANAGEMENT GROUP IIw-2

This group consists of soils of the Belknap, Dupo, and Wakeland series. These generally nearly level soils are somewhat poorly drained. They are on creek bottom lands. They have a surface layer of silt loam. Belknap and Wakeland soils have a subsoil of silt loam, and Dupo soils have a subsoil of silty clay. Also in this group is Alluvial land, though many areas of it are not suited to cultivated crops.

Permeability is moderate or moderately slow, but in places the permeability of the Dupo soil is slow. Available water capacity is high or very high, and content of organic matter is low in soils of this group. The Belknap soil is strongly acid, and Wakeland and Dupo soils are medium acid to neutral. In Alluvial land permeability is moderate to moderately rapid, and the available water capacity is moderate to high.

The soils of this group are well suited to such commonly grown crops as corn, soybeans, wheat, grasses, and legumes. In places, Alluvial land is used for these crops in years when flooding does not interfere. Plants easily damaged by heaving, such as alfalfa, should be avoided on these somewhat wet soils.

Crops respond well to applications of lime and fertilizer. Wetness and occasional flooding are the main limitations affecting the use of these soils. Surface drainage is beneficial in most areas. Diversion ditches are needed to intercept water from side hills. Alluvial land is subject to frequent flooding, streambank cutting, and deposition of sand and silt. Proper management of crop residue and use of animal manure help to maintain organic-matter content and improve tilth. Row crops can be grown several years in succession, but periodic use

of catch crops or grasses and legumes also helps to maintain tilth.

MANAGEMENT GROUP IIw-3

This group consists of soils of the Beaucoup and Petrolia series. These nearly level or depressional soils are poorly drained and are silty clay loam to a depth of at least 4 feet. Generally they occur on wide bottom lands. Petrolia soils, however, are also in narrow sloughs and drainageways.

Permeability is slow or moderately slow, and available water capacity is high to very high in soils of this group. These soils are slightly acid or neutral. Content of organic matter is moderate in Petrolia soils and high in Beaucoup soils.

These soils are well suited to such commonly grown crops as corn, soybeans, wheat, grasses, and legumes. Plants subject to damage by heaving, such as alfalfa, should not be grown.

Crops respond moderately well to applications of lime and fertilizer on these highly productive soils. Wetness and flooding are the main limitations to use. Surface ditches can be used to remove excess water, or tile can be used if flooding is not a hazard. Overwintering grasses and legumes are damaged by flooding that occurs in places on Petrolia soils, which are in sloughs and drainageways of the Ohio River bottom lands. Proper management of crop residue helps to maintain organic-matter content and tilth. Row crops or grasses and legumes also help to maintain tilth.

MANAGEMENT GROUP IIe-1

Burnside silt loam is the only soil in this group. It is a well drained or moderately well drained, nearly level soil on bottom lands near small creeks. It consists of a silt loam upper layer over a stony loam lower layer.

Permeability is moderate, and the content of organic matter is low in this soil. Available water capacity is only moderate because the lower layer is stony. This soil is very strongly acid.

This soil is suited to such commonly grown crops as corn, soybeans, wheat, grasses, and legumes.

Crops respond moderately well to applications of lime and fertilizer. In many places this soil is used for pasture or woodland because it is in narrow or small areas on bottom lands where lime and fertilizer are not easily applied. In a few places stones are at or near the surface, and these areas are generally left in woodland. This soil is subject to flash flooding and is likely to be damaged by streambank cutting, scouring, and the accumulation of silt and debris. Little protection generally is possible, but ditches and diversions help to control floodwater or divert water from critical areas. Proper management of crop residue and use of animal manure help to maintain organic-matter content, prevent surface crusting, and improve tilth. The periodic use of catch crops and grasses and legumes also helps to maintain tilth.

MANAGEMENT GROUP IIIe-1

This group consists of soils of the Alford, Alvin, Emma, Markland, and Wheeling series. These soils are well drained and moderately well drained. All are strongly sloping except for the Markland soil, which is sloping, and the Alvin soils, which are sloping in places. These soils

have a surface layer of silt loam except for the Emma soil, which has a surface layer of silty clay loam, and the Alvin soils, which have a surface layer of fine sandy loam. These soils have a subsoil of silty clay loam except for the Markland soil, which has a subsoil of silty clay.

Permeability is moderate or moderately slow except for the Markland soil, where it is slow. Available water capacity is high, except for Alvin soils, where it is moderate. Content of organic matter is low. These soils are very strongly acid, except for the Markland soil, which is strongly acid or very strongly acid in the upper part of the subsoil and neutral in the lower part of the subsoil. If the strongly sloping soils and the moderately sloping Markland soil are cultivated, the hazard of erosion is severe. On the sandy Alvin soils the hazard of erosion is slight to medium.

The soils of this group are suited to such commonly grown crops as corn, soybeans, wheat, grasses, and legumes.

Crops respond moderately well and well to applications of lime and fertilizer. Runoff is less on the sandy Alvin soils. Because the organic-matter content is low, crusts and clods form easily on the surface of these soils. Management is needed to control erosion. Proper management of crop residue and use of animal manure help to maintain organic-matter content, improve tilth, and control erosion.

MANAGEMENT GROUP IIIe-2

This group consists of soils of the Bedford, Grantsburg, Hosmer, Sciotoville, Stoy, Weinbach, and Zanesville series. These soils are sloping and strongly sloping. They are moderately deep to a fragipan. They have a slightly eroded or moderately eroded surface layer of silt loam and a subsoil of heavy silt loam to silty clay loam over a fragipan. They are moderately well drained except for Stoy and Weinbach soils, which are somewhat poorly drained.

Permeability is moderately slow to very slow in the soils of this group. Available water capacity is moderate except for Sciotoville soil, where it is high. Content of organic matter is low, and the soils are extremely acid to very strongly acid. In most of these soils, erosion has somewhat reduced the effective moisture storage area above the fragipan. If cultivated, the hazard of erosion is moderate or severe.

The soils of this group are suited to such commonly grown crops as corn, soybeans, wheat, grasses, and legumes.

Crops respond moderately well and well to applications of lime and fertilizer. Root growth is restricted by the fragipan. Management is needed to control erosion. Stoy and Weinbach soils are also limited for use by wetness. Because the organic-matter content is low, crusts and clods form easily on the surface. Proper management of crop residue and use of animal manure help to maintain organic-matter content, improve tilth, and control erosion.

MANAGEMENT GROUP IIIw-1

This group consists of soils of the Ginat, Racoon, and Weir series. These nearly level soils are poorly drained. They have a surface layer of silt loam and a subsoil of silty clay loam, except for some areas where the sur-

face layer of Ginat soil is silty clay loam. Weir soil is on uplands, and Ginat and Racoon soils are on stream terraces.

Permeability is slow to very slow, and available water capacity is high in soils of this group. Content of organic matter is low, and the soils are very strongly acid. Excess water is a major hazard.

The soils of this group are suited to such commonly grown crops as corn, soybeans, wheat, grasses, and legumes. Plants easily damaged by wet conditions or by heaving should be avoided.

The natural productivity of these soils is low, but crops respond moderately well to applications of lime and fertilizer. These soils remain waterlogged and cool until late in spring. Surface drainage is needed. Tilth is also a concern, and crusts tend to form easily on the surface of these soils. Proper management of crop residue, periodic use of grasses, legumes, and catch crops, and use of animal manure help to maintain organic-matter content and improve tilth.

MANAGEMENT GROUP IIIw-2

Bonnie silt loam is the only soil in this group. This nearly level, poorly drained soil is on bottom lands. It has a surface layer and subsoil of silt loam.

Permeability is slow, and available water capacity is high on this soil. Content of organic matter is low, and the soil is very strongly acid. Excess water and flooding are the main hazards.

This soil is suited to such commonly grown crops as corn, soybeans, and wheat. Hayland grasses and legumes should be adapted to wet conditions.

Crops respond moderately well to applications of lime and fertilizer. The soils remain waterlogged and cool until late in spring. Surface drainage is needed. Diversion ditches are used to intercept water from side hills in places. Drainage ditches that direct water safely along channels help to prevent scouring and deposition of new material or debris. Tilth is also a concern, and crusts tend to form easily on the surface of this soil. Proper management of crop residue and animal manure helps to maintain organic-matter content and improve tilth. Row crops can be grown several years in succession, but the periodic use of catch crops or grasses and legumes also helps to maintain tilth.

MANAGEMENT GROUP IIIw-3

This group consists of soils of the Cape, Darwin, and Karnak series. These nearly level and slightly depressional soils are on broad stream bottom lands. They are poorly drained and very poorly drained. The soils have a surface layer of silty clay or silty clay loam and a subsoil of silty clay. In places they have layers of silt loam overwash.

Permeability is slow or very slow, and available water capacity is moderate to high in soils of this group. Content of organic matter is low or moderate. Cape soils are strongly acid, and Darwin and Karnak soils are medium acid to mildly alkaline. Excess water and flooding are the main hazards.

These soils are better suited to such summer crops as corn or soybeans than to other crops. Hay and pasture plants grow well, but the hazard of flooding makes it risky to grow them.

Crops respond moderately well to applications of lime and fertilizer. The soils remain waterlogged and cool until late in spring. Surface drainage generally can be used, but many low spots are difficult to drain. Because these soils are clayey, maintaining favorable tilth is a severe concern. The mechanical power needed for tillage is increased, and farm machinery is difficult to operate. All tillage must be done with care, because the soils become cloddy if tilled when wet. Keeping tillage to a minimum, returning all crop residue to the soil, and using catch crops and cover crops in the cropping system help to improve tilth. Maintaining favorable tilth is less difficult in soils that have a surface layer of silty clay loam than in soils that have a surface layer of silty clay and is the least difficult in the silt loam overwash phases of these soils. Where material of these textures is present, mechanical power needs decrease and machinery is less difficult to operate.

MANAGEMENT GROUP IIIs-1

This group consists of soils of the Brandon, Lamont, and Saffell series. These gently sloping to strongly sloping soils are well drained and are on stream terraces. They have a surface layer of silt loam, gravelly silt loam, or fine sandy loam and a subsoil of silty clay loam, very gravelly clay loam, heavy fine sandy loam, or loam.

Permeability is moderate to rapid, and available water capacity is low to moderate in soils of this group. Content of organic matter is low, and the soils are very strongly acid except for Lamont soils, which are medium acid to strongly acid. Erosion is a hazard, but droughtiness is the main concern.

The soils of this group are moderately well suited to such commonly grown crops as corn, soybeans, wheat, grasses, and legumes.

Natural productivity is low, and crops respond poorly to applications of lime and fertilizer. Because these soils are loamy or gravelly, leaching of plant nutrients is rapid and fertilizer should be applied in amounts for the immediate crop rather than in large amounts expected to last a long period of time. Proper management of crop residue, use of grasses and legumes, and use of animal manure help to increase organic-matter content, improve tilth, increase the available water capacity, and increase the nutrient-holding capacity of these soils.

MANAGEMENT GROUP IVe-1

This group consists of soils of the Alford and Alvin series. These soils are strongly sloping and severely eroded or moderately steep and eroded. The Alford soils are on uplands, and they are well drained. They have a surface layer of silt loam or silty clay loam and a subsoil of silty clay loam. The Alvin soil has a surface layer of fine sandy loam and a subsoil of heavy fine sandy loam.

Permeability is moderate, and available water capacity is moderate or high in soils of this group. Content of organic matter is low, and the soils are very strongly acid. The hazard of erosion is severe.

The soils of this group are suited to small grain, grasses, and legumes, and they are well suited to hay and pasture. They are not well suited to such row crops as corn and soybeans.

Crops on Alford soils respond well to applications of lime and fertilizer. Such response is only moderate on the Alvin soil. Careful management is needed to control erosion and to maintain fertility and good tilth. Similar intensive management is needed whether the soils are strongly sloping and severely eroded or moderately steep and eroded. Such management is important on the strongly sloping soils because of the effects of past erosion and on the moderately steep soils because of the potential damage by further erosion. Under average management, row crops should be grown only occasionally in the cropping system. Keeping tillage to a minimum, conserving crop residue, and using winter cover crops help to improve tilth, especially in areas of severely eroded soils.

MANAGEMENT GROUP IVe-2

This group consists of soils of the Bedford, Grantsburg, Hosmer, Lax, Markland, Sciotoville, and Zanesville series. These soils are strongly sloping and severely eroded or moderately steep and eroded. They are on uplands and terraces, and they are moderately well drained. They have a surface layer of silt loam or silty clay loam and a subsoil of silty clay loam, except for the Markland soil, which has a subsoil of silty clay. They have a fragipan in the lower part of the subsoil except for the Markland soil, which has no fragipan.

Permeability is slow to very slow except for Sciotoville soils, where it is moderately slow. Available water capacity is moderate. Erosion has reduced the effective moisture storage area above the fragipan in severely eroded soils. Content of organic matter is low, and the

soils are extremely acid to very strongly acid in the subsoil except for the Markland soil, which is strongly acid or very strongly acid in the upper part of the subsoil and neutral in the lower part of the subsoil. The hazard of erosion is severe.

The soils of this group are suited to hay and pasture (fig. 16) and, in places, can be used for corn and wheat.

Root growth is restricted by the fragipan, but crops respond well or moderately well to applications of lime and fertilizer. Careful management is needed to control erosion and maintain fertility and good tilth. Intensive management is needed whether soils are strongly sloping and severely eroded or moderately steep and eroded. Such management is needed on the strongly sloping soils to control the effects of past erosion and on the moderately steep soils to control the potential damage from further erosion. Row crops should be grown only occasionally in the cropping system. Keeping tillage to a minimum, conserving crop residue, and using winter cover crops help to conserve moisture and improve tilth, especially in areas of severely eroded soils.

MANAGEMENT GROUP Vw-1

This group consists of soils of the Bonnie, Cape, Karnak, and Petrolia series. These poorly drained to very poorly drained soils are ponded or frequently flooded or have a high water table for long periods each year. On the soil map, these areas have a "W" preceding the soil symbol. These soils are nearly level or depressional and are on bottom lands. They have a surface layer and subsoil of silt loam, silty clay loam, or silty clay.



Figure 16.—Severely eroded Hosmer soils, management group IVe-2.

Permeability is slow or very slow, and available water capacity is moderate or high in soils of this group. Content of organic matter is low or moderate, and the soils range from very strongly acid to neutral.

The soils of this group are too wet to be used for cultivated crops. In some areas the water table remains within 6 inches of the surface for more than 6 months of the year. Because of this wetness, the choice of plants is limited. Most areas are wooded. In places, these soils can be used for pasture or wildlife habitat.

Areas that are used for pasture should be seeded to plants adapted to wetness and that can tolerate flooding for long periods. Grazing should be closely controlled, especially when the soil is wet. Controlling weeds, vines, and brush is especially difficult on these soils.

MANAGEMENT GROUP VIe-1

This group consists of soils of the Alford, Alvin, and Wheeling series. These well-drained soils are moderately steep and steep and are on uplands and stream terraces. Alford and Wheeling soils have a slightly to severely eroded surface layer of silt loam and a subsoil of silty clay loam. The Alvin soil has a surface layer and subsoil of sandy loam.

Permeability is moderate, and available water capacity is moderate to high in soils of this group. Content of organic matter is low, and the soils are very strongly acid. The hazard of erosion is severe.

The soils of this group are suited to all the pasture grasses and legumes commonly grown in the area.

Crops respond well to applications of lime and fertilizer. Soils that have been cultivated are severely eroded and subject to further erosion if used for cultivated crops. Use of the moderately steep soils for farming is limited by the effects of past erosion, and use of the steep soils is limited by the hazard of further erosion. These soils are better suited to hay, pasture, or trees than to other uses.

MANAGEMENT GROUP VIe-2

This group consists of soils of the Bedford, Grantsburg, Hosmer, Lax, and Zanesville series. These moderately well drained soils are moderately steep and severely eroded or steep and eroded and are on uplands. They have a surface layer of silt loam or silty clay loam and a subsoil of silty clay loam. A fragipan is in the lower part of the subsoil.

Permeability is slow to very slow, and the available water capacity is moderate. Erosion has reduced the effective moisture storage area above the fragipan in severely eroded areas. Content of organic matter is low, and the soils are extremely acid or very strongly acid in the subsoil. Rooting depth is restricted by the fragipan. The hazard of erosion is severe.

The soils of this group are suited to all the pasture grasses and legumes commonly grown in the area. They are better suited to pasture, trees, or wildlife habitat than to other uses.

Crops respond well or moderately well to applications of lime and fertilizer. In most areas that have been cultivated, the soils are severely eroded and are subject to further erosion if used for cultivated crops. Thus, pasture management practices that help to control erosion should be used.

MANAGEMENT GROUP VIe-3

In this group are Alford, Baxter, Beasley, Berks, and Wellston soils. They are moderately well drained and well drained and are moderately steep. These soils are on uplands. Most of them have a surface layer of stony or cherty silt loam and a subsoil of stony silty clay loam to clay that is underlain by bedrock.

Permeability is moderate to moderately slow, and available water capacity is moderate in soils of this group. Content of organic matter is low, and the soils generally are very strongly acid. The underlying material of the Beasley soil, however, is alkaline.

Most areas of these soils are wooded, and the soils are suited to this use. In places the surface layer is relatively free of stones. In other places, particularly on the upper parts of slopes in areas of the Alford-Baxter complex, the soils lack stones. The soils in this group are moderately well suited to pasture, but the hazard of erosion is severe. If used for pasture, management practices that control erosion should be used.

MANAGEMENT GROUP VIIe-1

In this group are Alford, Baxter, Beasley, Berks, and Wellston soils. They are steep and very steep and are on uplands. The soils are well drained and moderately well drained. They have a surface layer of silt loam or cherty silt loam and a subsoil of silty clay loam or cherty silty clay loam to clay that is underlain by bedrock. The Alford soil is in a complex with Baxter soils and is a silty soil that does not contain stones or bedrock. Areas of moderately steep, severely eroded Wellston soils are included in this group because the effects of prior erosion severely limit their use for farming.

Permeability is moderate to moderately slow, and available water capacity generally is moderate in soils of this group. Content of organic matter is low, and the soils generally are very strongly acid. The substratum of the Beasley soil, however, is alkaline. If cultivated, the hazard of erosion is severe.

Many of the soils of this group are too stony to be cultivated, and some are too steep for the safe operation of farm machinery. Most areas are better suited to trees or wildlife habitat or to recreation than to other uses.

In places small areas of less steep and less stony soils can be used for pasture if management practices that control erosion are used.

MANAGEMENT GROUP VIIe-1

In this group are Berks, Brandon, Clarksville, Muskingum, and Saffell soils. These are steep and very steep, well-drained soils on uplands. Most of them have a surface layer of stony, cherty, or gravelly silt loam. The subsoil ranges from stony loam to silty clay and is underlain by bedrock or Coastal Plain gravel. Also in this group is Sandstone rock land that contains many bedrock outcrops and bluffs.

Permeability is moderate to rapid, and available water capacity is moderate or low in soils of this group. Content of organic matter is low, and the soils are strongly acid or very strongly acid.

In most areas these soils are too steep and stony for the use of farm machinery. These soils are suited to trees, and all areas are wooded. The soils are also suited

to wildlife habitat and some recreational uses. Use of machinery and equipment on slopes of more than 30 percent is severely limited.

Estimated Yields

Table 4 shows the estimated average yields per acre of principal crops in Pope, Hardin, and Massac Counties under high-level management. These estimates are based on average yields for the period 1954 to 1963, on soil tests, and on the experience and records of farmers, agronomists, conservationists, and farm advisers (26). The estimates are adjusted to reflect the trend toward

higher yields during the period 1963 to 1968. Average yields are expected to increase in the future. A few farmers obtain yields as high as 200 bushels of corn per acre in some years, but yields this high are still uncommon.

Management was determined on the basis of farming techniques, crop varieties, and fertilizers commonly used in 1968. Differences in weather from year to year may cause annual yields to range 20 percent above or below estimates shown in the table. Hay and pasture yields are estimated for varieties of grasses and legumes adapted to the soil.

High-level management means that adequate drain-

TABLE 4.—Estimated average yields per acre of principal crops

Soil	Corn	Soybeans	Wheat	Mixed hay ¹	Rotation pasture
	Bu.	Bu.	Bu.	Tons	A.U.D. ²
Alford silt loam, 2 to 4 percent slopes	110	38	48	3.5	175
Alford silt loam, 4 to 7 percent slopes, eroded	105	35	45	3.5	175
Alford silt loam, 7 to 12 percent slopes, eroded	100	35	42	3.5	175
Alford soils, 7 to 12 percent slopes, severely eroded	90	32	40	3.5	175
Alford silt loam, 12 to 18 percent slopes, eroded	90	32	40	3.0	150
Alford soils, 12 to 18 percent slopes, severely eroded ³				3.0	150
Alford silt loam, 18 to 30 percent slopes, eroded ³					150
Alford-Baxter complex, 12 to 18 percent slopes, eroded ³					100
Alford-Baxter complex, 18 to 40 percent slopes, eroded ³					
Alluvial land	(4)	(4)	(4)		
Alvin fine sandy loam, 0 to 2 percent slopes	85	30	40	2.5	125
Alvin fine sandy loam, 2 to 4 percent slopes	80	30	38	2.5	125
Alvin fine sandy loam, 4 to 7 percent slopes	80	30	38	2.5	125
Alvin fine sandy loam, 7 to 12 percent slopes, eroded	70	28	35	2.5	125
Alvin fine sandy loam, 12 to 18 percent slopes, eroded	70	22	35	2.0	100
Alvin fine sandy loam, 18 to 30 percent slopes					75
Armiesburg silty clay loam	125	45	(4)	(4)	(4)
Baxter cherty silt loam, 12 to 18 percent slopes ³					70
Baxter cherty silt loam, 18 to 30 percent slopes ³					
Baxter cherty silt loam, 30 to 50 percent slopes ³					
Beasley silt loam, 12 to 18 percent slopes ³					110
Beasley silt loam, 18 to 30 percent slopes ³					
Beasley silt loam, 30 to 50 percent slopes ³					
Beaucoup silty clay loam	115	40	50	3.5	175
Bedford silt loam, 7 to 12 percent slopes	65	22	30	2.0	100
Bedford soils, 7 to 12 percent slopes, severely eroded	50	20	25	1.5	75
Bedford silt loam, 12 to 18 percent slopes, eroded	55	20	22	1.5	75
Bedford soils, 12 to 18 percent slopes, severely eroded ³					50
Bedford silt loam, 18 to 30 percent slopes, eroded ³					50
Belknap silt loam	105	38	48	3.5	175
Bonnie silt loam	90	32	40	3.0	150
Bonnie silt loam, wet					(4)
Brandon and Saffell soils, 1 to 4 percent slopes	60	25	32	2.0	100
Brandon and Saffell soils, 4 to 12 percent slopes, eroded	50	22	30	1.5	75
Brandon and Saffell soils, 12 to 30 percent slopes ³					
Burnside silt loam	85	28	38	3.5	175
Cape silt loam, overwash	95	32	40	3.0	150
Cape silty clay loam	95	32	40	3.0	150
Cape silty clay loam, wet					(4)
Clarksville cherty silt loam, 20 to 30 percent slopes ³					
Clarksville cherty silt loam, 30 to 60 percent slopes ³					
Darwin silty clay	90	32	38	2.5	125
Darwin silty clay loam	90	35	40	3.0	150
Dupo silt loam	105	40	50	3.5	175
Emma silty clay loam, 0 to 2 percent slopes	100	35	45	3.0	150
Emma silty clay loam, 2 to 7 percent slopes	95	35	42	2.8	140
Emma silty clay loam, 7 to 18 percent slopes, eroded	85	30	38	2.5	125
Ginat silt loam	80	28	35	2.0	100
Grantsburg silt loam, 2 to 4 percent slopes	80	30	38	2.5	125
Grantsburg silt loam, 4 to 7 percent slopes, eroded	70	25	32	2.0	100
Grantsburg silt loam, 7 to 12 percent slopes, eroded	65	22	30	1.5	75
Grantsburg soils, 7 to 12 percent slopes, severely eroded	50	20	25	1.5	75
Grantsburg silt loam, 12 to 18 percent slopes, eroded	55	20	25	1.5	75
Grantsburg soils, 12 to 18 percent slopes, severely eroded ³				1.0	50

See footnotes at end of table.

TABLE 4.—Estimated average yields per acre of principal crops—Continued

Soil	Corn	Soybeans	Wheat	Mixed hay ¹	Rotation pasture
	Bu.	Bu.	Bu.	Tons	A. U. D. ²
Haymond silt loam	115	40	50	3.5	175
Hosmer silt loam, 2 to 4 percent slopes	90	32	40	3.0	150
Hosmer silt loam, 4 to 7 percent slopes, eroded	80	30	35	2.5	125
Hosmer silt loam, 7 to 12 percent slopes, eroded	75	25	32	2.5	125
Hosmer soils, 7 to 12 percent slopes, severely eroded	60	22	25	2.5	125
Hosmer silt loam, 12 to 18 percent slopes, eroded	60	25	25	2.0	100
Hosmer soils, 12 to 18 percent slopes, severely eroded ³				1.5	75
Hosmer silt loam, 18 to 30 percent slopes, eroded ³					100
Hosmer-Lax silt loams, 12 to 18 percent slopes, eroded	55	22	22	2.0	100
Hosmer-Lax complex, 12 to 18 percent slopes, severely eroded				1.5	75
Hosmer-Lax silt loams, 18 to 30 percent slopes, eroded					75
Huntington silt loam	130	45	(4)	(4)	(4)
Hurst silty clay loam	80	28	38	2.5	125
Karnak silt loam, overwash	85	28	38	2.5	125
Karnak silty clay	85	28	38	2.0	100
Karnak silty clay, wet					(4)
Karnak silty clay loam, ashy	90	30	40	2.5	125
Lamont fine sandy loam, 2 to 7 percent slopes	70	25	35	2.0	100
Lamont fine sandy loam, 7 to 12 percent slopes, eroded	60	22	30	1.5	75
Lax silt loam, 12 to 18 percent slopes	65	25	28	2.5	125
Lax soils, 12 to 18 percent slopes, severely eroded ³				1.5	75
Lax silt loam, 18 to 30 percent slopes, eroded ³					75
Markland silt loam, 2 to 7 percent slopes, eroded	70	25	35	2.0	100
Markland silt loam, 7 to 15 percent slopes, eroded	70	22	32	1.5	75
McGary silt loam, 0 to 4 percent slopes	80	28	38	2.0	100
Muskingum and Berks soils, 15 to 30 percent slopes					
Muskingum and Berks soils, 30 to 60 percent slopes					
Petrolia silty clay loam	110	38	45	3.0	150
Petrolia silty clay loam, wet					(4)
Racoon silt loam	90	30	40	2.5	125
Reesville silt loam	115	40	50	3.5	175
Robbs silt loam, 1 to 4 percent slopes	90	30	40	3.0	150
Sandstone rock land					
Scioto silt loam, 0 to 2 percent slopes	100	35	45	4.0	200
Scioto silt loam, 2 to 4 percent slopes	100	35	45	4.0	200
Scioto silt loam, 4 to 7 percent slopes, eroded	90	32	40	3.5	175
Scioto silt loam, 7 to 12 percent slopes, eroded	85	30	38	3.0	175
Scioto silt loam, 12 to 18 percent slopes, eroded	75	28	35	2.5	125
Scioto soils, 7 to 12 percent slopes, severely eroded	75	28	35	2.5	125
Sharon silt loam	110	40	50	3.5	175
Stoy silt loam, 0 to 2 percent slopes	100	35	45	3.0	150
Stoy silt loam, 2 to 4 percent slopes	100	35	45	3.0	150
Stoy silt loam, 4 to 7 percent slopes, eroded	85	30	40	3.0	150
Wakeland silt loam	110	40	50	3.5	175
Weinbach silt loam, 0 to 2 percent slopes	95	35	45	3.0	150
Weinbach silt loam, 2 to 4 percent slopes	95	35	45	3.0	150
Weinbach silt loam, 4 to 7 percent slopes, eroded	85	30	40	3.0	150
Weir silt loam	90	32	42	2.5	125
Wellston silt loam, 12 to 18 percent slopes				2.0	100
Wellston soils, 12 to 18 percent slopes, severely eroded					75
Wellston silt loam, 18 to 30 percent slopes					
Wellston-Berks complex, 12 to 18 percent slopes ³					505
Wellston-Berks complex, 18 to 30 percent slopes ³					
Wellston-Berks complex, 30 to 60 percent slopes ³					
Wheeling silt loam, 0 to 2 percent slopes	100	35	45	4.0	200
Wheeling silt loam, 2 to 4 percent slopes	100	35	45	4.0	200
Wheeling silt loam, 4 to 7 percent slopes, eroded	90	32	40	3.5	175
Wheeling silt loam, 7 to 12 percent slopes, eroded	85	30	38	3.0	150
Wheeling silt loam, 12 to 25 percent slopes, eroded ³				3.0	150
Zanesville silt loam, 7 to 12 percent slopes, eroded	65	22	30	1.5	75
Zanesville soils, 7 to 12 percent slopes, severely eroded	50	20	25	1.5	75
Zanesville silt loam, 12 to 18 percent slopes, eroded	50	20	25	1.5	75
Zanesville soils, 12 to 18 percent slopes, severely eroded ³				1.0	50
Zanesville silt loam, 18 to 30 percent slopes, eroded ³					50

¹ Hay and pasture yields are estimated for mixed stands of grasses and legumes adapted to the soil. For the kinds of hay and pasture that are best suited to a particular soil, see the local soil conservationist or extension adviser.

² A. U. D. = Animal-unit days. The figure in this column represents the number of days that one acre will carry one animal unit—1

cow, 2 yearling cattle, 5 sheep, or 4 brood sows—without damage to the pasture.

³ Should be kept under permanent vegetation.

⁴ Variable.

age, flood control, and erosion control are provided; the proper number of plants is grown; high-quality seed is used; tillage is kept to a minimum and is done when soil moisture is favorable; weeds, plant diseases, and harmful insects are controlled; favorable soil reaction and near optimum levels of nitrogen, phosphorus, and potassium are maintained; efficient use is made of available crop residue, barnyard manure, and green-manure crops; crops are harvested with the smallest possible loss; the combination of practices used is efficient; and all operations are timely.

Woodland ³

Hardwoods originally covered almost all of Pope, Hardin, and Massac Counties. The Conservation Needs Inventory (25) shows that there were 137,800 acres of privately owned woodland in the three counties in 1967. Another 97,368 acres is in Shawnee National Forest. The total acreage of woodland is about 41 percent of the land

³ WILLIAM CLARK, woodland conservationist, Soil Conservation Service, assisted in the preparation of this section.

area. Most of this woodland is in areas that can produce hardwoods of high quality.

In table 5 the soils of Pope, Hardin, and Massac Counties are placed in 14 woodland suitability groups (16) on the basis of soil characteristics that affect the production of timber. In each group the soils are described briefly, a site index and an average annual growth in board feet per acre are given, and the hazards and limitations that affect the use of soils for woodland are rated. Also shown are preference ratings for trees in existing stands and for trees suitable for planting (fig. 17 and fig. 18).

The potential productivity of a soil for a given species is commonly expressed by a site index—the height in feet that the dominant trees of a given species, growing on a specified soil, will reach at a specified age. The site index for cottonwood is based on height at 30 years of age (6), and for other species on height at 50 years of age.

The estimated average annual growth per acre is given in board feet measured by the Doyle Rule. The estimates are based on data from well-stocked, well-managed stands



Figure 17.—Mixed planting of hardwoods and conifers on Hosmer silt loam, woodland suitability group 2o1.



Figure 18.—Loblolly pine pulpwood on Grantsburg silt loam, woodland suitability group 3d2.

of upland oaks, pin oak, yellow-poplar, and cottonwood (19) (21). Red oak and white oak were used to estimate the rate of growth for all upland oaks.

Four hazards that affect the growth or management of trees are rated in table 5. The ratings are slight, moderate, or severe for the soils in each group.

Seedling mortality is the failure of seedlings to grow in a soil after natural seedings have been planted. It is affected by the nature of the soil and by other environmental factors when plant competition is assumed not to be a limiting factor. The ratings for seedling mortality given in this survey are for trees in a natural environment. Mortality is *slight* if not more than 25 percent of the planted seedlings die or if trees ordinarily regenerate naturally in places where there are enough seeds. It is *moderate* if 25 to 30 percent of the seedlings die or if trees do not regenerate naturally in numbers needed for adequate restocking. In places replanting to fill open

spaces is necessary. Mortality is *severe* if more than 50 percent of the planted seedlings die or if trees do not ordinarily reseed naturally in places where there are enough seeds.

Plant competition ratings are determined by the rate that unwanted trees, shrubs, and weeds vegetate a site when openings are made in the canopy. The presence of well-stocked stands of desirable seedlings is assumed. A rating of *slight* indicates that competition from other plants is not a special problem, and undesirable plant species do not impede the growth of desirable plant species. Plant competition is *moderate* if unwanted plants develop, but generally do not prevent the establishment of an adequate stand of desirable species. Establishment, however, may be delayed and initial growth slowed. A rating of *severe* indicates that plant competition prevents desirable trees from restocking naturally. Special management and careful preparation of such sites are needed.

Erosion hazard is rated according to the risk of erosion on well-managed woodland that is not protected by special practices. It is *slight* where only a slight loss of soil is expected. Erosion generally is slight if slopes range from 0 to 12 percent and runoff is slow or very slow. It is *moderate* if the loss of soil is moderate in places where runoff is not controlled and the vegetative cover is not adequate for protection. It is *severe* if slopes are steep, runoff is rapid, and infiltration and permeability are slow.

Equipment limitation depends on soil characteristics and topographic features that restrict the use of equipment in planting, tending, or harvesting trees. Limitation is *slight* if there are no restrictions on the type of equipment or time of year that equipment can be used. It is *moderate* if slopes are moderately steep, if heavy equipment is restricted by wetness in winter and early in spring, or if the use of equipment damages tree roots to some extent. Equipment limitation is *severe* if many types of equipment cannot be used, if the amount of time the equipment cannot be used is more than 3 months in a year, and if the use of equipment severely damages the roots of trees and the structure and stability of the soil.

In rating species for preference in existing stands, trees listed as *more desirable* are those that have a high market value and grow well on the specified group of soils. These trees should be protected and favored in existing stands. Trees listed as *less desirable* have low market value or undesirable growth habits. They should be discouraged or removed to allow for the growth of more desirable trees.

The planting guide lists trees in order of their suitability for planting, both in areas that are not severely eroded and those that are. Some suitability groups give preferences for hot sites and cool sites.

Hot sites include all southeast, south, southwest, and west slopes of more than 12 percent; narrow ridgetops less than 600 feet wide; and the upper third of the northerly and easterly slopes of the ridges. In these areas moisture evaporates more rapidly, leaf litter decays more rapidly, and productivity is less than on the cooler north slopes.

Cool sites include the lower two-thirds of all north, northwest, northeast, and east slopes; slopes of less than 12 percent on ridgetops more than 600 feet wide or that are on gently rolling terrain; and coves, footslopes, stream terraces, and bottom lands.

Recreational Uses of the Soils

Pope, Hardin, and Massac Counties have a high potential for outdoor recreation. Extensive forests, panoramic views, hills, lakes, ponds, rivers, streams, and rocky bluffs provide a varied background for the development of recreational enterprises (fig. 19).

In table 6 the soils of the survey area are placed in 14 recreation groups and are rated according to their limitations for recreational uses. The ratings for the soils in each group are based on those soil characteristics that affect use, such as natural drainage, seasonal high water table, flooding hazard, permeability, slope, texture of the surface layer, and stoniness or rockiness.

The ratings are *slight*, *moderate*, or *severe*. A rating of *slight* means that the soil has few limitations for the use specified or that the limitations can be easily overcome. A rating of *moderate* means that the limitations can be overcome by careful planning and maintenance. A rating of *severe* means that the soil is poorly suited to the use specified, or that the limitations can only be overcome by intensive engineering practices requiring a large investment. The soil properties that determine moderate and severe limitations are mentioned with the ratings in table 6. The recreational uses given in the table are discussed in the following paragraphs.

Campsites for tents and trailers are areas suitable for tents, trailers, and the activities that accompany outdoor living. They are used frequently during the camping season and require little site preparation other than shaping and leveling for tents and parking areas. The soils are rated according to their limitations for unsurfaced parking areas for cars and camp trailers, and for heavy traffic by people, and for limited vehicular traffic. Capability of the soils for supporting vegetation needs to be considered in the final evaluation.

Picnic areas, parks, and extensive play areas are areas that can support intensive foot traffic. It is assumed that most vehicular traffic will be confined to access roads. Such features as the presence of trees or ponds can affect the desirability of site, but are not considered in the ratings. Capability of the soils for supporting vegetation needs to be considered in the final evaluation. If a golf course is planned, these ratings can be applied to golf fairways. Greens, traps, and hazards are not rated; they generally are made from transported soil material.

Playgrounds, athletic fields, and intensive play areas are areas developed for playgrounds and organized games, such as baseball, football, tennis, and badminton. They are subject to intensive foot traffic. It is assumed that a good vegetative cover can be established and maintained where needed.

Footpaths, trails, and bridle paths are areas that need to be capable of supporting intensive movement by people on foot or on horseback. It is assumed that such areas will be used as they are and that little soil will be moved. Placing paths and trails in sloping areas on the contour helps control erosion.

Necessary to most recreation areas are cottages, service or utility buildings, and streets or roads. For information on soil features affecting use for small buildings refer to the section "Engineering Uses of the Soils."

Wildlife ⁴

The wildlife population of any area depends on the availability of food, cover, and water in a suitable combination (27). Food, cover, and water are plentiful in Pope, Hardin, and Massac Counties, but they are not always in combinations suitable for wildlife habitat. The soil resources provide a good basis for the development of suitable wildlife habitat.

The soils are placed in wildlife groups and rated according to their suitability for elements of wildlife habi-

⁴ REX HAMILTON, biologist, Soil Conservation Service, assisted in the preparation of this section.

TABLE 5.—*Suitability of*

Woodland suitability group and soil description	Species	Site index	Average annual growth
<p>Group lo1: Well-drained, moderately permeable soils that have slopes of 0 to 12 percent, surface layers of silt loam, subsoils of silty clay loam, and high available water capacity; on uplands. 308B, 308C2, 308D2, 308D3.</p>	<p>Upland oaks----- Yellow-poplar-----</p>	<p>85+ 95+</p>	<p><i>Board feet per acre</i> 350-450 550-650</p>
<p>Group lo4: Well drained and moderately well drained, moderately permeable soils that have slopes generally of less than 4 percent, surface layers and subsoils of silt loam or silty clay loam, and high available water capacity; on bottom lands. 72, 331, 427, 455, 597, 600.</p>	<p>Cottonwood----- Yellow-poplar-----</p>	<p>105+ 95+</p>	<p>550-650 550-650</p>
<p>Group lr2: Well-drained, moderately permeable soils that have slopes of 12 to 30 percent, surface layers of silt loam, subsoils of silty clay loam, and high available water capacity. 308E2, 308E3, 308F2.</p>	<p>Upland oaks----- Yellow-poplar-----</p>	<p>85+ 95+</p>	<p>350-450 550-650</p>
<p>Group 2o1: Moderately well drained and well drained, moderately to slowly permeable soils that have slopes of 0 to 12 percent, surface layers of silt loam or fine sandy loam, subsoils of sandy clay loam to silty clay loam, and high to moderate available water capacity; on uplands and terraces. 131A, 131B, 131C, 131D2, 214B¹, 214C2, 214D2, 214D3, 462A, 462B, 462C2, 462D2, 462D3, 463A, 463B, 463C2, 463D2, 467C2, 467D2, 469A, 469B, 469D2, 723.</p>	<p>Upland oaks----- Yellow-poplar-----</p>	<p>75-85 85-95</p>	<p>250-350 450-550</p>
<p>Group 2o4: Somewhat poorly drained, moderately or moderately slowly permeable soils that have slopes generally of less than 4 percent, surface layers and subsoils of silt loam or silty clay loam, and high available water capacity; on bottom lands. 180, 333, 382.</p>	<p>Cottonwood----- Yellow-poplar-----</p>	<p>95-105 85-95</p>	<p>450-550 450-550</p>

the soils for woodland

Management hazards or limitations				Species to favor in existing stands		Planting guide	
Seedling mortality	Plant competition	Erosion hazard	Equipment limitation	More desirable	Less desirable	Uneroded to moderately eroded soils	Severely eroded soils
Slight-----	Slight-----	Slight-----	Slight-----	Yellow-poplar, white oak, red oak, sweetgum, ash.	Hickory, beech, blackgum, sassafras.	Cool sites: black walnut, sweetgum, yellow-poplar, white oak, ash, red oak, sugar maple. Hot sites: ash, loblolly pine.	Cool sites: white pine, loblolly pine, shortleaf pine, Scotch pine. Hot sites: shortleaf pine, Scotch pine, loblolly pine.
Slight-----	Moderate---	Slight-----	Slight-----	Cottonwood, sycamore, yellow-poplar, cherrybark oak, sweetgum, ash, southern red oak.	Hickory, boxelder, blackgum.	Cottonwood, black walnut, sycamore, cherrybark oak, pin oak, sugar maple, red maple, pecan.	No severely eroded soils in this group.
Slight-----	Moderate---	Moderate---	Moderate---	White oak, red oak, yellow-poplar, ash.	Hickory, black oak, beech, sassafras, blackgum.	Cool sites: black walnut, sweetgum, yellow-poplar, white oak, ash, red oak, sugar maple. Hot sites: ash, loblolly pine.	Cool sites: white pine, loblolly pine, shortleaf pine, Scotch pine. Hot sites: shortleaf pine, loblolly pine, Scotch pine.
Slight-----	Slight to moderate.	Slight-----	Slight-----	White oak, red oak, yellow-poplar, black walnut, sweetgum, ash, sycamore.	Hickory, soft maple, persimmon.	Black walnut, cottonwood, sweetgum, yellow-poplar, white oak, red oak, ash, sycamore, white pine, loblolly pine, shortleaf pine, sugar maple.	White pine, loblolly pine, shortleaf pine, Scotch pine.
Slight-----	Slight-----	Slight-----	Slight-----	Cottonwood, sycamore, yellow-poplar, sweetgum, pin oak.	Blackgum, hickory, boxelder.	Cottonwood, red maple, sycamore, sweetgum, cypress, pin oak, water tupelo.	No severely eroded soils in this group.

TABLE 5.—Suitability of

Woodland suitability group and soil description	Species	Site index	Average annual growth
<p>Group 2r2: Moderately well drained and well drained, moderately to slowly permeable soils that have slopes of 12 to 30 percent, surface layers of silt loam or fine sandy loam, subsoils of sandy loam to silty clay, and high to moderate available water capacity; on uplands and terraces. 131E2, 131F, 214E2¹, 214E3, 214F2, 339E, 339E3, 339F, 462E2, 463E2, 628E, 628E3, 628F2, 691E, 691F, 953E2, 953E3, 953F2.</p>	<p>Upland oaks----- Yellow-poplar-----</p>	<p>75-85 85-95</p>	<p><i>Board feet per acre</i> 250-350 450-550</p>
<p>Group 2w5: Poorly drained, moderately slowly to slowly permeable soils that have slopes of less than 2 percent, surface layers of silt loam or silty clay loam, subsoils of silt loam to silty clay, and high available water capacity; on bottom lands. 70, 108, 288, 422, 422+.</p>	<p>Pin oak----- Cottonwood-----</p>	<p>85-95 95-105</p>	<p>350-450 450-550</p>
<p>Group 3o1: Somewhat poorly drained, slowly permeable soils that have slopes of 0 to 12 percent, surface layers of silt loam or silty clay loam, subsoils of silty clay loam to silty clay, and moderate to high available water capacity; on uplands and terraces. 164A, 164B, 164C2, 173B, 335B, 461A, 461B, 461C2, 693.</p>	<p>Upland oaks-----</p>	<p>65-75</p>	<p>150-250</p>
<p>Group 3r2: Well-drained, moderately to slowly permeable soils that have slopes of 12 to 30 percent, surface layers of stony, cherty, or gravelly silt loam, subsoils of stony loam to very gravelly clay loam, and moderate to very low available water capacity; on uplands. 471F, 599E, 599F, 954E2, 954F2, 955F, 956F, 986E, 986F.</p>	<p>Upland oaks-----</p>	<p>65-75</p>	<p>150-250</p>
<p>Group 3r3: Well-drained, moderately to slowly permeable soils that have slopes of 30 to 60 percent, surface layers of stony, cherty, or gravelly silt loam, subsoils of very stony loam to stony clay loam, and high to low available water capacity; on uplands. 9², 471G, 599G, 691G, 955G, 986G.</p>	<p>Upland oaks-----</p>	<p>65-75</p>	<p>150-250</p>
<p>Group 3s2: Well-drained, moderately or moderately rapidly permeable soils that have slopes of 0 to 12 percent, surface layers of fine sandy loam to very gravelly silt loam, subsoils of fine sandy loam to very gravelly silty clay loam, and low to moderate available water capacity; on terraces. 175B, 175D2, 956B, 956C2.</p>	<p>Upland oaks-----</p>	<p>65-75</p>	<p>150-250</p>

the soils for woodland—Continued

Management hazards or limitations				Species to favor in existing stands		Planting guide	
Seedling mortality	Plant competition	Erosion hazard	Equipment limitation	More desirable	Less desirable	Uneroded to moderately eroded soils	Severely eroded soils
Slight to moderate.	Slight.....	Moderate...	Moderate.....	White oak, black walnut, red oak, yellow-poplar.	Hickory, soft maple, persimmon, post oak.	Cool sites: black walnut, cottonwood, sweetgum, yellow-poplar, white oak, red oak, ash, sycamore, white pine, loblolly pine, shortleaf pine, sugar maple. Hot sites: ash, loblolly pine.	Cool sites: white pine, loblolly pine, shortleaf pine, Scotch pine. Hot sites: shortleaf pine, Scotch pine, loblolly pine.
Moderate....	Severe.....	Slight.....	Moderate.....	Pin oak, cottonwood, sweetgum, cherrybark oak, sycamore.	Honey locust, hickory, willow.	Cottonwood, red maple, sycamore, sweetgum, cypress, pin oak, water tupelo.	No severely eroded soils in this group.
Slight.....	Slight to moderate.	Slight.....	Slight to moderate.	White oak, red oak, ash, bur oak, sweetgum.	Post oak, hickory, blackgum, black-jack oak, persimmon.	Shortleaf pine, loblolly pine, white pine, white oak, ash, sycamore.	No severely eroded soils in this group.
Moderate to severe.	Slight.....	Moderate...	Moderate.....	Red oak, white oak, black oak, redcedar, bur oak.	Hickory, black-jack oak, post oak.	Shortleaf pine, loblolly pine, white pine, redcedar.	No severely eroded soils in this group.
Moderate to severe.	Slight.....	Severe.....	Severe.....	White oak, red oak, black oak, redcedar.	Hickory, soft maple, post oak, black-jack oak.	Shortleaf pine, redcedar.	No severely eroded soils in this group.
Moderate....	Slight.....	Slight.....	Slight.....	Black oak, white oak, scarlet oak.	Post oak, hickory, black-jack oak, sassafras.	Shortleaf pine, loblolly pine, white pine.	No severely eroded soils in this group.

TABLE 5.—Suitability of

Woodland suitability group and soil description	Species	Site index	Average annual growth
Group 3d2: Moderately well drained, slowly permeable soils that have slopes of 2 to 30 percent, surface layers of silt loam, a dense, compact layer (fragipan), and moderate to very low available water capacity; on uplands. 301B, 301C2, 301D2, 301D3, 301E2, 301E3, 340D2, 340D3, 340E2, 340E3, 340F2, 598D, 598D3, 598E2, 598E3, 598F2.	Upland oaks-----	65-75	<i>Board feet per acre</i> 150-250
Group 3w6: Moderately slowly to very slowly permeable soils that have a water table at or near the surface more than 6 months of the year, surface layers and underlying material of silt loam to silty clay, and moderate to high available water capacity; on bottom lands. 71, W108, W288, W422, 426, 426†, 426‡, W426, 525.	Pin oak-----	75-85	200-350
Group 4w2: Poorly drained, slowly permeable soils that have slopes generally of less than 2 percent, surface layers of silt loam, subsoils of silty clay loam, and high available water capacity; on uplands and terraces. 109, 165, 460.	Pin oak-----	65-75	150-200

¹ Hosmer and Lax soils contain a fragipan that somewhat restricts rooting depth, permeability, and available water capacity.

tat and for kinds of wildlife. The ratings are *well suited*, *suitd*, *poorly suited*, and *unsuited*. A rating of well suited means that habitats are easily established, improved, or maintained. A rating of suited means that the soils have slight to moderate limitations for establishing and maintaining habitats. A rating of poorly suited means that the soils have severe limitations for establishing and maintaining habitats and that habitat management may be difficult and expensive. A rating of unsuited means that it generally is impractical to establish and maintain wildlife habitat on these soils.

The eight elements of wildlife habitat and the three kinds of wildlife in the counties are defined in the following paragraphs.

Grain and seed crops are domestic grains or seed-producing annual plants that include such crops as corn, sorghum, wheat, oats, soybeans, buckwheat, cowpeas, and sunflower.

Grasses and legumes are domestic perennial grasses and legumes that are planted to provide food and cover. They include such crops as fescue, reedtop, orchardgrass, reed canarygrass, clovers, trefoil, alfalfa, and sericea or Korean lespedeza.

Wild herbaceous upland plants are native or introduced perennial grasses and forbs or weeds that provide food and cover mainly for wildlife on uplands. These plants include bluestem, indiagrass, switchgrass, oatgrass, pokeweed, strawberries, partridge peas, lespedezas, beggarweed, wild beans, nightshade, and goldenrod.

Hardwood woodland plants are nonconiferous trees,

shrubs, and woody vines that produce fruits, nuts, buds, catkins, twigs (browse), or foliage used extensively as food by wildlife. These plants are commonly established by natural processes but also are planted. They include oak, cherry, persimmon, dogwood, viburnum, maple, birch, grapes, honeysuckle, briars, and roses.

Coniferous woodland plants are cone-bearing trees and shrubs primarily used as cover by wildlife. Food in the form of browse, seeds, or fruit-like cones is used to some extent by wildlife. These plants, established naturally or by planting, include pine, red cedar, cypress, juniper, and yew.

Wetland food and cover plants are annual and perennial wildlife herbaceous plants, exclusive of submerged or floating aquatics that grow on moist or wet sites. These plants, used mainly by wetland wildlife for food and cover, include smartweeds, wild millets, rushes, sedges, reeds, switchgrass, and cattails.

Shallow water developments are impoundments or excavations for controlling water and generally not more than 5 feet deep. Examples are low dikes and levees, shallow dugouts, level ditches, and devices for controlling the water level on marshy streams or channels.

Excavated ponds are dugout ponds or combinations of dugout areas and low dikes (dammed areas) that have water of suitable quality, of suitable depth, and in ample supply for the production of fish or wildlife.

Farm ponds of the impounded type are not included in these ratings. They attract resting migratory waterfowl, however, and can be of importance in producing

the soils for woodland—Continued

Management hazards or limitations				Species to favor in existing stands		Planting guide	
Seedling mortality	Plant competition	Erosion hazard	Equipment limitation	More desirable	Less desirable	Uneroded to moderately eroded soils	Severely eroded soils
Moderate....	Slight.....	Moderate....	Slight where slopes are 0 to 12 percent. Moderate where slopes are 12 to 30 percent.	White oak, red oak, black oak white ash.	Hickory, sassafras.	Cool sites: white pine, loblolly pine, ash, white oak, red oak, Scotch pine, shortleaf pine. Hot sites: ash, loblolly pine, Scotch pine, shortleaf pine.	Cool sites: white pine, loblolly pine, Scotch pine, shortleaf pine. Hot sites: shortleaf pine, loblolly pine, Scotch pine.
Severe.....	Moderate to slight.	Slight.....	Severe.....	Cypress, tupelo gum, swamp white oak, swamp chestnut oak.	Willow, birch, hickory.	Cypress.....	No severely eroded soils in this group.
Moderate....	Severe.....	Slight.....	Moderate....	Pin oak, white oak, black oak, ash.	Hickory, blackjack oak, post oak.	Cypress, pin oak, ash, water tupelo, red maple.	No severely eroded soils in this group.

² Sandstone rock land is variable in productivity and commonly has a site index of 45-55 for upland oaks.

freshwater fish. Features affecting the use of soils for impounded farm ponds are given in table 8.

Open-land wildlife includes species that normally frequent cropland, pasture, and land overgrown with grasses, herbs, and shrubs. Examples of open-land wildlife are rabbits, red fox, skunks, quail, and dove. Elements of wildlife habitat used in rating soils for this kind of wildlife are seed and grain crops, grasses and legumes, wild herbaceous upland plants, and hardwoods.

Woodland wildlife includes species that frequent areas of hardwoods and conifers, shrubs, or a combination of vegetation (fig. 20). Examples of woodland wildlife are squirrel, deer, raccoon, turkey, woodpeckers, and nut-hatches. Elements of wildlife habitat used in rating soils for this kind of wildlife are grasses and legumes, wild herbaceous upland plants, hardwoods, and conifers.

Wetland wildlife includes species that frequent wet areas, such as ponds, marshes, and swamps. Examples of wetland wildlife are muskrats, wild ducks and geese, and kingfishers and red-winged blackbirds. Elements of wildlife habitat used in rating soils for this kind of wildlife are wetland food and cover plants, seed and grain crops, shallow-water developments and excavated ponds.

WILDLIFE GROUP 1

This group consists of well drained and moderately well drained upland and terrace soils of the Alford, Alvin, Brandon, Emma, Grantsburg, Hosmer, Lamont, Markland, Saffell, Sciotoville, and Wheeling series. Slope ranges from 0 to 7 percent. The surface layer is generally

silt loam or silty clay loam. Soils that have a surface layer of fine sandy loam or gravelly silt loam, however, are also in this group.

Soils in this group provide habitat for open-land wildlife and are well suited to this use. Growth of grain and seed crops in sandy Lamont and gravelly Saffell soils is moderately limited by droughtiness. Wooded areas are well suited to woodland wildlife.

Unfavorable slope and drainage characteristics of all soils in this group make them unsuited to habitat for wetland wildlife. Because of these characteristics, use of the soils is severely limited for shallow-water developments, excavated ponds, and growth of wetland food and cover plants.

WILDLIFE GROUP 2

This group consists of well drained and moderately well drained upland and terrace soils of the Alford, Alvin, Bedford, Emma, Grantsburg, Hosmer, Lamont, Markland, Sciotoville, Wheeling, and Zanesville series. Slope ranges from 7 to 12 percent. The surface layer is generally silt loam or silty clay loam. Soils that have a surface layer of fine sandy loam, however, are also in this group.

Permeability is moderate to slow in soils of this group, and available water capacity is high to low.

Soils in this group provide habitat for open-land wildlife and are well suited to this use. Growth of grain and seed crops is moderately limited by slope and erosion. Wooded areas are well suited to woodland wildlife.



Figure 19.—Family recreation area on Hosmer silt loam.

Unfavorable slope and drainage characteristics make the soils of this group unsuited to habitat for wetland wildlife. Because of these characteristics, use of the soils is very severely limited for growth of food and cover plants, shallow-water developments, and excavated ponds.

WILDLIFE GROUP 3

This group consists of well drained and moderately well drained, upland and terrace soils of the Alford, Alvin, Baxter, Beasley, Bedford, Grantsburg, Hosmer, Lax, Sciotoville, Wellston, Wheeling, and Zanesville series. Slope ranges from 12 to 18 percent. The surface layer is generally silt loam, but many soils are severely eroded and have a surface layer of silty clay loam. Sandy soils and stony soils that have slopes of 12 to 18 percent are also in this group.

Permeability is moderate to slow in soils of this group, and available water capacity is high to low.

Soils in this group provide habitat for openland wildlife and are suited to this use. Growth of grain and seed crops is severely limited, and growth of grasses and legumes is moderately limited by slope and erosion. Wooded areas are suited to woodland wildlife. Slope and erosion moderately limit growth of grass and legume food patches.

Unfavorable slope and drainage characteristics make the soils of this group unsuited to habitat for wetland wildlife. Because of these characteristics, use of the soils is very severely limited for growth of wetland food and cover plants, shallow-water developments, and excavated ponds.

WILDLIFE GROUP 4

This group consists of well drained and moderately well drained, upland soils of the Alford, Alvin, Baxter, Beasley, Bedford, Hosmer, Lax, Wellston, and Zanes-

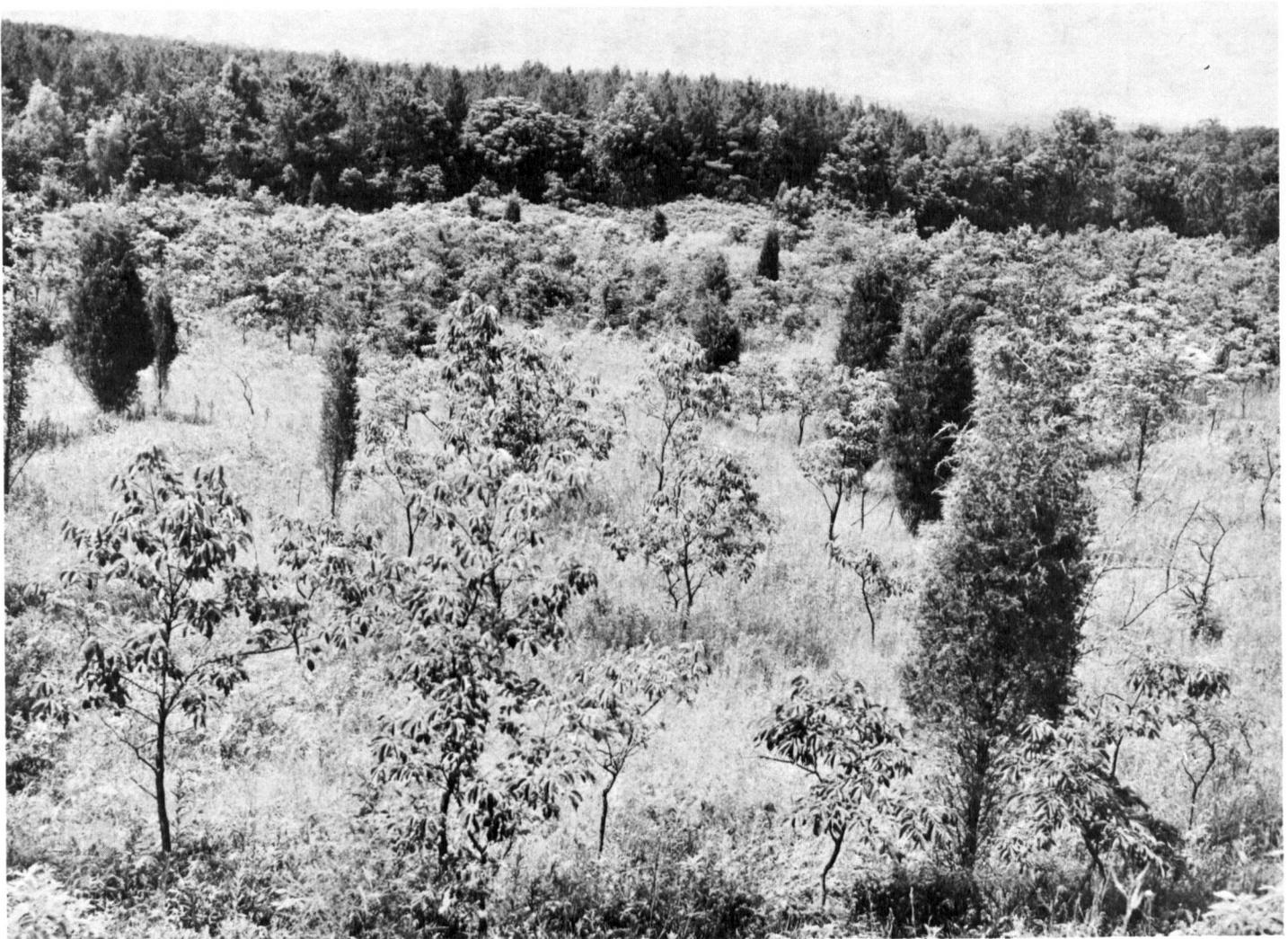


Figure 20.—Wild herbaceous upland plants and young woody plants in an abandoned area of a Grantsburg soil.

ville series. Slope ranges from 18 to 30 percent. The surface layer is generally silt loam, but sandy soils and stony soils are also in this group.

Permeability is moderate to slow in soils of this group, and available water capacity is high to low.

Soils in this group provide habitat for openland wildlife and are suited to this use. Growth of seed and grain crops is very severely limited, and growth of grasses and legumes is severely limited by steepness and the severe hazard of erosion. Wooded areas are suited to woodland wildlife. Growth of patches of grasses and legumes is severely limited by steepness.

Unfavorable slope characteristics of the soils of this group make them unsuited to habitat for wetland wildlife. Because of this characteristic, use of the soils is very severely limited for wetland food and cover plants, shallow-water developments, and excavated ponds.

WILDLIFE GROUP 5

This group consists of well-drained, stony and rocky, upland soils of the Baxter, Beasley, Berks, Brandon,

Clarksville, Muskingum, Saffell, and Wellston series and the land type Sandstone rock land. Slope ranges from 30 to 60 percent. Also in this group are stony and gravelly soils that have slopes of less than 30 percent.

Permeability is moderate to slow in soils of this group, and available water capacity is high to low.

Soils in this group are poorly suited to habitat for openland wildlife. Growth of seed and grain crops and grasses and legumes is very severely limited by steepness and stoniness.

Wooded areas are suited to woodland wildlife. Growth of hardwood woody plants is moderately limited on very rocky and very stony soils. Growth of coniferous woody plants is moderately limited by a moderately rapid growth rate. Growth of patches of grasses and legumes is very severely limited by steepness and stoniness.

Unfavorable slope characteristics of the soils in this group make them unsuited to habitat for wetland wildlife. Because of this characteristic, use of the soils is very severely limited for food and cover plants, shallow-water developments, and excavated ponds.

TABLE 6.—*Suitability of the soils for selected recreational uses*

Recreation group number and soil description	Degree and kind of limitation for—			
	Campsites for tents and trailers	Picnic areas, parks, and extensive play areas	Playgrounds, athletic fields, and intensive play areas	Footpaths, trails, and bridle paths
<p>Group 1: Well-drained, moderately permeable soils that have slopes of 0 to 7 percent and a silt loam or fine sandy loam surface layer; on uplands or terraces. 131A, 131B, 131C, 175B, 308B, 308C2, 463A, 463B, 463C2, 956B, 956C2.</p>	Slight.....	Slight.....	Slight where slopes are 0 to 2 percent. Moderate where slopes are 2 to 7 percent.	Slight.
<p>Group 2: Moderately well drained, moderately slowly and slowly permeable soils that have slopes of 0 to 7 percent and a silt loam surface layer; on uplands or terraces. 214B, 214C2, 301B, 301C2, 462A, 462B, 462C2, 467C2, 469A, 469B.</p>	Moderate: slow to dry..	Slight.....	Moderate where slopes are 0 to 2 percent; slow to dry. Slopes of 2 to 7 percent limit use.	Slight.
<p>Group 3: Well drained and moderately well drained, moderately to very slowly permeable soils that have slopes of 7 to 12 percent and a silt loam, fine sandy loam, or silty clay loam (severely eroded) surface layer; on uplands or terraces. 131D2, 175D2, 214D2, 214D3, 301D2, 301D3, 308D2, 308D3, 340D2, 340D3, 462D2, 462D3, 463D2, 467D2, 469D2, 598D, 598D3.</p>	Moderate: slopes limit use; silty clay loam surface layer sticky when wet.	Moderate: slopes limit use; silty clay loam surface layer sticky when wet.	Severe: slopes limit use.	Slight.
<p>Group 4: Well drained and moderately well drained, moderately to slowly permeable soils that have slopes of 12 to 18 percent and a surface layer that is generally silt loam or silty clay loam (severely eroded) but is sandy or stony in some soils; on uplands or terraces. 131E2, 214E2, 214E3, 301E2, 301E3, 308E2, 308E3, 339E, 339E3, 340E2, 340E3, 462E2, 463E2, 598E2, 598E3, 599E, 628E, 628E3, 691E, 953E2, 953E3, 954E2, 986E.</p>	Severe: slopes limit use.	Severe: slopes limit use.	Severe: slopes limit use.	Moderate: slopes limit use; silty clay loam surface layer sticky when wet.
<p>Group 5: Well drained and moderately well drained, moderately to slowly permeable soils that have slopes of 18 to 60 percent and a silt loam and stony, cherty, or gravelly silt loam surface layer; on uplands. 131F, 214F2, 303F2, 339F, 340F2, 598F2, 599F, 599G, 628F2, 691F, 691G, 953F2, 954F2, 956F</p>	Severe: slopes limit use..	Severe: slopes limit use..	Severe: slopes limit use..	Severe: slopes limit use.
<p>Group 6: Well-drained, generally moderately permeable soils that have slopes of 18 to 60 percent, a stony silt loam to very stony loam surface layer, and rock outcrops and bluffs in many places; on uplands. 9, 471F, 471G, 955F, 955G, 986F, 986G</p>	Severe: slopes and stoniness limit use.	Severe: slopes and stoniness limit use.	Severe: slopes and stoniness limit use.	Moderate to severe: slopes limit use, but rocks and bluffs provide esthetic value.

<p>Group 7: Somewhat poorly drained, moderately to very slowly permeable soils that have slopes of 0 to 7 percent and a silt loam or silty clay loam surface layer; on uplands and terraces. 164A, 164B, 164C2, 173B, 335B, 461A, 461B, 461C2, 693, 723</p>	<p>Moderate: seasonal high water table; slow to dry; all but 723 are slowly or very slowly permeable; silty clay loam surface layer sticky when wet.</p>	<p>Moderate: seasonal high water table; slow to dry; dusty when dry; silty clay loam surface layer sticky when wet.</p>	<p>Moderate: seasonal high water table; slow to dry; all but 723 are slowly or very slowly permeable; dusty when dry; silty clay loam surface layer sticky when wet; slopes of 2 to 7 percent limit use.</p>	<p>Moderate: seasonal high water table; slow to dry; silty clay loam surface layer sticky when wet.</p>
<p>Group 8: Poorly drained, slowly to very slowly permeable soils that have slopes generally of less than 2 percent and a silt loam surface layer; on uplands and terraces. 109, 165, 460</p>	<p>Severe: seasonal water table near surface; slowly or very slowly permeable; slow to dry; dusty when dry.</p>	<p>Severe: seasonal water table near surface; slow to dry; dusty when dry; difficult to maintain vegetative cover.</p>	<p>Severe: seasonal water table near surface; slowly or very slowly permeable; slow to dry; difficult to maintain vegetative cover.</p>	<p>Severe: seasonal water table near surface; slow to dry; dusty when dry.</p>
<p>Group 9: Well drained and moderately well drained, moderately permeable soils that have slopes generally of 0 to 4 percent and a silt loam or silty clay loam surface layer; on bottom lands. 72, 331, 427, 597,600</p>	<p>Severe: subject to flooding; silty clay loam surface layer of 597 sticky when wet.</p>	<p>Moderate: subject to flooding; silty clay loam surface layer of 597 sticky when wet.</p>	<p>Severe: subject to flooding; silty clay loam surface layer of 597 sticky when wet.</p>	<p>Moderate: subject to flooding.</p>
<p>Group 10: Somewhat poorly drained, moderately to very slowly permeable soils that have slopes generally of less than 2 percent and a silt loam surface layer; on bottom lands. 180,333,382.</p>	<p>Severe: subject to flooding; seasonal high water table; slow to dry.</p>	<p>Moderate to severe: subject to flooding; seasonal high water table; slow to dry.</p>	<p>Severe: subject to flooding; seasonal high water table; slow to dry.</p>	<p>Moderate: subject to flooding; seasonal high water table; slow to dry.</p>
<p>Group 11: Poorly drained, slowly permeable soils that have slopes generally of less than 2 percent and a silt loam surface layer; on bottom lands. 108.</p>	<p>Severe: subject to flooding; seasonal water table near surface; slow to dry; slowly permeable; difficult to drain; dusty when dry.</p>	<p>Severe: subject to flooding; seasonal water table near surface; slow to dry; slowly permeable; difficult to drain; dusty when dry; difficult to maintain vegetative cover.</p>	<p>Severe: subject to flooding; seasonal water table near surface; slow to dry; slowly permeable; difficult to drain; dusty when dry; difficult to maintain vegetative cover.</p>	<p>Severe: subject to flooding; seasonal water table near surface; slow to dry; dusty when dry.</p>
<p>Group 12: Poorly drained and very poorly drained, moderately to very slowly permeable soils that are nearly level or depressional and have a silty clay loam or silt loam surface layer; on bottom lands. 70, 288, 422, 422+.</p>	<p>Severe: subject to flooding; seasonal water table near surface; slippery and sticky when wet; slow to dry; turf easily damaged when wet.</p>	<p>Severe: subject to flooding; seasonal water table near surface; slippery and sticky when wet; slow to dry; turf easily damaged when wet.</p>	<p>Severe: seasonal water table near surface; slow to dry; slippery and sticky when wet; subject to flooding; turf easily damaged when wet; surface layer cracks when dry.</p>	<p>Severe: seasonal water table near surface; slippery and sticky when wet; slow to dry; subject to flooding.</p>

TABLE 6.—*Suitability of the soils for selected recreational uses—Continued*

Recreation group number and soil description	Degree and kind of limitation for—			
	Campsites for tents and trailers	Picnic areas, parks, and extensive play areas	Playgrounds, athletic fields, and intensive play areas	Footpaths, trails, and bridle paths
<p>Group 13: Poorly drained or very poorly drained, very slowly permeable soils that are nearly level or depressional and have a silty clay or heavy silty clay loam surface layer; on bottom lands. 71, 426, 426+, 426‡, 525.</p>	<p>Severe: subject to flooding; subject to ponding; seasonal water table near surface; slowly to very slowly permeable; difficult to drain; slow to dry; slippery and sticky when wet; hard and rough when dry.</p>	<p>Severe: subject to flooding and ponding; seasonal water table near surface; slippery and sticky when wet; hard and rough when dry; slow to dry; turf easily damaged when wet.</p>	<p>Severe: subject to flooding and ponding; seasonal water table near surface; slippery and sticky when wet; hard and rough when dry; slowly to very slowly permeable; difficult to drain.</p>	<p>Severe: subject to flooding and ponding; seasonal water table near surface; slow to dry; slippery when wet; hard and rough when dry.</p>
<p>Group 14: Soils that are very wet or ponded for much of the year and very frequently flooded areas; on bottom lands. These soils have the characteristics of Groups 11, 12, and 13, but they are too wet for too long each year to be suitable for campsites, picnic areas, or intensive play areas. They may provide areas of scenic or esthetic value for paths and trails, but they are not suited to intensive foot or vehicular traffic. W108, W288, W422, W426, 455.</p>				

WILDLIFE GROUP 6

In this group are somewhat poorly drained, upland and terrace soils of the Hurst, Reesville, Stoy, and Weinbach series. Slope ranges from 0 to 2 percent. The surface layer is silt loam, and the subsoil is silty clay loam.

Permeability is moderate to slow in soils of this group, and available water capacity is moderate to high.

Soils in this group provide habitat for openland wildlife and are well suited to this use. In areas where artificial drainage is not adequate, growth of grain and seed crops and grass and legume seedlings is moderately limited. Wooded areas are well suited to woodland wildlife.

These soils are naturally somewhat poorly drained and are suited to habitat for wetland wildlife. Because of this drainage characteristic, however, use of the soils is moderately limited for wetland food and cover plants, shallow-water developments, and excavated ponds.

WILDLIFE GROUP 7

In this group are somewhat poorly drained, upland and terrace soils of the McGary, Robbs, Stoy, and Weinbach series. Slope ranges from 2 to 7 percent. The surface layer is silt loam, and the subsoil is silty clay loam or silty clay.

Permeability is moderate to slow in soils of this group, and available water capacity is moderate to high.

Soils in this group provide habitat for openland wildlife and are well suited to this use. Wooded areas are well suited to woodland wildlife.

Unfavorable slope and surface runoff drainage characteristics of all soils in this group make them poorly suited to habitat for wetland wildlife. Because of these characteristics, use of the soils is severely limited for wetland food and cover plants, shallow-water developments, and excavated ponds.

WILDLIFE GROUP 8

In this group are poorly drained, upland and terrace soils of the Ginat, Racoon, and Weir series. These soils are generally nearly level. The surface layer is silt loam, and the subsoil is silty clay loam.

Permeability is slow in soils of this group, and available water capacity is high.

Soils in this group provide habitat for openland wildlife and are well suited to this use if they are adequately drained and are poorly suited if not adequately drained. If these soils are adequately drained, growth of grain and seed crops is moderately limited by wetness. If these soils are not adequately drained, growth of seed and grain crops is severely limited, and growth of grasses and legumes is moderately limited by wetness.

Wooded areas are well suited to woodland wildlife. Growth of coniferous woody plants is moderately limited by wetness.

These soils are well suited to habitat for wetland wildlife.

WILDLIFE GROUP 9

This group consists of well-drained, bottom-land soils of the Armiesburg, Burnside, Haymond, Huntington, and Sharon series. These soils generally are nearly level

or gently sloping. The surface layer and subsoil are silt loam or silty clay loam. Burnside soils have a stony substratum, and some areas of Huntington soils have sandy layers.

Permeability is moderate in soils of this group, and available water capacity is moderate to very high.

Soils in this group provide habitat for openland wildlife and are well suited to this use. Wooded areas are well suited to woodland wildlife.

Because of natural good drainage, moderate permeability, and a hazard of flooding, the soils in this group are unsuited to habitat for wetland wildlife. Because these soils are naturally well drained, use of the soils is very severely limited for wetland food and cover plants. Because of permeability and the hazard of flooding, these soils are very severely limited for shallow-water developments and excavated ponds.

WILDLIFE GROUP 10

In this group are somewhat poorly drained and poorly drained, bottom land soils of the Belknap, Bonnie, Dupo, and Wakeland series. These soils are generally nearly level. The surface layer and subsoil are generally silt loam, but the Dupo soil is underlain by silty clay loam.

Permeability is moderately slow or slow in soils of this group, and available water capacity is high.

Soils in this group provide habitat for openland wildlife and are well suited to this use. Growth of grain and seed crops is moderately limited by poor drainage.

Wooded areas are well suited to woodland wildlife. Growth of coniferous woody plants is moderately limited on Bonnie soils by wetness.

These soils are suited to habitat for wetland wildlife. Growth of wetland food and cover plants and use of these soils for shallow-water developments are moderately limited. Use of these soils for excavated ponds is severely limited by the hazard of flooding.

WILDLIFE GROUP 11

This group consists of poorly drained and very poorly drained, bottom land soils of the Beaucoup, Cape, Darwin, Karnak, and Petrolia series. These soils are nearly level or depressional. The surface layer and subsoil are silty clay loam or silty clay. Also in this group are areas of these soils that have a silt loam overwash layer.

Permeability is moderate to very slow in soils of this group, and available water capacity is high or very high.

Soils in this group provide habitat for openland wildlife and are well suited to this use if they are adequately drained and protected from flooding. They are poorly suited to this use if they are not adequately drained. Growth of grain and seed crops is moderately limited by poor drainage. Growth of grain and seed crops and grasses and legumes in soils that have a surface layer of silty clay is moderately limited by poor tilth.

Wooded areas are well suited to woodland wildlife. Growth of coniferous woody plants is moderately limited by wetness. Growth of patches of grasses and legumes in soils that have a surface layer of silty clay is moderately limited by poor tilth.

These soils are well suited to habitat for wetland wildlife if protected from or seldom subject to flooding and

are suited to habitat for wetland wildlife if flooding is a hazard. In areas where flooding is a hazard, these soils are moderately limited for shallow-water developments and excavated ponds.

WILDLIFE GROUP 12

In this group are very poorly drained, bottom land soils of the Bonnie, Cape, Karnak, and Petrolia series. These soils are ponded or have a high water table for long periods each year. Texture ranges from silt loam to silty clay. Also in this group is Alluvial land, a land type adjacent to the Ohio River that is subject to frequent flooding rather than to ponding of water.

Permeability is moderate to slow in soils of this group.

Soils in this group are poorly suited to habitat for openland wildlife. Growth of grain and seed crops is very severely limited, growth of grasses and legumes is severely limited, and growth of wild herbaceous plants is moderately limited by excessive wetness.

Wooded areas are suited to woodland wildlife. Growth of hardwood woody plants is slightly limited, growth of grasses and legumes is severely limited, and growth of wild herbaceous plants is moderately limited by excessive wetness. Growth of coniferous woody plants is moderately to severely limited by high seedling mortality.

These soils are suited to habitat for wetland wildlife. Because of a flooding hazard, these soils are moderately limited for shallow-water developments and excavated ponds.

Engineering Uses of the Soils ⁵

This section is useful to those who need information about soils used as structural material or as foundation upon which structures are built. Among those who can benefit from this section are planning commissions, town and city managers, land developers, engineers, contractors, and farmers.

Among properties of soils highly important in engineering are 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 to those who—

1. Select potential residential, industrial, commercial, and recreational areas.
2. Evaluate alternate routes for roads, highways, pipelines, and underground cables.
3. Seek sources of gravel, sand, or clay.
4. Plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil.

5. Correlate 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. Predict the trafficability of soils for cross-country movement of vehicles and construction equipment.
7. Develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in tables 7, 8, and 9, which show, respectively, several estimated soil properties significant to engineering, interpretations for various engineering uses, and results from engineering laboratory tests on soil samples.

This information, along with the soil map and other parts of this survey, can be used to make interpretations in addition to those given in tables 7 and 8. It also can be used to make other useful maps.

This information, however, does not eliminate need for further investigations at sites selected for engineering works, especially works that involve heavy loads or that require excavations to depths greater than those shown in the tables, generally depths greater than 6 feet. Also, inspection of sites, especially small ones, is needed because many delineated areas of a given soil mapping unit may contain small areas of other kinds of soil that have strongly contrasting properties and different suitabilities or limitations for soil engineering.

Some of the terms used in this soil survey have a special meaning in soil science that is not known to all engineers. The Glossary defines many such terms as they are used in soil science.

Engineering soil classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system used by the SCS engineers, Department of Defense, and others, and the AASHO system adopted by the American Association of State Highway Officials.

In the Unified system soils are classified according to particle-size distribution, plasticity, liquid limit, and organic-matter content. In this system soils are grouped in 15 classes, of which eight are coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes are fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class is 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 through 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 clayey soils that have low strength when wet and 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-1-b,

⁵ HERBERT DAVENPORT, agricultural engineer, Soil Conservation Service, was consulting adviser during the preparation of this section.

A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, and A-7-6. An additional refinement is the group index number, which gives the engineering value of a soil material. Group indexes range from 0 for the best material to 20 or more for the poorest. The AASHO classification for tested soils, with group index numbers in parentheses, is shown in table 9; the estimated classification, without group index numbers, is given in table 7 for all soils mapped in the survey area.

Estimated soil properties significant to engineering

Table 7 provides estimates of soil properties important to engineering. The estimates are based on field classification and descriptions, physical and chemical tests of selected representative samples (table 9), test data from comparable soils in adjacent areas and from detailed experience in working with the individual soils in the survey area.

Depth to seasonal high water table is the distance between the surface of the soil and the highest level reached in most years by ground water. This generally is early in spring and the estimates are for soils that have not been artificially drained.

USDA texture is determined by the relative proportions of sand, silt, and clay in soil material that is less than 2.0 millimeters in diameter. "Sand," "silt," "clay," and some of the other terms used in the USDA textural classification are defined in the Glossary.

The *coarse fraction greater than 3 inches* indicates the percentage of stones in a soil material that have a minimum width or diameter greater than 3 inches.

Permeability is the quality of a soil horizon that enables water or air to move through it. It is estimated on the basis of soil characteristics observed in the field, especially structure and texture. The estimates in table 6 do not take into account lateral seepage or such soil features as plowpans and surface crusts.

Available water capacity is the capacity 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 as a pH value. The pH value and relative terms used to describe soil reaction are explained in the Glossary.

Shrink-swell potential indicates the volume change to be expected of the soil material with changes in moisture content. Shrinking and swelling of soils cause much damage to building foundations, roads, and other structures. A high shrink-swell potential indicates hazards to the maintenance of structures constructed in, on, or with such materials.

Corrosion potential for concrete, as used here, indicates the degree of danger to concrete structures through chemical action that dissolves or weakens the structural material. If buried in the soil, a structural material may corrode. In some kinds of soil a given material corrodes more rapidly than in others. Extensive installations that intersect soil boundaries or soil horizons are more likely to be damaged by corrosion than are installations entirely in one kind of soil or soil horizon.

Interpretation of the engineering properties of soils

Table 8 contains selected information useful to engineers and others who plan to use soil material to construct highways, farm facilities, buildings, and sewage disposal systems. Detrimental or undesirable features are emphasized; but very important desirable features may also be listed. The ratings and other interpretations in this table are based on the estimated engineering properties of the soils in table 6; on available test data, including those in table 8; and on field experience. Although, strictly speaking, the information applies only to soil depths indicated in table 6, it is reasonably reliable to depths of about 6 feet for most soils, and several more feet for some.

Topsoil is a term used to designate a fertile soil or soil material that can be used as a topdressing for lawns, gardens, roadbanks, and the like. The ratings indicate suitability for such use.

Road fill is material used to build embankments. The ratings indicate performance of soil material moved from borrow areas for these purposes.

Highway and street location is influenced by features of the undisturbed soil that affect construction and maintenance of highways. The soil features, favorable as well as unfavorable, are the main ones that affect geographic location of highways and streets.

Farm pond reservoir areas are affected mainly by seepage loss of water, and the soil features are those that influence such seepage.

Farm pond embankments serve as dams. The soil features, of both subsoil and substratum, are those important to the use of soils for constructing embankments.

Drainage for crops and pasture is affected by features and qualities of the soil which affect the installation and performance of surface and subsurface drainage systems. Artificial drainage is needed on many of the nearly level soils. Tile drains are not effective on most of the soils, and systems of surface ditches must be used.

Irrigation is affected by soil features that influence water intake rates, storage, and drainage and runoff of excess water.

Terraces and diversions are affected mainly by soil features that affect construction or that indicate exposure of materials poorly suited for crop growth.

Grassed waterway construction and maintenance is affected by soil features that influence the establishment, growth, and maintenance of plants and by factors that hinder layout and construction.

Foundations for low buildings are affected mainly by features of the undisturbed soil that influence its capacity to support low buildings that have normal foundation loads. Specific values of bearing strength have not been assigned.

Septic-tank filter fields are affected mainly by permeability, location of the water table, slope, and susceptibility to flooding. The degree of limitations and main reasons for assigning moderate or severe limitations are given.

Sewage lagoons are affected mainly by soil features, such as permeability, location of the water table, slope, and susceptibility to flooding. The degree of limitation and main reasons for assigning moderate or severe limitations are given.

TABLE 7.—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. The soils in referring to other series in the first column of this table. The

Soil series and map symbols	Depth to—		Depth from surface	Classification		
	Bedrock	Seasonal high water table		USDA texture	Unified (24)	AASHO (1)
*Alford: 308B, 308C2, 308D2, 308D3, 308E2, 308E3, 308F2, 954E2, 954F2. For Baxter part of 954E2 and 954F2, see Baxter series.	Feet 5-20	Feet 5-10	Inches 0-10 10-50 50-60	Silt loam..... Silty clay loam and heavy silt loam. Silt loam.....	ML CL ML or CL	A-4 A-6 or A-7 A-6 or A-4
Alluvial land: 455..... Too variable for valid estimates.	>10	(2)				
Alvin: 131A, 131B, 131C, 131D2, 131E2, 131F.	>10	5-10	0-10 10-58 58-65	Fine sandy loam..... Heavy fine sandy loam..... Fine sandy loam or loamy fine sand.	SM or ML SC or CL SM	A-2 or A-4 A-4 or A-6 A-2
Armiesburg: 597.....	>10	2 5-10	0-67	Silty clay loam.....	CL	A-6 or A-7
Baxter: 599E, 599F, 599G.....	4-10	5-10	0-10 10-24 24-60	Cherty silt loam..... Cherty silty clay loam and very cherty silty clay. Cherty clay and clay.....	GM or ML GM, GC, CL or CH CH	A-2 or A-4 A-2, A-6, or A-7 A-7
Beasley: 691E, 691F, 691G.....	3-5	(3)	0-7 7-14 14-36 36	Silt loam..... Silty clay..... Silty clay to clay..... Shale bedrock.	ML or CL CL or CH CH	A-4 or A-6 A-7 A-7
Beaucoup: 70.....	>10	2 0-1	0-60	Silty clay loam.....	CL	A-6 or A-7
Bedford: 598D, 598D3, 598E2, 598E3, 598F2.	4 >10	1½-3	0-6 6-19 19-30 30-61	Silt loam..... Silty clay loam..... Silt loam..... Cherty silt loam.....	ML CL ML GM or ML	A-4 A-6 A-4 A-2 or A-4
Belknap: 382.....	>6	2 1-3	0-65	Silt loam.....	ML or CL	A-4
Berks..... Mapped only with Muskingum and Wellston soils.	1½-3	(3)	0-20 20-28 28	Very stony loam..... Very stony sandy loam..... Sandstone bedrock.	GM or ML GM or ML	A-2 or A-4 A-2 or A-4
Bonnie: 108, W108.....	>6	2 0-1	0-60	Silt loam.....	ML or CL	A-4
Brandon: 956B, 956C2, 956F.....	>10	5-10	0-7 7-24 24-75	Silt loam..... Silty clay loam..... Very gravelly clay loam.....	ML CL GC or CL	A-4 A-6 A-1, A-2, or A-6
Burnside: 427.....	3½-8	2 3-5	0-27 27-60	Silt loam..... Gravelly silt loam and gravelly loam.	ML GM or ML	A-4 A-2 or A-4
Cape: 422, 422+, W422.....	>10	2 0-1	0-23 23-60	Silty clay loam..... Silty clay.....	CL CH	A-6 A-7
Clarksville: 471F, 471G.....	5-8	(3)	0-16 16-26 26-60 60	Cherty silt loam..... Very cherty silt loam and silty clay loam. Very cherty silty clay..... Chert bedrock.	GM or ML GM, GC, or ML GM	A-4 A-1, A-2, or A-4 A-1

See footnotes at end of table.

significant to engineering

such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for symbol > means more than; the symbol < means less than]

Coarse fraction greater than 3 inches	Percentage passing sieve—			Permeability	Available water capacity	Reaction	Shrink-swell potential	Corrosion potential for concrete ¹
	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)					
Percent				Inches per hour	Inches per inch of soil	pH		
0	100	100	95-100	0.6-2.0	0.20-0.25	6.1-7.3	Low.	Moderate.
0	100	100	95-100	0.6-2.0	0.19-0.21	4.5-5.5	Low.....	Moderate.
0	100	100	95-100	0.6-2.0	0.18-0.23	5.1-5.5	Low.....	Moderate.
0	100	100	30-60	2.0-6	0.13-0.17	4.5-5.5	Low.	High.
0	100	100	40-65	0.6-2.0	0.14-0.18	4.5-5.5	Low.....	High.
0	95-100	95-100	20-35	6.0-20.0	0.08-0.12	5.1-5.5	Low.....	High.
0	100	100	90-100	0.6-2.0	0.19-0.23	6.1-7.8	Moderate.....	Low.
0-5	50-90	50-85	45-85	0.6-2.0	0.10-0.17	4.0-5.5	Low.....	High.
0-5	25-70	20-65	20-60	0.6-2.0	0.18-0.12	4.0-5.0	Low.....	High.
0-2	80-95	80-95	75-95	0.6-2.0	0.06-0.10	4.5-5.5	High.....	High.
0-5	90-100	90-100	85-100	0.6-2.0	0.20-0.25	4.5-6.0	Low.	
0-5	90-100	90-100	85-100	0.2-0.6	0.10-0.14	5.1-6.5	Moderate.....	Low.
0-5	70-100	70-95	65-95	0.06-0.6	0.08-0.12	6.1-7.8	Moderate.....	Low.
0	100	100	95-100	0.6-2.0	0.19-0.21	6.1-7.8	Moderate to high....	Low.
0	100	100	95-100	0.6-2.0	0.20-0.25	4.5-6.5	Low.	High.
0	100	100	95-100	0.2-0.6	0.19-0.21	4.0-5.5	Moderate.....	High.
0	100	100	95-100	<0.06	0.14-0.18	4.0-5.5	Low to moderate.....	High.
0-5	20-75	20-80	20-80	<0.06	0.04-0.14	4.5-6.0	Low.....	Moderate.
0	100	95-100	70-95	0.2-0.6	0.20-0.25	4.5-5.5	Low.....	High.
10-50	25-75	20-65	20-60	0.6-2.0	0.05-0.15	4.5-6.0	Low.	
10-50	25-75	20-65	15-60	0.6-6.0	0.04-0.12	4.5-5.5	Low.....	High.
0	100	100	90-100	0.06-0.20	0.18-0.21	4.5-5.5	Low to moderate....	High.
0	95-100	95-100	90-100	0.6-2.0	0.20-0.25	4.5-5.5	Low.	
0-5	85-100	85-100	85-100	0.6-2.0	0.19-0.21	4.5-5.5	Moderate.....	High.
0-25	25-60	20-55	15-60	0.6-2.0	0.04-0.12	4.5-5.5	Low.....	High.
0	90-100	85-100	75-100	0.6-2.0	0.18-0.25	4.5-6.0	Low.....	Moderate.
0-50	30-80	20-60	25-55	2.0-6.0	0.05-0.16	4.5-5.5	Low.....	Moderate.
0	100	100	95-100	0.06-0.20	0.18-0.20	4.5-6.0	Moderate.....	Moderate.
0	100	100	95-100	<0.06	0.15-0.18	4.5-6.0	High.....	Moderate.
1-10	45-85	40-80	40-80	0.6-2.0	1.10-0.20	4.5-5.5	Low.	
2-50	30-75	20-65	20-60	0.6-6.0	0.05-0.15	4.5-5.5	Low.....	High.
50-90	5-50	5-35	5-25	0.6-6.0	0.01-0.06	4.5-5.5	Low.....	High.

TABLE 7.—Estimated soil properties

Soil series and map symbols	Depth to—		Depth from surface	Classification		
	Bedrock	Seasonal high water table		USDA texture	Unified (24)	AASHO (1)
	Feet	Feet	Inches			
Darwin:						
71-----	>10	2 0-1	0-19 19-60	Silty clay----- Silty clay-----	CH CH	A-7 A-7
525-----	>10	2 0-1	0-18 18-60	Silty clay loam----- Silty clay-----	CL CH	A-6 or A-7 A-7
Dupo: 180-----	>10	2 1-3	0-27 27-61	Silt loam----- Silty clay loam to silty clay.	ML or CL CL or CH	A-4 or A-6 A-6 or A-7
Emma: 469A, 469B, 469D2-----	>10	2 3-5	0-88	Silty clay loam-----	CL	A-7
Ginat: 460-----	>10	0-1	0-19 19-60	Silt loam----- Silty clay loam-----	ML or CL CL or CH	A-4 or A-6 A-6 or A-7
Grantsburg: 301B, 301C2, 301D2, 301D3, 301E2, 301E3.	4-10	4 1½-3	0-7 7-27 27-71	Silt loam----- Heavy silt loam to silty clay loam. Silty clay loam to silt loam.	ML or CL CL CL or ML	A-4 A-6 or A-4 A-6 or A-4
Haymond: 331-----	>6	2 5-10	0-60	Silt loam-----	ML or CL	A-4 or A-6
*Hosmer: 214B, 214C2, 214D2, 214D3, 214E2, 214E3, 214F2, 953E2, 953E3, 953F2. For Lax part of 953E2, 953E3, and 953F2, see Lax series.	4-10	4 1½-3	0-10 10-31 31-72	Silt loam----- Silt loam and silty clay loam. Silt loam and silty clay loam.	ML or CL CL ML or CL	A-4 or A-6 A-6 or A-7 A-7 or A-6
Huntington: 600-----	>10	2 5-10	0-65	Silt loam-----	ML or CL	A-4 or A-6
Hurst: 693-----	>10	1-3	0-10 10-72	Silty clay loam----- Heavy silty clay loam or light silty clay.	CL CL or CH	A-6 A-6 or A-7
Karnak: 426, 426+, W426, 426†-----	>10	2 0-1	0-50 50-65	Silty clay----- Silty clay loam-----	CH CL	A-7 A-6 or A-7
Lamont: 175B, 175D2-----	>10	5-10	0-11 11-27 27-60	Fine sandy loam----- Loam or heavy fine sandy loam. Loamy fine sand-----	SM or ML SM or ML SM	A-2 or A-4 A-4 A-2
Lax: 628E, 628E3, 628F2-----	>10	4 1½-3	0-8 8-20 20-32 32-52 52-63	Silt loam----- Silty clay loam----- Silty clay loam----- Very gravelly loam to gravelly silty clay loam. Very gravelly clay loam--	ML CL CL GM, ML, or CL GM, CL, or GC	A-4 A-6 A-6 A-2, A-4, or A-6 A-2 or A-6
Markland: 467C2, 467D2-----	>10	3-5	0-6 6-26 26-60	Silt loam----- Silty clay----- Silty clay-----	ML or CL CH CH or CL	A-4 or A-6 A-7 A-7
McGary: 173B-----	>10	1-3	0-7 7-13 13-55 55-60	Silt loam----- Silty clay loam----- Silty clay----- Silty clay-----	ML or CL CL CH CH or CL	A-4 or A-6 A-6 A-7 A-7
Muskingum: 955F, 955G-----	1½-3	(3)	0-20 20-34 34	Stony silt loam----- Gravelly loam----- Sandstone bedrock.	ML CL or ML	A-4 A-6 or A-4

See footnotes at end of table.

significant to engineering—Continued

Coarse fraction greater than 3 inches	Percentage passing sieve—			Permeability	Available water capacity	Reaction	Shrink-swell potential	Corrosion potential for concrete ¹
	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)					
Percent				Inches per hour	Inches per inch of soil	pH		
0	100	100	95-100	0.06-0.2	0.12-0.14	6.1-7.3	High.....	
0	100	100	95-100	<0.06	0.11-0.13	6.1-7.8	High.....	Low.
0	100	100	95-100	0.6-2.0	0.19-0.21	6.1-7.3	Moderate to high.	
0	100	100	95-100	<0.06	0.11-0.13	6.1-7.8	High.....	Low.
0	100	100	95-100	0.6-2.0	0.20-0.25	5.6-6.5	Low.....	Low.
0	100	100	95-100	0.06-0.6	0.15-0.19	6.6-7.8	Moderate to high....	Low.
0	100	100	95-100	0.2-0.6	0.19-0.23	4.5-5.5	Moderate.....	High.
0	90-100	90-100	85-100	0.6-2.0	0.20-0.25	4.5-5.5	Low.	
0	90-100	90-100	85-100	<0.2	0.15-0.19	4.5-5.5	Moderate.....	High.
0	100	100	95-100	0.6-2.0	0.20-0.25	4.5-6.0	Low.	
0	100	100	95-100	0.6-2.0	0.19-0.21	4.5-5.5	Moderate.....	High.
0	100	100	95-100	<0.2	⁵ 0.14-0.18	4.5-5.5	Moderate to low....	High.
0	100	95-100	80-100	0.6-2.0	0.18-0.25	5.6-7.8	Low.....	Low.
0	100	100	95-100	0.6-2.0	0.20-0.25	4.5-6.0	Low.	
0	100	100	95-100	0.6-2.0	0.19-0.21	4.0-5.5	Moderate.....	High.
0	100	100	95-100	0.06-0.2	⁵ 0.14-0.18	4.0-6.0	Low to moderate....	High.
0	100	100	90-100	0.6-2.0	0.18-0.25	6.1-8.4	Low.....	Low.
0	100	100	95-100	0.2-0.6	0.19-0.21	4.5-6.0	Moderate.	
0	100	100	95-100	0.06-0.2	0.15-0.19	4.5-5.5	Moderate to high....	High.
0	100	100	95-100	<0.2	0.11-0.13	5.6-7.8	High.	
0	100	100	95-100	<0.2	0.15-0.18	5.6-7.8	Moderate.....	Low.
0	100	95-100	25-60	2.0-6.0	0.07-0.13	5.1-6.0	Low.	
0	100	95-100	45-75	2.0-6.0	0.12-0.14	5.1-6.0	Low.....	Moderate.
0	100	90-100	15-35	6.0-20.0	0.02-0.06	5.1-6.5	Low.....	Moderate.
0	95-100	95-100	95-100	0.6-2.0	0.20-0.25	4.5-6.0	Low.	
0	95-100	95-100	95-100	0.6-2.0	0.19-0.21	4.5-5.5	Moderate.....	High.
0	85-100	85-100	80-100	0.06-0.2	⁵ 0.18-0.19	4.5-5.5	Moderate.....	High.
0-5	35-85	20-80	15-65	0.06-0.2	⁵ 0.07-0.12	4.5-5.5	Low to moderate....	High.
0-25	30-70	25-65	20-60	0.6-6.0	0.04-0.12	4.5-5.5	Low.....	High.
0	100	100	95-100	0.6-2.0	0.20-0.25	4.5-6.5	Low to moderate.	
0	100	100	95-100	0.06-0.2	0.11-0.13	5.1-7.3	High.....	Low.
0	90-100	90-100	85-100	0.06-0.2	⁵ 0.10-0.12	7.4-8.4	High.....	Low.
0	100	100	95-100	0.6-2.0	0.20-0.25	5.1-6.5	Low.	
0	100	100	95-100	0.6-2.0	0.19-0.21	4.5-5.5	Moderate.	
0	100	100	90-100	<0.2	0.11-0.13	4.0-8.4	High.....	Low.
0	90-100	90-100	85-100	<0.2	⁵ 0.10-0.12	7.4-8.4	High.....	Low.
15-35	70-90	65-85	60-85	0.6-2.0	0.10-0.16	4.5-6.0	Low.	
15-35	70-90	65-85	60-85	0.6-2.0	0.08-0.12	4.5-6.0	Low.....	Moderate.

TABLE 7.—*Estimated soil properties*

Soil series and map symbols	Depth to—		Depth from surface	Classification		
	Bedrock	Seasonal high water table		USDA texture	Unified (24)	AASHO (1)
Petrolia: 288, W288.....	<i>Feet</i> >10	<i>Feet</i> 2 0-1	<i>Inches</i> 0-62	Silty clay loam.....	CL	A-6
Racoon: 109.....	>10	0-1	0-30 30-70	Silt loam..... Silty clay loam.....	ML or CL CL or CH	A-4 or A-6 A-6 or A-7
Reesville: 723.....	>10	1-3	0-12 12-33 33-69	Silt loam..... Silty clay loam and heavy silt loam. Silt loam.....	ML CL ML or CL	A-4 A-6 or A-7 A-4 or A-6
Robbs: 335B.....	>6	1-3	0-8 8-29 29-44 44-65	Silt loam..... Silty clay loam..... Silty clay loam and heavy silt loam. Silt loam.....	ML CL CL ML	A-4 A-6 A-6 A-4
Saffell..... Mapped only with Brandon soils.	>10	5-10	0-10 10-24 24-68	Gravelly silt loam..... Very gravelly clay loam..... Very gravelly clay loam to clay.	GM or ML GC or CL GC, CL, or MH	A-2 or A-4 A-1, A-2, or A-6 A-1, A-2, or A-6
Sandstone rock land: 9..... Too variable for valid estimates.	0-5					
Sciotoville: 462A, 462B, 462C2, 462D2, 462D3, 462E2.	>10	4 1½-3	0-8 8-24 24-52 52-72	Silt loam..... Silt loam and heavy silt loam. Heavy silt loam to silty clay loam. Silty clay loam or silt loam.	ML CL CL CL or ML	A-4 A-6 A-6 A-6 or A-4

See footnotes at end of table.

significant to engineering—Continued

Coarse fraction greater than 3 inches	Percentage passing sieve—			Permeability	Available water capacity	Reaction	Shrink-swell potential	Corrosion potential for concrete ¹
	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)					
<i>Percent</i>				<i>Inches per hour</i>	<i>Inches per inch of soil</i>	<i>pH</i>		
0	100	100	95-100	0.2-0.6	0.19-0.23	6.1-8.4	Moderate.....	Low.
0	90-100	90-100	85-100	0.2-0.6	0.20-0.23	4.5-5.5	Low.....	High.
0	90-100	90-100	85-100	0.06-0.2	0.18-0.20	4.5-6.0	Moderate to high....	High.
0	100	100	95-100	0.6-2.0	0.20-0.25	4.5-6.5	Low.	
0	100	100	95-100	0.2-2.0	0.19-0.21	5.5-7.3	Moderate.....	Low.
0	100	95-100	90-100	0.6-2.0	0.18-0.23	7.4-8.4	Low.....	Low.
0	100	100	95-100	0.6-2.0	0.20-0.25	4.5-6.0	Low.	
0	100	100	95-100	0.6-2.0	0.19-0.21	4.5-5.5	Moderate.....	High.
0	100	100	95-100	0.06-0.2	0.14-0.18	4.5-5.5	Moderate.....	High.
0	100	100	95-100	0.2-0.6	0.18-0.20	4.5-5.5	Low to moderate....	High.
0-5	35-85	20-80	15-65	0.6-2.0	0.07-0.12	4.5-6.0	Low.	
0-5	20-70	20-65	15-60	0.6-20.0	0.04-0.12	4.5-5.5	Low.....	High.
0-25	20-70	20-65	15-60	0.6-20.0	0.04-0.12	4.5-5.5	Low.....	High.
0	100	100	95-100	0.6-2.0	0.18-0.23	4.5-6.0	Low.	
0	100	100	95-100	0.6-2.0	0.18-0.20	4.5-5.5	Moderate.....	High.
0	100	100	90-100	0.2-0.6	0.15-0.18	4.5-5.5	Moderate.....	High.
0	100	100	90-100	0.2-2.0	0.18-0.20	4.5-6.5	Moderate.....	Moderate.

TABLE 7.—Estimated soil properties

Soil series and map symbols	Depth to—		Depth from surface	Classification		
	Bedrock	Seasonal high water table		USDA texture	Unified (24)	AASHO (1)
Sharon: 72-----	Feet >6	Feet ² 3-10	Inches 0-60	Silt loam-----	ML or CL	A-4 or A-6
Stoy: 164A, 164B, 164C2-----	>6	1-3	0-13 13-38 38-49 49-62	Silt loam----- Silty clay loam----- Silty clay loam----- Silt loam-----	ML CL or CH CL ML	A-4 A-6 or A-7 A-6 A-4
Wakeland: 333-----	>6	² 1-3	0-60	Silt loam-----	ML	A-4
Weinbach: 461A, 461B, 461C2-----	>10	1-3	0-14 14-36 36-45 45-72	Silt loam----- Silty clay loam----- Heavy silt loam----- Silt loam-----	ML or CL CL or CH CL ML or CL	A-4 or A-6 A-6 or A-7 A-6 A-4 or A-6
Weir: 165-----	>6	0-1	0-18 18-44 44-70	Silt loam----- Silty clay loam----- Silt loam-----	ML, ML-CL CL or CH CL	A-4 A-6 or A-7 A-6
*Wellston: 339E, 339E3, 339F, 986E, 986F, 986G. For Berks part of 986E, 986F, and 986G, see Berks series.	3-5	(3)	0-5 5-38 38-42 42	Silt loam----- Light silty clay loam----- Stony silt loam to gravelly silty clay. Sandstone bedrock.	ML CL ML, CL, or CH	A-4 A-6 A-4, A-6, or A-7
Wheeling: 463A, 463B, 463C2, 463D2, 463E2-----	>10	5-10	0-10 10-49 49-60	Silt loam----- Clay loam----- Fine sandy loam-----	ML CL SM	A-4 A-6 A-4 or A-2
Zanesville: 340D2, 340D3, 340E2, 340E3, 340F2-----	3½-6	⁴ 1½-3	0-7 7-22 22-42 42-60 60	Silt loam----- Silty clay loam----- Silt loam----- Shaly silt loam to very shaly silty clay. Sandstone or shale bedrock.	ML CL CL or ML GM, ML, SC, GC, CL, or CH	A-4 A-6 A-6 or A-4 A-2, A-4, or A-6

¹ Corrosion potential is estimated only for layers in which conduits are likely to be buried.

² Subject to flooding or overflow.

³ A thin water table (3 to 6 inches thick) is above bedrock.

significant to engineering—Continued

Coarse fraction greater than 3 inches	Percentage passing sieve—			Permeability	Available water capacity	Reaction	Shrink-swell potential	Corrosion potential for concrete ¹
	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)					
Percent 0	100	100	75-100	Inches per hour 0.6-2.0	Inches per inch of soil 0.20-0.23	pH 4.5-5.5	Low.....	High.
0	100	100	90-100	0.6-2.0	0.20-0.25	4.5-6.0	Low.	
0	100	100	90-100	0.6-2.0	0.18-0.20	4.5-5.5	Moderate.....	High.
0	100	100	90-100	0.06-0.2	⁵ 0.14-0.18	4.5-5.5	Moderate.....	High.
0	100	100	90-100	0.2-0.6	0.18-0.20	4.5-5.5	Low.....	High.
0	100	100	90-100	0.6-2.0	0.20-0.25	5.6-7.8	Low.....	Low.
0	100	95-100	85-100	0.6-2.0	0.20-0.25	4.5-6.0	Low.	
0	100	95-100	90-100	0.6-2.0	0.19-0.21	4.0-5.5	Moderate.....	High.
0	100	95-100	90-100	0.06-0.2	⁵ 0.14-0.18	4.0-5.5	Moderate.....	High.
0	100	95-100	85-100	0.06-0.2	⁵ 0.14-0.18	4.5-6.5	Low.....	High to moderate.
0	100	100	90-100	0.2-0.6	0.20-0.25	4.5-6.0	Low.	
0	100	100	90-100	0.06-0.2	0.19-0.21	4.5-5.5	Moderate to high....	High.
0	100	100	90-100	0.2-0.6	0.18-0.23	4.5-5.5	Low.....	High.
0-20	80-100	80-100	70-100	0.6-2.0	0.20-0.25	4.5-6.0	Low.	
0-25	75-100	75-100	60-100	0.6-2.0	0.18-0.20	4.5-6.0	Moderate.....	Moderate.
10-30	70-90	65-85	60-85	0.6-2.0	0.08-0.12	4.5-6.0	Low.....	Low to moderate.
0	100	100	90-100	0.6-2.0	0.20-0.25	4.5-6.0	Low.	
0	100	100	70-95	0.6-2.0	0.15-0.20	4.5-5.5	Moderate.....	High.
0	100	95-100	25-45	0.6-6.0	0.14-0.19	4.5-6.0	Low.....	Moderate.
0	100	100	95-100	0.6-2.0	0.20-0.25	4.5-6.0	Low.	
0	95-100	95-100	95-100	0.2-0.6	0.19-0.21	4.0-5.5	Moderate.....	High.
0-5	75-100	75-95	70-95	0.06-0.2	⁵ 0.14-0.18	4.5-5.5	Low to moderate....	High.
0-20	25-75	20-70	20-70	0.06-0.2	⁵ 0.04-0.14	5.0-7.3	Moderate.....	Moderate.

⁴ A thin water table (3 to 6 inches thick) is perched above the fragipan layer.
⁵ Root penetration is restricted in these layers, and plants cannot use all the available water.

TABLE 8.—*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. The soils in for referring to other series in

Soil series and map symbols	Suitability as source of—		Soil features affecting—			
	Topsoil	Road fill	Highway and street location	Farm ponds		Drainage for crops and pasture
				Reservoir area	Embankments	
*Alford: 308B, 308C2, 308D2, 308D3, 308E2, 308E3, 308F2, 954E2, 954F2. For Baxter part of 954E2 and 954F2, see Baxter series.	Good in surface layer if not severely eroded. Poor to fair in subsoil: somewhat clayey; low organic-matter content.	Poor to fair: poor to fair compaction characteristics, stability, and shear strength.	Rolling to steep topography; many cuts and fills needed; silty material highly erodible where exposed on embankments; fair to poor stability in silty material below depth of 4 feet.	Sinkhole areas have high seepage rate and are generally unfavorable, other areas generally favorable: moderate to low seepage rate; gently sloping to very steep.	Fair stability and compaction characteristics in subsoil; low permeability where compacted; good resistance to piping. Poor stability, compaction characteristics, and resistance to piping in substratum.	Natural drainage is adequate.
Alluvial land: 455. Too variable for valid interpretations.						
Alvin: 131A, 131B, 131C, 131D2, 131E2, 131F.	Fair: somewhat sandy.	Fair in subsoil: low shrink-swell potential; fair shear strength. Fair to good in underlying material: needs soil binder in places.	Fair to good stability and bearing strength; exposed sand highly erodible and difficult to vegetate.	Sand below depth of 3 feet; excessive seepage.	Fair to good stability and compaction characteristics; low permeability in upper 2 to 3 feet when compacted; rapid seepage and poor resistance to piping in underlying material.	Natural drainage is adequate.
Armiesburg: 597.	Fair: somewhat clayey; moderate organic-matter content; subject to flooding.	Fair: moderate shrink-swell potential; fair compaction characteristics, stability, and bearing strength; subject to flooding.	Subject to flooding; moderate susceptibility to frost heave.	Subject to flooding; low seepage rate.	Fair stability and compaction characteristics; good resistance to piping; low permeability where compacted.	Natural drainage is adequate.
Baxter: 599E, 599F, 599G.	Poor: too steep; stony.	Poor: moderately steep to very steep; highly plastic cherty clays; bedrock at depth of 4 to 10 feet.	Moderately steep to very steep; stony and clayey material; bedrock at depth of 4 to 10 feet; needs deep rocky cuts or cross-slope locations.	Moderately steep to very steep; stony; bedrock at depth of 4 to 10 feet; variable high to low seepage rate.	Fair to poor stability and compaction characteristics; stony; good resistance to piping; bedrock at depth of 4 to 10 feet; moderately steep to very steep.	Natural drainage is adequate.

See footnote at end of table.

engineering properties of the soils

such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions the first column of this table]

Soil features affecting—Continued				Limitations for sewage disposal	
Irrigation	Terraces and diversions	Grassed waterways	Foundations for low buildings	Septic-tank filter fields	Sewage lagoons
Moderate intake rate; moderate permeability; high available water capacity; subject to runoff and erosion; slopes of 4 to 12 percent limit use; slopes of 12 to 30 percent severely limit use.	No major construction concerns if topography is favorable; highly erodible.	No major construction concerns on gently sloping soils; where slopes are more than 12 percent, soils are highly erodible and difficult to vegetate.	Well drained; low shrink-swell potential; fair to poor shear strength; slopes of 7 to 12 percent limit use; slopes of 12 to 30 percent severely limit use. ¹	Slight where slopes are 2 to 7 percent. Moderate where slopes are 7 to 12 percent. Severe where slopes are 12 to 30 percent.	Moderate where slopes are 2 to 7 percent. Severe where slopes are 7 to 30 percent.
Rapid intake rate; moderate permeability in subsoil; moderate available water capacity; slopes of 4 to 12 percent limit use; slopes of 12 to 30 percent severely limit use.	Where exposed, sandy substratum is highly erodible and difficult to vegetate.	Where exposed, sandy substratum is highly erodible and difficult to vegetate.	Well drained; sandy; slight compressibility; low shrink-swell potential; fair to good shear strength; slopes of 7 to 12 percent limit use; slopes of 12 to 30 percent severely limit use. ¹	Slight where slopes are 0 to 7 percent. Moderate where slopes are 7 to 12 percent. Severe where slopes are 12 to 30 percent. Nearby water supplies may become contaminated by seepage through sandy substratum.	Severe: moderately rapid permeability in sandy substratum.
Moderate intake rate; moderate permeability; high available water capacity; slopes of 4 to 10 percent limit use.	Not needed.....	Seldom used; subject to flooding.	Subject to flooding; moderate shrink-swell potential; fair shear strength and bearing strength.	Severe: subject to flooding.	Severe: subject to flooding.
Steep soils unsuitable for irrigation.	Too steep to terrace.	Moderately steep to very steep; difficult to stabilize grades; difficult to vegetate.	Fair to poor stability; cherty; bedrock at depth of 4 to 10 feet; slopes of 12 to 50 percent severely limit use.	Severe: slopes of 12 to 50 percent.	Severe: slopes of 12 to 50 percent.

TABLE 8.—*Interpretations of*

Soil series and map symbols	Suitability as source of—		Soil features affecting—			
	Topsoil	Road fill	Highway and street location	Farm ponds		Drainage for crops and pasture
				Reservoir area	Embankments	
Beasley: 691E, 691F, 691G.	Poor: too steep; thin surface layer; contains a few stones in places.	Poor: moderately steep to very steep; highly plastic subsoil; moderate shrink-swell potential; shale bedrock within depth of 5 feet.	Moderately steep to very steep; cuts and fills needed; stony and clayey material; shale bedrock within depth of 5 feet.	Moderately steep to very steep; shale bedrock within depth of 5 feet; generally low seepage rates.	Fair to good compaction characteristics, stability, and resistance to piping; stones and rocks common; shale bedrock within depth of 5 feet; moderately steep to very steep.	Natural drainage is adequate.
Beaucoup: 70...	Fair: somewhat clayey; high organic-matter content; subject to flooding.	Fair: fair compaction characteristics, stability, and shear strength; medium compressibility; seasonal high water table.	Seasonal water table near surface; subject to flooding; poor stability when wet.	Subject to flooding; seasonal water table near surface; low seepage rate.	Fair stability and compaction characteristics; low permeability where compacted; medium compressibility; moderate to high shrink-swell potential; good resistance to piping.	Poorly drained; subject to flooding; moderate permeability; suitable for tile if outlets are available; suitable for open ditches.
Bedford: 598D, 598D3, 598E2, 598E3, 598F2.	Poor: surface layer thin or absent due to erosion; strongly sloping to steep.	Poor to fair: poor to fair compaction characteristics and stability; limestone bedrock within depth of 10 feet; strongly sloping to steep.	Strongly sloping to steep; many cuts and fills needed; cuts expose highly erodible material; limestone bedrock within depth of 10 feet; seepage likely above fragipan and bedrock; susceptible to frost heave.	Strongly sloping to steep; limestone bedrock within depth of 10 feet; variable high to low seepage rate.	Fair to poor stability and compaction characteristics; fair resistance to piping; low permeability where compacted; limestone bedrock within depth of 10 feet.	Natural drainage is adequate.
Belknap: 382...	Good: subject to flooding; seasonal high water table.	Poor: poor to fair compaction characteristics, stability, and shear strength; seasonal high water table; subject to flooding.	Subject to flooding; seasonal high water table; high susceptibility to frost heave; poor stability when wet.	Subject to flooding; seasonal high water table; hazard of seepage.	Poor to fair stability and compaction characteristics; low to moderate permeability where compacted; poor resistance to piping.	Somewhat poorly drained; moderately slow permeability; subject to flooding; needs drainage in places; tile or open ditches can be used; needs flood protection in places.
Berks----- Mapped only with Muskingum and Wellston soils.	Poor: steep and very steep; very stony.	Poor: steep and very steep; very stony; bedrock within depth of 3 feet.	Steep; very stony; bedrock within depth of 3 feet; needs deep rocky cuts or cross-slope location.	Steep and very steep; rocky; bedrock within depth of 3 feet.	Steep and very steep; very stony; bedrock within depth of 3 feet.	Natural drainage is adequate.

engineering properties of the soils—Continued

Soil features affecting—Continued				Limitations for sewage disposal	
Irrigation	Terraces and diversions	Grassed waterways	Foundations for low buildings	Septic-tank filter fields	Sewage lagoons
Steep soils unsuitable for irrigation.	Too steep to terrace.	Moderately steep to very steep; difficult to stabilize grades; difficult to vegetate cuts; cuts expose bedrock in places.	Fair stability; stony; shale bedrock within depth of 5 feet; slopes of 12 to 50 percent severely limit use.	Severe: slopes of 12 to 50 percent.	Severe: slopes of 12 to 50 percent.
Moderate intake rate; moderate permeability; very high available water capacity; needs drainage.	Not needed: nearly level to depression.	Seldom used; no major construction problems except seasonal wetness.	Subject to flooding; seasonal water table near surface; medium to high compressibility; moderate to high shrink-swell potential; fair shear strength and stability.	Severe: seasonal high water table; subject to flooding.	Moderate: moderately permeable; hazard of seepage; high organic-matter content; needs protection from flooding in places.
Moderate intake rate (slow if severely eroded); very slow permeability; moderate available water capacity; subject to runoff and erosion; slopes of 12 to 30 percent severely limit use.	Deep cuts likely to expose fragipan; difficult to vegetate; erodible; limestone bedrock within depth of 10 feet.	Strongly sloping to steep; cuts expose fragipan, stones, or bedrock in places; erodible; hard to stabilize; difficult to vegetate.	Poor to fair stability and shear strength; fragipan layer causes seeps around foundation; limestone bedrock within depth of 10 feet; slopes of 12 to 30 percent severely limit use.	Severe: very slowly permeable; steep.	Severe: strongly sloping to steep.
Moderate intake rate; moderately slow permeability; very high available water capacity; needs drainage in places.	Not needed; diversions adequate to intercept runoff from adjacent hillsides.	Generally not needed; seasonal wetness may interfere with construction.	Subject to flooding; seasonal high water table; fair to poor shear strength and stability; liquifies in places.	Severe: subject to flooding.	Moderate to severe: moderately slow permeability; hazard of seepage; poor to fair compaction characteristics; subject to flooding.
Steep and very steep; very stony; unsuited for irrigation.	Too steep and stony to terrace.	Not suitable: steep and very steep; very stony; difficult to vegetate.	Steep and very steep; very stony; bedrock within depth of 3 feet.	Severe: slopes of 12 to 60 percent.	Severe where slopes are 15 to 60 percent.

TABLE 8.—*Interpretations of engineering*

Soil series and map symbols	Suitability as source of—		Soil features affecting—			
	Topsoil	Road fill	Highway and street location	Farm ponds		Drainage for crops and pasture
				Reservoir area	Embankments	
Bonnie: 108, W108.	Poor: low organic-matter content and fertility; subject to flooding; seasonal high water table.	Fair to poor: fair to poor compaction characteristics, stability, and shear strength; subject to flooding; seasonal high water table.	Subject to flooding; seasonal water table near surface; high susceptibility to frost heave; poor stability when wet.	Subject to flooding; seasonal high water table; low to moderate seepage rate.	Fair to poor stability and compaction characteristics; moderate to low permeability where compacted; poor resistance to piping.	Poorly drained; slow permeability; subject to flooding; needs open-ditch drainage; needs flood protection in places.
Brandon: 956B, 956C2, 956F.	Fair to poor: thin surface layer; gravelly subsoil; low organic-matter content.	Fair in subsoil: fair compaction characteristics, stability, and shear strength. Good in substratum: low shrink-swell potential below depth of 2 feet; good stability; good source of gravel.	Good stability and bearing strength; steep areas need deep cuts to expose gravelly material.	Underlain by gravel; variable seepage rate; onsite investigation needed.	Shallow to gravel; fair stability, compaction, and resistance to piping; moderate to low permeability where compacted.	Natural drainage is adequate.
Burnside: 427..	Good if surface layer is free of stones; poor if stony; subject to flooding.	Fair to poor: poor compaction characteristics and stability; bedrock at depth of 3 to 7 feet; subject to flooding.	Subject to flooding; high susceptibility to frost heave.	Subject to flooding; bedrock at depth of 3 to 7 feet; hazard of seepage in gravelly or stony layer.	Poor stability and compaction characteristics; stony or gravelly layer; bedrock at depth of 3 to 7 feet.	Drainage generally not needed; subject to flooding in places.
Cape: 422, 422+, W422.	Poor: clayey; poor workability; low organic-matter content; subject to flooding; seasonal high water table.	Poor: high shrink-swell potential; poor shear strength, compaction characteristics, stability, and workability; subject to flooding; seasonal high water table.	Seasonal high water table; subject to flooding; high susceptibility to frost heave; poor stability when wet.	Subject to flooding; seasonal water table near surface; slight or no seepage; poor workability.	Fair to poor stability; high compressibility; high shrink-swell potential; low permeability where compacted; good resistance to piping.	Poorly drained; slow to very slow permeability; subject to flooding; needs open-ditch drainage; needs protection from flooding in places.
Clarksville: 471F, 471G.	Poor: steep to very steep; very cherty surface layer.	Poor: steep to very steep; very cherty subsoil; bedrock at depth of 5 to 8 feet.	Steep to very steep; very cherty subsoil; bedrock at depth of 5 to 8 feet.	Steep to very steep; very cherty subsoil; bedrock at depth of 5 to 8 feet; hazard of seepage.	Steep to very steep; very cherty subsoil; bedrock at depth of 5 to 8 feet.	Natural drainage is adequate.

properties of the soils—Continued

Soil features affecting—Continued				Limitations for sewage disposal	
Irrigation	Terraces and diversions	Grassed waterways	Foundations for low buildings	Septic-tank filter fields	Sewage lagoons
Moderately slow intake rate; slow permeability; high available water capacity; needs drainage.	Not needed; in places diversions adequate to control runoff from higher ground.	Generally not needed; seasonal wetness interferes with construction in places.	Subject to flooding; seasonal water table near surface; liquifies in places; fair to poor stability.	Severe: subject to flooding; slow permeability.	Severe: poor to fair compaction characteristics; subject to flooding.
Moderate intake rate; moderate permeability; moderate available water capacity; slopes of 4 to 12 percent limit use; slopes of 12 to 30 percent severely limit use.	Cuts generally expose gravelly material; not needed in steep areas.	Cuts may expose gravelly material; difficult to vegetate.	Fair stability and shear strength; gravelly substratum; low shrink-swell potential below depth of 2 feet; slopes of 12 to 30 percent severely limit use.	Slight where slopes are 1 to 4 percent. Moderate where slopes are 4 to 12 percent. Severe where slopes are 12 to 30 percent. Nearby water supplies may become contaminated by seepage through gravelly material.	Severe where slopes are 1 to 30 percent; hazard of excessive seepage through underlying gravelly material.
Moderate intake rate; moderate permeability; moderate available water capacity.	Not needed; in places diversions adequate to control runoff from higher ground.	Generally not needed; no major construction problems.	Subject to flooding; fair to poor shear strength and stability; stones, gravel, and bedrock within depth of 3 to 7 feet.	Severe: subject to flooding; stony or gravelly layer in subsoil; bedrock at depth of 3 to 7 feet.	Severe: moderate permeability; poor compaction characteristics; bedrock or stones in places; subject to flooding.
Moderate intake rate; slow to very slow permeability; high available water capacity; needs drainage.	Not needed.....	Seldom needed; poor workability and seasonal high water table hinder construction in places.	Subject to flooding; poorly drained; seasonal high water table near surface; high compressibility; high shrink-swell potential; low shear strength; clayey surface layer; poor workability.	Severe: slow to very slow permeability; subject to flooding.	Severe: subject to flooding.
Steep and very steep topography unsuited for irrigation.	Too steep to terrace..	Steep to very steep; very cherty subsoil; seldom needed.	Steep to very steep; very cherty subsoil; bedrock at depth of 5 to 8 feet.	Severe: slopes of 20 to 60 percent.	Severe: slopes of 20 to 60 percent.

TABLE 8.—*Interpretations of engineering*

Soil series and map symbols	Suitability as source of—		Soil features affecting—			
	Topsoil	Road fill	Highway and street location	Farm ponds		Drainage for crops and pasture
				Reservoir area	Embankments	
Darwin: 71, 525.	Poor: clayey; very poor workability; subject to flooding; seasonal high water table.	Very poor: high compressibility; poor compaction characteristics, stability, and workability; subject to flooding; seasonal high water table.	Very poorly drained; seasonal high water table; subject to flooding and ponding; poor stability when wet; high shrink-swell potential, high compressibility; sticky and plastic when wet, hard when dry.	Subject to flooding; seasonal high water table; slight to or no seepage; poor workability.	Poor stability and compaction characteristics; low permeability where compacted; high compressibility; high shrink-swell potential; good resistance to piping.	Poorly drained; very slow permeability; subject to flooding; needs open-ditch drainage; needs protection from flooding in places.
Dupo: 180-----	Good: subject to flooding; seasonal high water table.	Poor to fair: moderate to high shrink-swell potential; high compressibility; poor compaction characteristics and shear strength; seasonal high water table.	Subject to flooding; seasonal high water table; high susceptibility to frost heave; poor stability when wet.	Subject to flooding; seasonal high water table; highly plastic and difficult to excavate below depth of 2 to 3 feet; low seepage rate.	Fair to poor stability and compaction characteristics; medium to high compressibility; low permeability where compacted; good resistance to piping.	Somewhat poorly drained; moderately slow to slow permeability; needs open-ditch drainage in places; needs protection from flooding in places.
Emma: 469A, 469B, 469D2.	Fair: somewhat clayey; subject to flooding.	Fair: fair compaction characteristics, stability, and shear strength.	Nearly level to strongly sloping; cuts and fills needed; susceptible to frost heave; somewhat sticky and plastic when wet; subject to flooding in some areas.	Nearly level to strongly sloping; low seepage rate; subject to flooding.	Fair stability and compaction characteristics; low permeability where compacted; good resistance to piping.	Natural drainage is adequate.
Ginat: 460-----	Fair: low organic-matter content; seasonal high water table.	Poor: fair to poor compaction characteristics, stability, and shear strength; seasonal high water table.	Seasonal water table near surface; high susceptibility to frost heave; poor stability when wet.	Nearly level; seasonal water table near surface; low seepage rate.	Fair to poor compaction characteristics and stability; low permeability where compacted; good resistance to piping.	Poorly drained; slow to very slow permeability; needs open-ditch drainage.
Grantsburg: 301B, 301C2, 301D2, 301D3, 301E2, 301E3.	Fair in surface layer: generally thin surface layer. Poor in subsoil: somewhat clayey; low organic-matter content; poor where slopes are more than 12 percent.	Poor to fair: poor to fair compaction characteristics, stability, and shear strength.	Gently sloping to steep; many cuts and fills needed; cuts expose highly erodible material; hazard of seepage at top of fragipan; fair to poor stability; susceptible to frost heave; bedrock at depth of 4 to 10 feet.	Gently sloping to steep; low seepage rate where compacted.	Fair stability and compaction characteristics in subsoil. Fair to poor stability, compaction characteristics, and resistance to piping in substratum.	Natural drainage is adequate; hillsides seep in the spring in places.

properties of the soils—Continued

Soil features affecting—Continued				Limitations for sewage disposal	
Irrigation	Terraces and diversions	Grassed waterways	Foundations for low buildings	Septic-tank filter fields	Sewage lagoons
High available water capacity; very slow permeability; high shrink-swell potential; water intake rates vary with amount of vertical cracking upon drying; needs drainage.	Not needed-----	Seldom needed; poor workability and high water table hinder construction in places.	Subject to flooding; poorly drained; seasonal high water table near surface; high compressibility; high shrink-swell potential; low shear strength; clayey surface layer; poor workability.	Severe: very slow permeability; subject to flooding.	Severe: moderate organic-matter content; subject to flooding; very slow permeability.
Moderate intake rate; moderately slow to slow permeability; high available water capacity; needs drainage.	Not needed; in places diversions adequate to control runoff from uplands.	Seldom needed; no major construction concerns.	Subject to flooding; seasonal high water table; somewhat poorly drained; fair to poor shear strength; high compressibility in substratum.	Severe: subject to flooding; moderately slow to slow permeability.	Severe: poor compaction in silty upper layers; subject to flooding; moderately slow to slow permeability.
Moderate to slow intake rate; moderately slow permeability; high available water capacity; slopes subject to runoff and erosion; slopes of 7 to 18 percent limit use.	No major construction concerns; exposed subsoil very strongly acid and low in fertility.	No major construction concerns.	Moderately well drained; subject to flooding; medium compressibility; moderate shrink-swell potential; fair shear strength and stability.	Severe: moderately slow permeability.	Slight if flood-water does not enter lagoon.
Moderate intake rate; slow to very slow permeability; high available water capacity; needs drainage.	Not needed-----	No major construction concerns; seasonal high water table hinders construction in places; low fertility; difficult to establish grass.	Seasonal water table near surface; poorly drained; fair to poor shear strength and stability; moderate shrink-swell potential.	Severe: slow to very slow permeability.	Slight.
Moderate intake rate (slow if severely eroded); slow to very slow permeability; moderate to low available water capacity; subject to runoff and erosion; slopes of 4 to 12 percent limit use; slopes of more than 12 percent severely limit use.	Deep cuts expose fragipan in places; difficult to vegetate; erodible.	Cuts expose fragipan and sandstone rock in places; erodible and hard to stabilize; difficult to vegetate on steep slopes and in deep channels.	Moderately well drained; fragipan causes seeps around basements and foundations; fair to poor shear strength and stability; slopes of 7 to 12 percent limit use; slopes of more than 12 percent severely limit use. ¹	Severe: slow to very slow permeability.	Moderate where slopes are 2 to 7 percent. Severe where slopes are 7 to 18 percent.

TABLE 8.—*Interpretations of engineering*

Soil series and map symbols	Suitability as source of		Soil features affecting—			
	Topsoil	Road fill	Highway and street location	Farm ponds		Drainage for crops and pasture
				Reservoir area	Embankments	
Haymond: 331	Good: thick surface layer; subject to flooding.	Poor: poor to fair compaction characteristics, stability, and shear strength.	Subject to flooding; low shrink-swell potential.	Subject to flooding; underlain by sandy strata in places; hazard of excessive seepage.	Poor to fair stability and compaction characteristics; moderate permeability where compacted; poor resistance to piping.	Natural drainage is generally adequate; needs protection from flooding in places.
*Hosmer: 214B, 214C2, 214D2, 214D3, 214E2, 214E3, 214F2, 953E2, 953E3, 953F2. For Lax part of 953E2, 953E3, and 953F2, see Lax series.	Good to fair in surface layer: thin if eroded. Poor in subsoil: somewhat clayey; low organic matter content; poor where slopes are more than 12 percent.	Fair to poor: fair to poor compaction characteristics, stability, and shear strength.	Gently sloping to steep; many cuts and fills needed; cuts expose highly erodible material; hazard of seepage at top of fragipan; fair to poor stability; susceptible to frost heave.	Gently sloping to steep; low seepage rate where compacted.	Subsoil: fair to poor stability and compaction characteristics; low to moderate permeability where compacted; fair resistance to piping. Substratum: fair to poor stability, compaction characteristics, and resistance to piping.	Natural drainage is adequate; seepy spots on hillsides in spring in places.
Huntington: 600.	Good: moderate organic-matter content and fertility; subject to flooding.	Poor: poor to fair compaction characteristics, stability, and shear strength; subject to flooding.	Subject to flooding; high susceptibility to frost heave.	Subject to flooding; underlain by sandy strata in places; hazard of excessive seepage.	Poor to fair stability and compaction characteristics; low to moderate permeability where compacted; poor resistance to piping.	Natural drainage is adequate; needs protection from flooding in places.
Hurst: 693-----	Fair: somewhat clayey; seasonal high water table; subject to infrequent flooding.	Poor: fair to poor compaction characteristics, stability, and shear strength; seasonal high water table.	Seasonal high water table; sticky and plastic when wet; fair to poor stability.	Generally nearly level; seasonal high water table; slight or no seepage; subject to infrequent flooding.	Fair: fair to poor compaction characteristics and stability; moderate to high shrink-swell potential; high compressibility; low permeability where compacted; good resistance to piping.	Somewhat poorly drained; slow permeability; low areas subject to flooding; needs open-ditch drainage in places.

properties of the soils—Continued

Soil features affecting—Continued				Limitations for sewage disposal	
Irrigation	Terraces and diversions	Grassed waterways	Foundations for low buildings	Septic-tank filter fields	Sewage lagoons
Moderate intake rate; moderate permeability; very high available water capacity.	Not needed; diversions adequate to intercept runoff from adjacent hill slopes.	Seldom used; no major construction concerns.	Subject to flooding; low shrink-swell potential; fair to poor shear strength and stability.	Moderate to severe; subject to flooding.	Severe: moderate permeability; hazard of seepage; poor to fair compaction characteristics; subject to flooding.
Moderate intake rate (slow if severely eroded); slow permeability; moderate to low available water capacity; subject to runoff and erosion; slopes of 4 to 12 percent limit use; slopes of 12 to 30 percent severely limit use.	Deep cuts expose fragipan in places; difficult to vegetate; erodible.	Cuts expose fragipan in places; erodible; hard to stabilize; difficult to vegetate on steep slopes and in deep channels.	Moderately well drained; fragipan causes seeps around basements and foundations; fair to poor shear strength and stability; slopes of 7 to 12 percent limit use; slopes of 12 to 30 percent severely limit use. ¹	Severe: slow permeability below depth of about 30 inches.	Moderate where slopes are 2 to 7 percent. Severe where slopes are 7 to 30 percent.
Moderate intake rate; moderate permeability; very high available water capacity.	Not needed.....	Seldom needed; no major construction concerns.	Subject to flooding; fair to poor shear strength and stability.	Severe: subject to flooding.	Severe: subject to flooding.
Slow intake rate; slow permeability; high available water capacity; needs drainage in places.	Not needed.....	No major construction concerns; low fertility; difficult to vegetate.	Seasonal high water table; high compressibility; moderate to high shrink-swell potential; fair to poor shear strength and stability.	Severe: slow permeability.	Slight.

TABLE 8.—*Interpretations of engineering*

Soil series and map symbols	Suitability as source of—		Soil features affecting—			
	Topsoil	Road fill	Highway and street location	Farm ponds		Drainage for crops and pasture
				Reservoir area	Embankments	
Karnak: 426, 426+, W426, 426†.	Poor: clayey; very poor workability; subject to flooding; seasonal high water table.	Very poor: high compressibility; poor compaction characteristics, stability, and workability; seasonal high water table; subject to flooding.	Very poorly drained; seasonal water table near surface; subject to flooding and ponding; poor stability when wet; sticky and plastic when wet; high shrink-swell potential; high compressibility.	Subject to flooding; seasonal water table near surface; plastic clay; slight or no seepage; poor workability.	Poor workability; poor stability and compaction characteristics; low permeability where compacted; high compressibility; high shrink-swell potential; good resistance to piping.	Poorly drained or very poorly drained; slow to very slow permeability; subject to flooding; needs open-ditch drainage; needs protection from flooding in places.
Lamont: 175B, 175D2.	Poor: sandy; low organic-matter content; low available water capacity.	Fair to good: fair to good stability, compaction characteristics, and shear strength; sandy material needs soil binder in places.	Sandy material; slumps when wet; well drained; gently to strongly sloping.	Excessive seepage due to underlying sand.	Fair to poor compaction characteristics and stability; subject to piping; hazard of seepage through embankments.	Natural drainage is adequate.
Lax: 628E, 628E3, 628F2.	Poor: generally thin surface layer; moderately steep to steep.	Fair: fair to poor compaction characteristics, stability, and shear strength in subsoil, fair to good in substratum; good source of gravel.	Moderately steep to steep, cuts and fills needed; cuts expose highly erodible material; hazard of seepage at top of fragipan; gravelly material within depth of 4 feet.	Moderately steep to steep; underlain by gravel; low to excessive seepage rate; onsite investigation needed.	Fair compaction characteristics and stability; low permeability where compacted; fair resistance to piping; gravelly material within depth of 4 feet.	Natural drainage is adequate.
Markland: 467C2, 467D2.	Poor: generally thin surface layer due to erosion.	Poor: poor shear strength; fair to poor stability and compaction characteristics; high shrink-swell potential; poor workability.	Gently to strongly sloping; cuts and fills needed; poor workability; sticky and plastic when wet, hard when dry; moderate to high shrink-swell potential; high compressibility.	Gently to strongly sloping; slight or no seepage; poor workability.	Fair to poor stability and compaction characteristics; low permeability where compacted; high shrink-swell potential; high compressibility; good resistance to piping.	Natural drainage is adequate.
McGary: 173B.	Fair to poor: low organic-matter content; generally thin surface layer.	Poor: poor shear strength; fair to poor stability and compaction characteristics; high shrink-swell potential; poor workability; seasonal high water table.	Nearly level to gently sloping; seasonal high water table; poor workability; sticky and plastic when wet, hard when dry; high shrink-swell potential; high compressibility.	Nearly level to gently sloping; seasonal high water table; slight or no seepage; poor workability.	Fair to poor stability and compaction characteristics; low permeability where compacted; high shrink-swell potential; high compressibility; good resistance to piping; poor workability.	Somewhat poorly drained; slow to very slow permeability; nearly level areas need open-ditch drainage in places.

properties of the soils—Continued

Soil features affecting—Continued				Limitations for sewage disposal	
Irrigation	Terraces and diversions	Grassed waterways	Foundations for low buildings	Septic-tank filter fields	Sewage lagoons
Moderate available water capacity; slow to very slow permeability; high shrink-swell potential; water intake rates vary with amount of vertical cracking upon drying; needs drainage.	Not needed.....	Seldom needed; poor workability and high water table hinder construction in places.	Subject to flooding; poorly drained; seasonal water table near surface; high compressibility; high shrink-swell potential; low shear strength; clayey; poor workability.	Severe: slow to very slow permeability; subject to flooding.	Severe: subject to flooding; slow to very slow permeability.
Rapid intake rate; moderately rapid permeability; low available water capacity; slopes of 7 to 12 percent limit use.	Not suitable; deep sand.	Sandy; difficult to vegetate; low available water capacity.	Well drained; sandy; low compressibility; fair to good shear strength and stability.	Slight where slopes are 2 to 7 percent. Moderate where slopes are 7 to 12 percent. Nearby water supplies may become contaminated by seepage through sandy substratum.	Severe: excessive seepage due to rapid permeability in underlying sand.
Moderate intake rate (slow if severely eroded); slow permeability; moderate to low available water capacity; subject to runoff and erosion; slope severely limits use.	Too steep to terrace.	Cuts expose fragipan and gravelly material in places; erodible; hard to stabilize; difficult to vegetate on steep slopes and in deep channels.	Moderately well drained fragipan causes seeps around foundations; fair to poor shear strength and stability; gravelly material within depth of 4 feet; slopes of 12 to 30 percent severely limit use.	Severe: slopes of 12 to 30 percent.	Severe: slopes of 12 to 30 percent.
Moderate to slow intake rate; moderate to high available water capacity; slow permeability; subject to runoff and erosion; slope limits use.	Cuts expose heavy clay; difficult to vegetate; slopes generally short and irregular.	No major construction concerns; difficult to vegetate in places because of exposed clayey material of low fertility.	Hazard of seepage around basements and foundations; high compressibility; high shrink-swell potential; poor shear strength and stability.	Severe: slow permeability.	Moderate where slopes are 2 to 7 percent. Severe where slopes are 7 to 15 percent.
Moderately slow intake rate; slow to very slow permeability; moderate to high available water capacity; needs drainage.	Cuts expose heavy clay; slopes generally short and irregular.	No major construction concerns; difficult to vegetate in places because of exposed clayey material of low fertility.	Somewhat poorly drained; seasonal high water table; high compressibility; high shrink-swell potential; poor shear strength and stability.	Severe: slow to very slow permeability.	Slight where slopes are 0 to 2 percent. Moderate where slopes are 2 to 4 percent.

TABLE 8.—*Interpretations of engineering*

Soil series and map symbols	Suitability as source of—		Soil features affecting—			
	Topsoil	Road fill	Highway and street location	Farm ponds		Drainage for crops and pasture
				Reservoir area	Embankments	
Muskingum: 955F, 955G.	Poor: stony; steep or very steep.	Poor: steep or very steep; stony; bedrock within depth of 3 feet.	Steep or very steep; stony; bedrock within depth of 3 feet; needs deep rocky cuts or cross-slope location.	Steep or very steep; stony; bedrock within depth of 3 feet.	Steep or very steep; stony; bedrock within depth of 3 feet.	Natural drainage is adequate.
Petrolia: 288, W288.	Poor: somewhat clayey; moderate organic-matter content; subject to flooding; seasonal high water table.	Poor: fair stability and compaction characteristics; medium compressibility; moderate shrink-swell potential; seasonal high water table; subject to flooding.	Subject to flooding; seasonal water table near surface; fair stability; high susceptibility to frost heave.	Subject to flooding; seasonal water table near surface; low seepage rate.	Fair stability and compaction characteristics; medium compressibility; moderate shrink-swell potential; low permeability where compacted; good resistance to piping.	Poorly drained; moderately slow permeability; subject to flooding; needs open-ditch drainage; suitable for tile if outlets are available; needs protection from flooding.
Racoon: 109---	Poor: low organic-matter content; seasonal high water table.	Poor: fair to poor compaction characteristics, stability, and shear strength; seasonal high water table.	Seasonal water table near surface; high susceptibility to frost heave; nearly level; subject to runoff from higher ground.	Nearly level; seasonal water table near surface; low seepage rate.	Fair to poor stability and compaction characteristics; low permeability where compacted; good resistance to piping.	Poorly drained, slow permeability; needs open-ditch drainage.
Reesville: 723---	Good: low organic-matter content; seasonal high water table.	Poor to fair: poor to fair compaction characteristics and stability; seasonal high water table.	Seasonal high water table; high susceptibility to frost heave; cuts expose highly erodible material; poor stability in substratum.	Nearly level or gently sloping; seasonal high water table; moderate to high seepage rate in substratum.	Subsoil: fair stability and compaction characteristics; low permeability where compacted; good resistance to piping. Substratum: poor stability, compaction characteristics, and resistance to piping.	Somewhat poorly drained; moderate or moderately slow permeability; nearly level areas need tile or open-ditch drainage in places.
Robbs: 335B---	Fair to good: low organic-matter content; seasonal high water table.	Poor to fair: poor to fair compaction characteristics, stability, and shear strength; seasonal high water table.	Seasonal high water table; hazard of seepage in cuts; high susceptibility to frost heave; nearly level to gently sloping.	Nearly level to gently sloping; seasonal high water table; low seepage rate.	Subsoil: fair stability, compaction characteristics, and resistance to piping. Substratum: poor stability, compaction characteristics, and resistance to piping; low permeability where compacted.	Somewhat poorly drained; slow permeability; needs open-ditch drainage in places.

properties of the soils—Continued

Soil features affecting—Continued				Limitations for sewage disposal	
Irrigation	Terraces and diversions	Grassed waterways	Foundations for low buildings	Septic-tank filter fields	Sewage lagoons
Steep or very steep; stony; unsuited for irrigation.	Too steep and stony to terrace.	Not suitable: steep or very steep; stony; difficult to vegetate.	Steep or very steep; stony; bedrock within depth of 3 feet.	Severe: slopes of 15 to 60 percent.	Severe: slopes of 15 to 60 percent.
Moderate intake rate; moderately slow permeability; high available water capacity; needs drainage.	Not needed-----	Seldom used; no major construction concerns except seasonal wetness.	Subject to flooding; poorly drained; seasonal water table near surface; high compressibility; moderate shrink-swell potential; fair shear strength.	Severe: moderately slow permeability; seasonal high water table; subject to flooding.	Severe: subject to flooding.
Moderate to slow intake rate; slow permeability; high available water capacity; needs drainage.	Nearly level; terraces not needed; diversions needed in places to divert runoff from adjacent slopes.	Seldom needed; wetness delays construction in places.	Poorly drained; seasonal water table near surface; medium to high compressibility; moderate to high shrink-swell potential; fair to poor shear strength and stability.	Severe: slow permeability; seasonal water table near surface.	Slight.
Moderate intake rate; moderate to moderately slow permeability; high available water capacity.	Generally not needed.	No major construction concerns; in places cuts expose calcareous material which is difficult to vegetate.	Somewhat poorly drained; seasonal high water table; low shrink-swell potential below subsoil; poor shear strength and stability below subsoil.	Severe: moderate to moderately slow permeability; seasonal high water table.	Slight to moderate where slopes are 0 to 2 percent; poor compaction characteristics below depth of 2 to 4 feet. Moderate where slopes are 2 to 4 percent; poor compaction characteristics below depth of 2 to 4 feet.
Moderately slow intake rate; slow permeability; moderate available water capacity; needs drainage in places.	No major construction concerns; wetness may be a problem in terrace channels.	No major construction concerns; difficult to vegetate due to low fertility and seasonal high water table.	Somewhat poorly drained; seasonal high water table; medium compressibility; moderate shrink-swell potential; fair to poor shear strength and stability.	Severe: slow permeability.	Moderate: slopes of 1 to 4 percent

TABLE 8.—*Interpretations of engineering*

Soil series and map symbols	Suitability as source of—		Soil features affecting—			
	Topsoil	Road fill	Highway and street location	Farm ponds		Drainage for crops and pasture
				Reservoir area	Embankments	
Saffell----- Mapped only with Brandon soils.	Poor: steep and gravelly.	Fair: steep, but a good source of gravel; fair to good compaction characteristics, shear strength, and stability.	Good stability and bearing strength; steep areas need deep cuts through gravelly material.	Underlain by gravel; variable seepage rate; onsite investigation needed.	Shallow to gravel; fair compaction characteristics and stability; moderate permeability; where compacted, fair resistance to piping.	Natural drainage is adequate.
Sandstone rock land: 9. Too variable for valid interpretations.						
Sciotoville: 462A, 462B, 462C2, 462D2, 462D3, 462E2.	Fair to good: low organic-matter content; thin surface layer in eroded areas.	Poor to fair: poor to fair compaction characteristics and stability.	High susceptibility to frost heave; poor stability; cuts expose highly erodible material; hazard of seepage at top of fragipan in cuts.	Nearly level to strongly sloping; low seepage rate where compacted.	Subsoil: fair stability and compaction characteristics; fair resistance to piping; low permeability where compacted. Substratum: poor stability, compaction characteristics, and resistance to piping.	Natural drainage is adequate.
Sharon: 72-----	Good: thick surface layer; subject to flooding.	Poor: poor compaction characteristics and stability.	Subject to flooding; susceptible to frost heave.	Subject to flooding; underlain by sandy strata in some places; hazard of seepage.	Poor stability and compaction characteristics; moderate permeability where compacted; poor resistance to piping.	Natural drainage is generally adequate; needs protection from flooding in places.
Stoy: 164A, 164B, 164C2.	Fair: low organic-matter content; seasonal high water table.	Poor to fair: poor to fair compaction characteristics, stability, and shear strength.	Seasonal high water table; erodible slopes; high susceptibility to frost heave; nearly level to moderately sloping; few low cuts.	Nearly level to moderately sloping; seasonal high water table; low seepage rate.	Subsoil: fair compaction characteristics and stability; low permeability where compacted; fair resistance to piping. Substratum: poor stability and compaction characteristics; poor resistance to piping.	Somewhat poorly drained; slow permeability; needs open-ditch drainage in places.

properties of the soils—Continued

Soil features affecting—Continued				Limitations for sewage disposal	
Irrigation	Terraces and diversions	Grassed waterways	Foundations for low buildings	Septic-tank filter fields	Sewage lagoons
Moderate intake rate; moderate to rapid permeability; low available water capacity; slopes of 4 to 12 percent limit use; slopes of 12 to 30 percent severely limit use.	Cuts generally expose gravelly material; not needed on steep slopes.	Cuts expose gravelly material; difficult to vegetate.	Fair to good stability and shear strength; low shrink-swell potential; gravelly material; slopes of 12 to 30 percent severely limit use.	Slight where slopes are 1 to 4 percent. Moderate where slopes are 4 to 12 percent. Severe where slopes are 12 to 30 percent. Nearby water supplies may become contaminated by seepage through gravelly material.	Severe: moderate to rapid permeability; hazard of excessive seepage where slopes are 1 to 12 percent; 12 to 30 percent slopes too steep.
Moderate intake rate; moderately slow permeability; high available water capacity; slopes subject to runoff and erosion; slopes of more than 4 percent limit use.	No major construction concerns; difficult to apply because of shape of areas; highly erodible.	No major construction concerns; strongly sloping areas highly erodible; difficult to vegetate.	Moderately well drained; fragipan causes seepage around basements and foundations; fair to poor shear strength and stability; slopes of more than 7 percent limit use. ¹	Severe: moderately slow permeability.	Slight where slopes are 0 to 2 percent. Moderate where slopes are 2 to 7 percent. Severe where slopes are 7 to 18 percent.
Moderate intake rate; moderate permeability; very high available water capacity.	Terraces not needed; diversions adequate to intercept runoff from adjacent hillsides.	Seldom needed; no major construction concerns.	Subject to flooding; low shrink-swell potential; poor shear strength and stability.	Moderate to severe: subject to flooding.	Severe: moderate permeability; hazard of seepage; poor compaction characteristics; subject to flooding.
Moderately slow intake rate; slow permeability; high available water capacity.	No major construction concerns; wetness is a concern in terrace channels in places.	No major construction concerns; difficult to vegetate due to low fertility and seasonal high water table.	Somewhat poorly drained; seasonal high water table; medium compressibility; moderate shrink-swell potential; fair shear strength and stability.	Severe: slow permeability.	Slight where slopes are 0 to 2 percent. Moderate where slopes are 2 to 7 percent.

TABLE 8.—*Interpretations of engineering*

Soil series and map symbols	Suitability as source of—		Soil features affecting—			
	Topsoil	Road fill	Highway and street location	Farm ponds		Drainage for crops and pasture
				Reservoir area	Embankments	
Wakeland: 333-	Good: subject to flooding and seasonal high water table.	Poor: poor compaction characteristics, stability, and shear strength; subject to flooding; seasonal high water table.	Subject to flooding; seasonal high water table; high susceptibility to frost heave; poor stability when wet.	Subject to flooding; seasonal high water table; hazard of seepage.	Poor stability and compaction characteristics; moderate permeability where compacted; poor resistance to piping.	Somewhat poorly drained; moderate permeability; subject to flooding; needs tile or open-ditch drainage in places; needs protection from flooding in places.
Weinbach: 461 A, 461 B, 461 C2.	Fair: low organic-matter content; thin surface layer in eroded areas; seasonal high water table.	Poor to fair: poor to fair compaction characteristics, stability, and shear strength; seasonal high water table.	High susceptibility to frost heave; poor stability; seasonal high water table; seepage on slopes.	Nearly level to moderately sloping; seasonal high water table; low seepage rate.	Subsoil: fair compaction characteristics and stability; low permeability where compacted; fair resistance to piping. Substratum: poor stability and compaction characteristics; poor resistance to piping; moderate permeability where compacted.	Somewhat poorly drained; slow permeability; needs open-ditch drainage.
Weir: 165-----	Fair: low organic-matter content; seasonal high water table.	Poor to fair: fair compaction characteristics and stability; poor to fair shear strength; seasonal high water table.	Nearly level: seasonal water table near surface; high susceptibility to frost heave; poor stability and bearing strength when wet.	Nearly level; seasonal water table near surface; low seepage rate.	Subsoil: fair stability and compaction characteristics; low permeability where compacted; good resistance to piping. Substratum: poor stability and compaction characteristics; fair resistance to piping.	Poorly drained; slow permeability; needs open-ditch drainage.

properties of the soils—Continued

Soil features affecting—Continued				Limitations for sewage disposal	
Irrigation	Terraces and diversions	Grassed waterways	Foundations for low buildings	Septic-tank filter fields	Sewage lagoons
Moderate intake rate; moderate permeability; very high available water capacity; needs drainage in places.	Terraces not needed; diversions adequate to intercept runoff from adjacent hillsides.	Generally not needed; seasonal wetness interferes with construction in places.	Subject to flooding; seasonal high water table; low shrink-swell potential; poor shear strength; liquifies in places.	Severe: subject to flooding; seasonal high water table.	Severe: moderate permeability; hazard of seepage; poor compaction characteristics; subject to flooding.
Moderate intake rate; slow permeability; high available water capacity; needs drainage in places.	No major construction concerns; wetness may be a problem in terrace channels.	No major construction concerns; difficult to vegetate due to low fertility and seasonal high water table.	Somewhat poorly drained; seasonal high water table; moderate shrink-swell potential; fair stability and shear strength.	Severe: slow permeability.	Slight where slopes are 0 to 2 percent. Moderate where slopes are 2 to 7 percent.
Moderately slow intake rate; slow permeability; high available water capacity; needs drainage.	Not needed.....	No major construction concerns; difficult to vegetate due to low fertility and seasonal high water table.	Poorly drained; seasonal high water table near surface; medium to high compressibility; moderate to high shrink-swell potential; fair to poor shear strength.	Severe: very slow permeability.	Slight.

TABLE 8.—*Interpretations of engineering*

Soil series and map symbols	Suitability as source of—		Soil features affecting—			
	Topsoil	Road fill	Highway and street location	Farm ponds		Drainage for crops and pasture
				Reservoir area	Embankments	
<p>*Wellston: 339E, 339E3, 339F, 986E, 986F, 986G. For Berks part of 986E, 986F, and 986G, see Berks series.</p>	Poor: stony; moderately steep to very steep.	Poor to fair: moderately steep to very steep topography; generally stony; poor to fair compaction characteristics, shear strength, and stability; bedrock within depth of 5 feet.	Moderately steep to very steep; needs deep cuts or cross-slope location; exposed cuts highly erodible; generally stony.	Moderately steep to very steep; bedrock within depth of 5 feet; generally low seepage rate.	Fair to poor stability and compaction characteristics; low permeability where compacted; fair resistance to piping; generally stony; bedrock within depth of 5 feet.	Natural drainage is adequate.
<p>Wheeling: 463A, 463B, 463C2, 463D2, 463E2.</p>	Good: thin surface layer in eroded areas.	Poor to fair: poor to fair stability, compaction characteristics, and shear strength.	Nearly level to strongly sloping; needs short cuts in places; cuts expose highly erodible material.	Nearly level to strongly sloping; variable seepage rate due to sandy to clayey substratum.	Subsoil: fair stability and compaction characteristics; low permeability where compacted; fair resistance to piping. Substratum: poor stability and compaction characteristics; poor resistance to piping.	Natural drainage is adequate.
<p>Zanesville: 340D2, 340D3, 340E2, 340E3, 340F2.</p>	Fair: low organic-matter content; surface layer thin or absent in eroded areas. Poor where slopes are more than 12 percent.	Poor to fair: poor to fair stability; compaction characteristics, and shear strength; bedrock within depth of 6 feet; strongly sloping to steep.	Strongly sloping to steep; cuts and fills needed; cuts expose highly erodible material; bedrock within depth of 6 feet; hazard of seepage above fragipan and bedrock.	Strongly sloping to steep; bedrock within depth of 6 feet; generally low seepage rate.	Fair to poor stability and compaction characteristics; low permeability where compacted; fair resistance to piping; bedrock within depth of 6 feet.	Natural drainage is adequate; seepy areas on hillsides in spring.

¹ For areas of intensive use, such as shopping centers or industrial areas, slopes of 4 to 7 percent limit use, and slopes of more than 7 percent severely limit use.

properties of the soils—Continued

Soil features affecting—Continued				Limitations for sewage disposal	
Irrigation	Terraces and diversions	Grassed waterways	Foundations for low buildings	Septic-tank filter fields	Sewage lagoons
Not generally suited because of steep slopes and stoniness.	Generally too steep and stony to terrace.	Moderately steep to very steep; stony; cuts expose bedrock in places; grades difficult to stabilize; difficult to vegetate.	Stony; bedrock within depth of 5 feet; low to moderate shrink-swell potential; fair shear strength and stability; slopes of 12 to 60 percent severely limit use.	Severe: slopes of 12 to 60 percent.	Severe: slopes of 12 to 60 percent.
Moderate intake rate; moderate permeability; high available water capacity; slopes subject to runoff and erosion; slopes of more than 4 percent limit use.	No major construction concerns; slopes are generally short and irregular.	No major construction concerns; highly erodible where strongly sloping; difficult to vegetate.	Fair to poor stability and shear strength; slopes of 7 to 12 percent limit use; slopes of 12 to 25 percent severely limit use. ¹	Slight where slopes are 0 to 7 percent. Moderate where slopes are 7 to 12 percent. Severe where slopes are 12 to 25 percent.	Moderate where slopes are 0 to 7 percent; moderate permeability; hazard of seepage. Severe where slopes are 7 to 25 percent.
Moderate intake rate (slow if severely eroded); slow permeability; moderate to low available water capacity; subject to runoff and erosion; slope severely limits use.	Deep cuts likely to expose fragipan; difficult to vegetate; erodible.	Cuts expose fragipan, stones, or bedrock in places; steep slopes erodible and hard to stabilize; difficult to vegetate.	Moderately well drained; fragipan causes seepage around basements and foundations; fair to poor shear strength and stability; bedrock within depth of 6 feet; slopes of 12 to 30 percent severely limit use.	Severe: slow permeability.	Severe: slopes of 7 to 30 percent.

TABLE 9.—Engineering

[Tests performed by Illinois Division of Highways, Bureau of Materials, Springfield, in accordance

Soil name and location	Parent material	Report number	Depth from surface	Moisture-density ¹	
				Maximum dry density	Optimum moisture
Alford silt loam: Hardin County; SE $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 19, T. 11 S., R. 10 E.; 150 feet north of well casing. (Modal)	Loess.	069-2-1	Inches 5-10	Pounds per cubic foot 107	Percent 16
		069-2-2	22-33	103	21
		069-2-3	50-66	108	17
Armiesburg silty clay loam: Massac County; NE $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 28, T. 16 S., R. 6 E.; 360 feet north of east-west gravel road and 310 feet east of north-south gravel road. (Modal)	Ohio River alluvium.	127-5-1	15-40	104	19
Cape silty clay loam: Massac County; SW $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 22, T. 14 S., R. 4 E.; 620 feet south of quarterline and 150 feet west of centerline of blacktop road. (Modal)	Ohio River alluvium.	127-3-1	14-23	106	18
		127-3-2	23-41	103	20
Emma silty clay loam: Massac County; SW $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 26, T. 16 S., R. 6 E.; 100 feet north of fence on west side of road, 40 feet east of centerline of road. (Modal)	Ohio River alluvium.	127-2-1	12-21	98	22
		127-2-2	27-43	102	22
Grantsburg silt loam: Pope County; NE $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 4, T. 13 S., R. 5 E.; 990 feet east of iron stake in northwest corner of section 4, between old and new roads and 106 feet south of section line. (Modal)	Loess.	151-1-1	17-24	106	18
		151-1-2	61-71	106	19
Hosmer silt loam: Massac County; SW $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 16, T. 15 S., R. 4 E.; 820 feet east of T-road junction and 45 feet north of middle of gravel road. (Modal)	Loess.	127-6-1	16-25	104	20
		127-6-2	31-37	103	19
		127-6-3	37-51	106	17
Karnak silty clay: Massac County; SE $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 18, T. 14 S., R. 3 E.; 230 feet north of east-west fence line and 45 feet west of north-south fence line. (Modal)	Alluvium.	127-4-1	12-33	107	18
Sharon silt loam: Hardin County; NW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 18, T. 11 S., R. 8 E.; 125 feet south of edge of bridge, 60 feet east of centerline of road. (Modal)	Local stream alluvium.	069-1-1	19-28	110	16
Weinbach silt loam: Massac County; SE $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 36, T. 14 S., R. 3 E.; 235 feet along lane southwest from gravel road, and 15 feet southeast of lane. (Modal)	Ohio River alluvium.	127-3-1	7-14	108	18
		127-3-2	14-25	103	20
		127-3-3	45-59	108	18
Weir silt loam: Massac County; NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 27, T. 15 S., R. 4 E.; 105 feet south of middle of east-west blacktop road, and 213 feet west of middle of north-south blacktop road. (Modal)	Loess.	127-1-1	8-18	107	16
		127-1-2	25-39	106	18
		127-1-3	48-70	108	17
Wellston silt loam: Pope County; SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 7, T. 11 S., R. 7 E.; 115 feet east of culvert which is one-tenth mile east of T-road junction; then 80 feet north of center of road. (Nonmodal, finer textured in lower horizons)	Sandstone and shale-loess cap.	151-2-1	13-19	117	13
	Material weathered from shale.	151-2-2	26-49	102	21
Zanesville silt loam: Hardin County; NW $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 2, T. 11 S., R. 8 E.; from first concrete dam in road ditch east of stream, go 175 feet north along drainageway; on east side of drainageway where it becomes a broad eroded area. (Modal)	Loess on sandstone and shale material.	069-3-1	7-16	106	19
		069-3-2	22-35	112	17
		069-3-3	42-48	136	11

¹ Based on AASHO Designation T-99-57, Method A (1).² Mechanical analyses according to the AASHO Designation T-88 (1). Results by this procedure may differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2

test data

with standard procedures of the American Association of State Highway Officials (AASHO) ¹

Mechanical analysis ²										Liquid limit	Plasticity index	Classification	
Percentage passing sieve—						Percentage smaller than—						AASHO ³	Unified
¾-in.	⅜-in.	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.				
				100	99	90	58	20	13	Percent 27	9	A-4(8)	CL or ML
					100	91	68	34	13		44	20	A-7-6(13)
				100	99	93	65	24	18	34	11	A-6(8)	CL
				100	99	93	74	42	31	44	24	A-7-6(14)	CL
			100	96	82	80	70	36	26	41	20	A-7-6(17)	CL
			100	99	93	88	75	52	41	54	32	A-7-6(30)	CH
			100	99	94	90	81	53	35	48	25	A-7-6(15)	CL
			100	99	95	93	84	48	36	48	22	A-7-6(14)	CL
			100	99	97	92	69	31	22	33	10	A-4(8)	CL
				100	98	93	67	29	22	36	19	A-6(12)	CL
				100	99	92	69	30	25	41	20	A-7-6(12)	CL
				100	99	96	88	28	24	41	22	A-7-6(13)	CL
					100	90	66	22	19	33	13	A-6(9)	CL
					100	93	72	42	40	51	30	A-7-6(18)	CH
			100	98	90	81	45	19	16	29	11	A-6(8)	CL
			100	95	88	86	70	34	17	33	16	A-6(10)	CL
			100	97	93	84	76	48	28	49	27	A-7-6(17)	CL
			100	99	87	84	66	36	27	33	18	A-6(11)	CL
		100	99	96	93	88	56	18	15	25	4	A-4(8)	CL-ML
		100	98	96	94	88	60	33	30	40	21	A-6(12)	CL
		100	99	96	96	90	62	27	22	36	20	A-6(12)	CL
⁴ 90	83	77	75	74	64	59	45	24	18	37	21	A-6(12)	CL
⁴ 92	90	38	87	87	72	68	59	47	42	61	43	A-7-6(15)	CH
100	99	98	98	97	96	79	60	27	21	38	19	A-6(12)	CL
⁴ 98	97	96	95	94	83	77	49	27	20	32	16	A-6(10)	CL
⁴ 96	87	70	49	39	29	27	19	10	8	25	12	A-2-6(1)	SC

millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for use in naming textural classes for soils.

³ Based on Standard Specifications for Highway Materials and Methods of Sampling and Testing: Interim Recommended Practice for the Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes: AASHO Designation M-145-66-1 (I).

⁴ 100 percent passing 1½-inch sieve.

Engineering test data

Table 9 contains engineering test data for some of the major soils in Pope, Hardin, and Massac Counties. The test results do not represent the entire range of characteristics of soils within the county, nor do they represent the entire range of characteristics of the soils tested. Nevertheless, the results can be used as a general guide in estimating properties of the other soils in the county.

Moisture density data are obtained by compacting soil material at a successively higher moisture content. Assuming that the compactive effort remains constant, the density of the compacted material increases until the optimum moisture content is reached. After that, the density decreases with increase in moisture content. The highest dry density obtained in the compaction test is termed "maximum dry density." Optimum stability generally is obtained if the soil is compacted to about the maximum dry density when at approximately the optimum moisture content.

Mechanical analysis refers to the measurement of the amounts of various size classes of soil grains (sand, silt, or clay) in a sample. Proportions of the size classes determine the textural class of the material. Names used by engineers for various size classes of particles differ from those used by soil scientists. For example, fine sand in engineering terminology consists of particles 0.42 to 0.74 millimeter in diameter; whereas, fine sand, as determined by the soil scientist, consists of particles 0.25 to 0.10 millimeter in diameter.

The tests to determine liquid limit and plastic limit measure the effect of water upon the consistence of the soil material. As the moisture content of a clayey soil increases from a very dry state, the material changes from a semisolid to a plastic. As the moisture content is further increased, the material changes from a plastic to a liquid. The plastic limit is the moisture content at which a soil material passes from a semisolid to a plastic. The liquid limit is the moisture content at which the material passes from a plastic to a liquid. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which soil material is in a plastic condition.

Residential Uses of Soils

Soil features may greatly affect the suitability of individual locations for farmsteads, rural home sites, or rural-fringe residential areas. Among the soil features considered are kind of drainage, depth to bedrock, nature of the subsoil and underlying material, slope, and the hazard of flooding. The effect of soil on the planting and maintenance of lawns, flowers, shrubs, and trees should also be considered.

Qualities of individual soils that affect building sites are listed in table 8 of this survey, "Interpretations of the Engineering Properties of Soils," in the columns "Foundations for low buildings" and "Limitations for sewage disposal."

This information is general and cannot take the place of onsite investigation at individual sites. Soils do vary from place to place and within single areas on the map.

Some of these variations are given in the descriptions of the individual soils; others are apparent only by field examination.

Some soils, such as the Weir and Stoy soils, have poor internal drainage, are slowly permeable, or are wet. Such soils have limitations as building sites. If basements are built in wet sites, special effort is needed to overcome the wetness and keep the basement dry. Septic tank filter fields do not function properly in soils that have a slowly permeable subsoil or a seasonal high water table. Bottom-land soils, such as Armiesburg, Belknap, Bonnie, and Sharon, are poor for use as building sites because they are subject to flooding (fig. 21).

Alford soils, on the other hand, are well drained and moderately permeable. They have no major construction problems and are suitable for use as septic tank filter fields unless the slopes are too steep. Soils that contain fragipans, such as the Hosmer and Grantsburg soils, have only minor construction limitations due to the fragipan, but they are unsuitable for septic tank filter fields because of their slow permeability. All strongly sloping or steep soils demand special design and construction techniques.

Certain information on lawns, shrubs, and trees can be obtained from table 6, "Suitability of the soils for selected recreational use." Comments in the column "Picnic areas, parks, and extensive play areas" can be applied to the use of soils for lawns. Other information can be derived from the descriptions of the soils.

Grasses, shrubs, and trees adapted to wet conditions should be used on areas of poorly drained soils, such as the Weir and Ginat soils, and on nearly level areas of somewhat poorly drained soils, such as the Stoy and Weinbach soils. Shaping the lawn to provide drainage is desirable.

While a lawn is being shaped or graded, the silt loam surface layer of any soil should be removed and stockpiled. Then, after the shaping is completed, it should be respread. If the surface soil is not good at a given site, topsoil can be hauled in from a borrow area. See the column "Suitability as a source for topsoil" in table 8 for soils that provide suitable material for topdressing lawns.

Shaping soils that contain a fragipan, such as Hosmer or Grantsburg soils, can expose the fragipan or leave it within rooting depth of the shaped surface. This will result in a droughty, infertile soil that is impenetrable to roots. If extensively shaped, such soils need a spread of 1 to 2 feet of permeable soil over the fragipan. Planting shrubs or trees is a special problem because they are planted deeper and root growth is inhibited by the fragipan.

Erosion is a concern on sloping soils where lawns are not yet established. Severe erosion following soil disturbance by heavy machinery or shaping disfigures the lawn and causes deposition of sediment in streets, drainage ditches, and streams. To reduce the hazard of erosion, temporary ground cover can be seeded during construction and special protective mulches used while establishing a new sod.

A few soils, such as the Lamont and the Brandon and Saffell soils, are droughty. They need frequent watering



Figure 21.—Flooded area of Belknap silt loam.

and smaller, more frequent applications of fertilizer. Steep, stony soils, such as Wellston and Berks soils, are not likely to be used for lawns, but a few sites exist that might be used as planted areas of special design.

Bottom-land soils, such as Belknap and Karnak soils, are subject to flooding. They can be used for lawns or play areas if they are kept free of plants or equipment that may be damaged by flooding.

The soil maps and soil descriptions give further information that can be used as a guide in long-range planning by planning groups and others responsible for the development of a community or a county.

Formation and Classification of Soils

This section consists of two main parts. The first part tells how the factors of soil formation have affected the development of soils in Pope, Hardin, and Massac Counties. The second explains the system of soil classification currently used and places each soil series in the classes of that system.

Factors of Soil Formation

Soil is produced by soil-forming processes acting on materials deposited or accumulated by geologic agencies. The characteristics of a soil at any given time are determined by the physical and mineralogical composition of the *parent material*, the *climate* under which the soil material has accumulated and existed since accumulation, the *plant and animal life* on and in the soil, the *relief*, or lay of the land, and the length of *time* the forces of soil formation have acted on the soil material.

Climate and plant and animal life, mainly plants, are active factors of soil formation. They act on the parent

material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material also affects the kind of soil profile that is formed and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil profile. It may be much or little, but some time is always required for differentiation of soil horizons. A long time generally is required for the development of distinct horizons.

The five factors of soil formation are so closely inter-related in their effects on the soil that few generalizations can be made about the effect of any one factor unless conditions are specified for the other four. Many of the processes of soil development are unknown.

Parent material

The parent materials in Pope, Hardin, and Massac Counties are loess, residuum from bedrock, and alluvium (fig. 22).

About 43 percent of the soils formed entirely in windblown silt called loess, and 10 percent formed in 20 to 60 inches of loess underlain by residuum or bedrock. The Grantsburg, Hosmer, and Stoy series are examples of soils that formed entirely in loess, and the Zanesville series is an example of soils that formed in loess and residuum.

The glaciers that covered most of North America reached within a few miles north of Pope County, and they affected the soils of the survey area through the loess, which was derived from Illinoian and Wisconsinan glacial materials. The loess is thickest near its source which, for these counties, was generally the Ohio River. The Saline River Valley, the Cache River-Bay Creek Valley, and the Mississippi River, however, have also

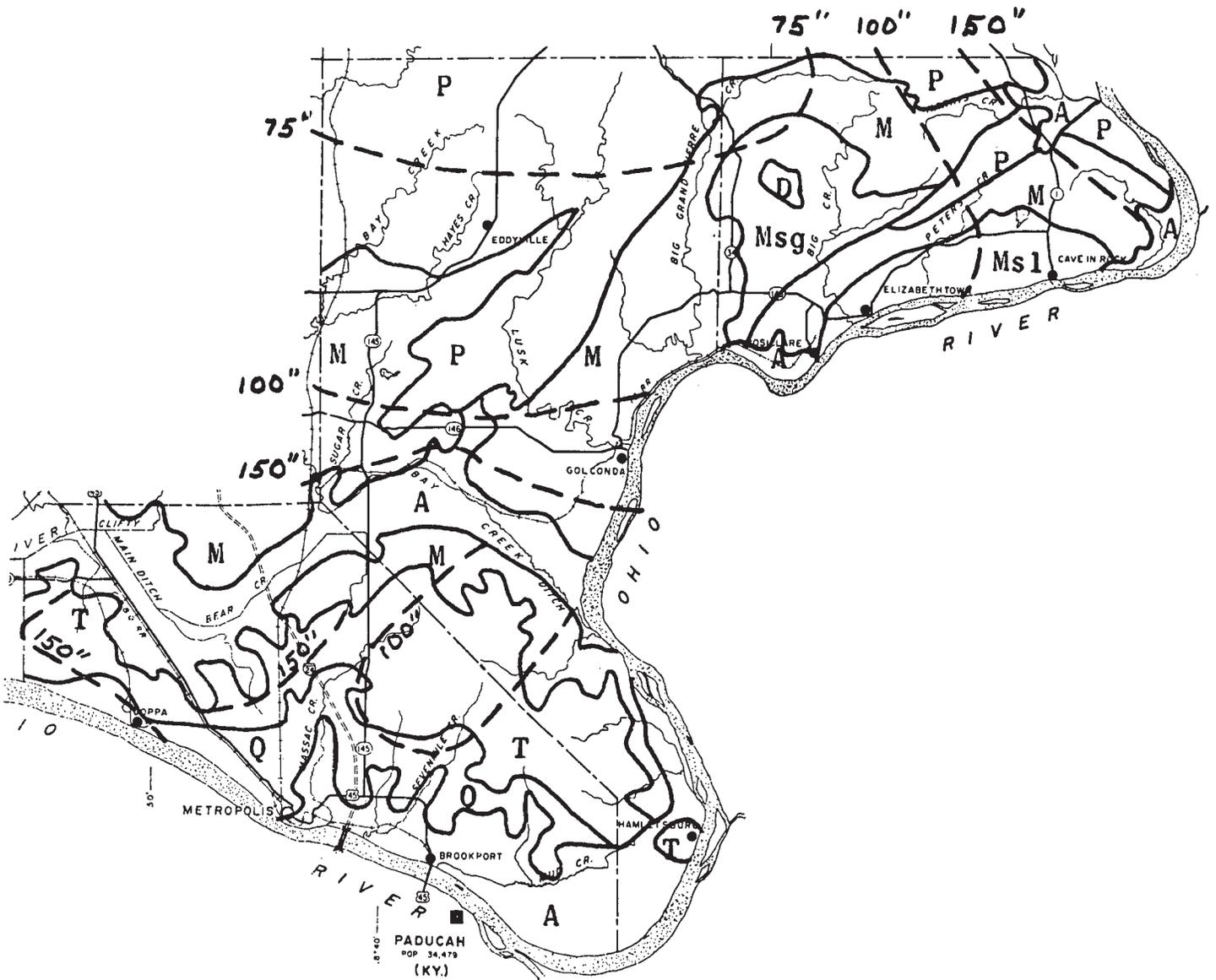


Figure 22.—Generalized geologic map of Pope, Hardin, and Massac Counties.

- A—Alluvium (flood lands and stream terraces).
 D—Devonian limestone.
 M—Mississippian thick-bedded sandstone and thin-bedded shale and limestone.
 Msg—Mississippian Ste. Genevieve, St. Louis, and Salem Limestone.
 Msl—Mississippian St. Louis Limestone and cherty limestone; sinkholes.

- P—Pennsylvanian thin-bedded sandstone, siltstone, shale, and limestone.
 Q—Alluvial high terraces that are covered by loess.
 T—Tertiary gravel (Coastal Plain material).
 --- Loess depth (isothickness in inches).

served as sources and have influenced the distribution of the loess (8).

In Hardin County the loess is more than 12 feet thick near the eastern side of the Ohio River and thins to about 6 feet in the northwest corner of the county. In Pope County it averages about 6 feet thick on the ridgetops at the north side of the county, and thickens to 10 feet or more between Illinois Route No. 146 and the south end of the county. In Massac County the loess ranges from about 8 feet thick on the east side of the county to more than 12 feet thick on the west side.

Soils such as those of the Alford series that formed in thick loess deposits commonly are well drained and moderately permeable. Soils that formed in thinner loess are moderately well drained, slowly permeable, and contain a fragipan. An example of this is Hosmer soils. Generally, the thinner the loess deposit, the denser the fragipan. The development of the fragipan is believed to be related to the stage of weathering, the texture of the parent material, and the depth to a perched water table (9). Close packing of the silt particles that are

bridged by clay is the possible cause of the density of the fragipan.

About 18 percent of the soils formed mainly in residuum from sandstone, shale, limestone, or Coastal Plains gravel. About 10 percent, as mentioned in the discussion of loess, formed in 20 to 60 inches of loess underlain by residuum. Soils that formed entirely in loess are influenced to some extent by the underlying rock formations.

Bedrock of Pennsylvanian age underlies much of the northern part of Pope County and the northern part of Hardin County (3, 4, 5). It consists generally of thin-bedded sandstone, siltstone, shale, and limestone. On long, steep slopes several kinds of rock crop out, and the soils have somewhat mixed parent materials. Soils such as those of the Wellston, Muskingum, and Berks series generally occur where there is sandstone and acid shale. Calcareous shale, the parent material for Beasley soils, is present in a few places. Soils that formed in limestone material are uncommon. Soils that formed in thick loess underlain by sandstone or shale generally contain a fragipan.

Bedrock of Mississippian age is in most of Hardin County, the central part of Pope County, and the northern part of Massac County (14). These formations generally are thick beds of sandstone and thin beds of shale. Wellston, Muskingum, and Berks soils formed in the residuum. Thick beds of St. Louis Limestone occur between Elizabethtown and Cave in Rock. The cherty Bedford and Baxter soils formed in material weathered from the limestone. This area has many sinkholes, and well-drained Alford soils formed in the thick loess that overlies the limestone. In the area around Hicks Dome, formations of Ste. Genevieve Limestone are dominant, and cherty Baxter, Bedford, and Clarksville soils formed in the residuum.

Coastal Plain gravel of Tertiary age and silt, clay, and sand of Cretaceous age underlie much of Massac County and some of the southern part of Pope County (18, 20). The silt, clay, and sand are only rarely in the soil profiles, but reddish-brown gravel makes up most of the Brandon and Saffell soils and the lower layers of Lax soils. Also, the loessial soils of association 8 are underlain by Coastal Plain gravel.

Nearly 29 percent of the soils formed in water-deposited sand, silt, and clay. About one-third of these soils are on stream terraces and two-thirds are on flood plains.

The lowland along the present Cache River and Bay Creek was the channel of the Ohio River until late Pleistocene times. Stream terraces, consisting of areas of such soils as those of the Alivin, Ginat, Markland, and Sciotoville series, are along both this old channel and the present channel of the Ohio River. Lower stream terraces, in which Emma and Hurst soils formed, still have extremely severe floods. The present Ohio River bottom lands consist of such soils as those of the Armiesburg and Huntington series. In the Cache River-Bay Creek bottom lands are such soils as those of the Bonnie, Cape, and Karnak series. In upland areas stream alluvium, derived mainly from the silty loess deposits, is represented by Sharon, Belknap, and Burnside soils.

Climate

Climate affects soil formation through its effect on weathering, vegetation, and erosion. Freezing and thawing help to break down minerals and rock fragments. Water received as rainfall percolates downward in soils that have favorable slope and permeability and carries with it bases and clay, which then accumulate in the lower horizons.

The survey area has a humid, temperate climate that has been favorable to soil development. Rainfall and temperature encourage the growth of hardwood forests. Enough water has percolated through the soil to cause fine particles, colloids, and soluble minerals to move downward. Consequently, most of the soils have a greater proportion of silica in the surface layer than elsewhere, an accumulation of clay in the subsoil, and a strongly acid reaction.

As a result of the high average soil temperature, soils are classified as intermediate between the mesic and thermic soil families. Because of the high annual rainfall and mild winter temperatures the rate of weathering has made the soils very strongly acid, and the base saturation is about 35 percent. Thus, some soils are classified as Alfisols and some as Ultisols (table 10 in the section "Classification of the Soils").

Plants and animals

Plants have had the main effect on the formation of the soils of the survey area, but animals and organisms that live on and in the soils have also been important. The changes they cause depend mainly on the kinds of life processes peculiar to each species. The kinds of plants and animals that live on and in the soils are affected in turn by climate, parent material, relief, and the age of the soil.

Most of the soils in these counties formed under forest and are light colored. A few dark-colored soils on bottom lands probably were influenced by grass to some extent and probably developed under a mixed stand of grass and forest. Soils that formed under grasses generally are darker colored and contain more organic matter than those that formed under trees.

Small burrowing animals, such as insects, grubs, earthworms, crawfish, fungi, microbes, and other such organisms, influence the formation of soil by mixing organic matter into the soil, and by helping break down the remains of plants. It is generally quite evident, for example, that earthworms have mixed some of the soils to varying degrees and depths. Bacteria and fungi aid in the decomposition of plant and animal remains and thus add organic matter to the soil.

Relief

Relief controls the amount of moisture in the soil through its influence on the amount of runoff, the degree of erosion, and the amount of water infiltrating the soil.

In uniform material, such as loess, the differences in natural soil drainage generally are closely associated with slope or relief. Soil drainage in turn greatly affects the color of the soil. Soils that have developed under good drainage, such as Alford and Wheeling, have a uniformly brown subsoil. Soils that have developed under poor drainage, however, such as Weir and Ginat,

have a grayish subsoil. Soils that have developed where the drainage is intermediate between good and poor have a subsoil with gray and brown mottles. Stoy and Reesville soils are examples. The grayish colors persist, even though the drainage is greatly improved by ditches and tile drains.

Where runoff is rapid on steep soils, geologic erosion is likely to almost keep pace with soil development. Steep soils, such as Muskingum and Berks soils, are thin, and their horizons are weakly developed.

Relief, or the lack of it, is also related to the eluviation of clay from the A to the B horizon. In the sloping Hosmer soil, and in other steeper, well-drained soils, the rate at which clay moves downward in the soil is only moderate. In nearly level soils such as those in the Weir series, on the other hand, more clay has accumulated, and the profile is generally more distinct than that in Hosmer soils.

Time

Time is necessary for the formation of soil in parent material. Normally, a long period of time is required for the formation of soils that have distinct, well-expressed horizons, but the length of time is largely dependent upon the combined action of the other soil-forming factors.

Soils normally become more strongly developed with increased time of exposure to weathering processes. On slopes where geologic erosion is rapid, however, such soils as the steep Berks may be in the early stages of development even though the slopes have been exposed to weathering for thousands of years.

Bottom-land soils, such as Armiesburg or Belknap, accumulate surface deposits each time they become flooded. They are relatively young and are only weakly developed. Weinbach soils also formed in alluvium, but because they no longer become flooded, they have, in time, developed a more distinct profile.

Loess, although geologically recent, has allowed such soils as the Hosmer and Weir soils to develop well-defined horizons over thousands of years. Soils, such as those of the Saffell series, which developed in the geologically older Coastal Plain gravel, have characteristics that developed over hundreds of thousands of years.

Classification of the 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. 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 classifications, 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 (23). Because this system is under continual study, readers interested in developments of the current system should search the latest literature available.

The current system of classification has six categories. Beginning with broadest, these categories are order, suborder, great group, subgroup, family, and series. In this system the criteria used as a basis for classification are soil properties that are observable and measurable. The properties are chosen, however, so that the soils of similar genesis, or mode of origin, are grouped. In table 10, the soil series of Pope, Hardin, and Massac Counties are placed in four categories of the current system. Classes of the current system are briefly defined in the following paragraphs.

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 subdivided into suborders that are based primarily on those soil characteristics that seem to produce classes with the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of waterlogging, or soil differences resulting from the climate or vegetation. The names of suborders have two syllables. The last syllable indicates the order. An example is *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 have 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 Haplaquents (*Hapl*, meaning simple horizons, *aqu* for wetness or water, and *ent*, from Entisols).

SUBGROUP. Great groups are subdivided into subgroups, one representing 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 of the range of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group. An example is Typic Haplaquents (a typical Haplaquent).

FAMILY. Soil families are separated within a subgroup primarily 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 10.) An example is the coarse-loamy, mixed, mesic family of Typic Hapludalfs.

Laboratory Data

Laboratory data considered representative for Armiesburg silty clay loam in Massac County is given in Table 11. These data are useful to soil scientists in classifying soils and in developing concepts of soil genesis. They help to estimate fertility, tilth, and other properties that affect soil management, and they also serve as a check against

field estimates and determinations. The profile of the sampled Armiesburg soil in Table 11 is described in the section "Descriptions of the Soils."

Physical and chemical laboratory data for Grantsburg silt loam, sampled in Pope County, and for Wheeling silt loam, sampled in Massac County, are published in the soil survey for Johnson County, Illinois (7). The profile of the sampled Grantsburg soil in the Johnson County survey is the same as the one described as representative for the series in the section "Descriptions of the Soils" in this survey. The Wheeling soil is in Massac County, NW $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 22, T. 14 S., R. 4 E.

The samples used to determine the data in table 11 were collected from a carefully selected pit. All laboratory analyses were made on oven-dry material that had passed a 2-millimeter sieve. The soil was tested at the Soil Survey Laboratory at Lincoln, Nebraska. Standard methods were used.

TABLE 10.—Soil series classified according to the current system of classification

Series	Family ¹	Subgroup	Order
Alford	Fine-silty, mixed, mesic	Typic Hapludalfs	Alfisols.
Alvin	Coarse-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Armiesburg	Fine-silty, mixed, mesic	Fluventic Hapludolls	Mollisols.
Baxter	Clayey, mixed, mesic	Typic Paleudults	Ultisols.
Beasley	Fine, mixed, mesic	Typic Hapludalfs	Alfisols.
Beaucoup	Fine-silty, mixed, mesic	Fluvaquentic Haplaquolls (Typic)	Mollisols.
Bedford	Fine-silty, mixed, mesic	Typic Fragiudults	Ultisols.
Belknap	Coarse-silty, mixed, acid, mesic	Aeric Fluvaquents	Entisols.
Berks	Loamy-skeletal, mixed, mesic	Typic Dystrochrepts	Inceptisols.
Bonnie	Fine-silty, mixed, mesic	Typic Fluvaquents	Entisols.
Brandon ²	Fine-silty, mixed, thermic	Typic Hapludults	Ultisols.
Burnside	Loamy-skeletal (coarse-loamy), mixed, acid, mesic	Typic Udifuvents	Entisols.
Cape	Fine, montmorillonitic, acid, mesic	Typic Fluvaquents	Entisols.
Clarksville	Loamy-skeletal, siliceous (mixed), mesic	Typic Paleudults (Ultic Paleudults)	Ultisols.
Darwin	Fine, montmorillonitic, mesic	Vertic Haplaquolls	Mollisols.
Dupo	Coarse-silty over clayey, mixed, nonacid, mesic (fine-silty over clayey)	Aquic Udifuvents	Entisols.
Emma	Fine-silty, mixed, mesic	Typic Dystrochrepts	Inceptisols.
Ginat	Fine-silty, mixed, mesic	Typic Fragiaqualfs	Alfisols.
Grantsburg	Fine-silty, mixed, mesic	Typic Fragiudalfs	Alfisols.
Haymond	Coarse-silty, mixed, nonacid, mesic	Typic Udifuvents	Entisols.
Hosmer	Fine-silty, mixed, mesic	Typic Fragiudalfs	Alfisols.
Huntington	Fine-silty, mixed, mesic	Fluventic Hapludolls	Mollisols.
Hurst	Fine, montmorillonitic, mesic	Aeric Ochraqualfs	Alfisols.
Karnak	Fine, montmorillonitic, nonacid, mesic	Vertic Haplaquents	Entisols.
Lamont	Coarse-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Lax	Fine-silty, mixed, thermic	Typic Fragiudults	Ultisols.
Markland	Fine, mixed, mesic	Typic Hapludalfs	Alfisols.
McGary	Fine, mixed, mesic	Aeric Ochraqualfs	Alfisols.
Muskingum	Fine-loamy (loamy-skeletal), mixed, mesic	Typic Dystrochrepts	Inceptisols.
Petrolia	Fine-silty, mixed, nonacid, mesic	Typic Fluvaquents	Entisols.
Racoon	Fine-silty, mixed, mesic	Typic Ochraqualfs	Alfisols.
Reesville	Fine-silty, mixed, mesic	Aeric Ochraqualfs	Alfisols.
Robbs	Fine-silty, mixed, mesic	Aquic Fragiudalfs	Alfisols.
Saffell ²	Loamy-skeletal, siliceous, thermic	Typic Hapludults	Ultisols.
Sciotoville	Fine-loamy, mixed, mesic	Aquic Fragiudalfs (Aqueptic)	Alfisols.
Sharon	Coarse-silty, mixed, acid, mesic	Typic Udifuvents	Entisols.
Stoy	Fine-silty, mixed, mesic	Aquic Fragiudalfs	Alfisols.
Wakeland	Coarse-silty, mixed, nonacid, mesic	Aeric Fluvaquents	Entisols.
Weinbach	Fine-silty, mixed, mesic	Aeric Fragiaqualfs (Typic)	Alfisols.
Weir	Fine, montmorillonitic, mesic	Typic Ochraqualfs	Alfisols.
Wellston	Fine-silty, mixed, mesic	Ultic Hapludalfs	Alfisols.
Wheeling	Fine-loamy, mixed, mesic	Ultic Hapludalfs	Alfisols.
Zanesville	Fine-silty, mixed, mesic	Typic Fragiudalfs	Alfisols.

¹ The mesic-thermic boundary passes through the survey area, and the appropriate family in the thermic zone is used as well as that of the mesic zone.

² Most of the Brandon and Saffell soils in the survey area are taxadjuncts to their respective series because they have a thicker solum than that defined for the series.

TABLE 11.—Laboratory data

Soil type and location	Horizon	Depth from surface	Particle-size distribution			Organic carbon ¹	Exchangeable cations ²				Cation exchange capacity	Base saturation	Re-action
			Sand (2.0-0.05 mm.)	Silt (0.05-0.002 mm.)	Clay (less than 0.002 mm.)		Ca	Mg	Na	K			
		Inches	Percent	Percent	Percent	Percent	Meq./100 gm.	Meq./100 gm.	Meq./100 gm.	Meq./100 gm.	Percent	Percent	pH
Armiesburg silty clay loam, SW $\frac{1}{4}$ NE $\frac{1}{4}$ -SW $\frac{1}{4}$ sec. 28, T. 16 S., R. 6 E. (Massac County)	Ap	0-6	4.8	68.5	26.7	1.40	12.9	4.3	0.3	0.2	21.0	84	6.8
	A1	6-15	8.4	61.4	30.2	1.07	14.1	4.3	.2	.1	22.9	82	6.8
	B1	15-30	17.8	53.5	28.7	.96	13.8	3.8	.2	.2	22.2	81	6.7
	B21	30-42	3.4	61.6	35.0	.88	14.4	4.7	.3	.2	24.5	80	6.7
	B22	42-54	1.0	65.3	33.7	.75	14.0	4.9	.3	.1	23.9	81	6.7
	B23	54-67	2.6	67.0	30.4	.63	12.9	4.6	.3	.2	22.4	80	6.6
	C	67-130	12.2	65.3	22.5	.41	9.7	3.7	.2	.2	17.1	81	6.8

¹ The percentage of organic carbon times 1.724 equals the percentage of organic matter.

² One milliequivalent of calcium (Ca) per 100 grams of soil material equals 400 pounds per acre, or per 2 million pounds of soil material, 1 milliequivalent of magnesium (Mg) per 100 grams of

soil material equals 240 pounds per acre, or per 2 million pounds of soil material; 1 milliequivalent of potassium (K) per 100 grams of soil material equals 780 pounds per acre, or per 2 million pounds of soil material.

Determinations of clay were made by the pipette method (12, 13). The reaction of the saturated paste was measured with a glass electrode. Organic carbon was determined by wet combustion, using a modification of the Walkley-Black method (17). The cation-exchange capacity was determined by direct distillation of absorbed ammonia (17). Extractable calcium and magnesium were determined by EDTA titration (2). Extractable sodium and potassium were determined on original extract with a flame spectrophotometer.

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Glossary

Acidity. 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 aggregates produced by tillage or logging.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

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.

Bottom land. Nearly level land on the bottom of a valley that has a stream flowing through it. Subject to flooding and often referred to as a flood plain.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

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.

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.

Contour farming. Plowing, planting, cultivating, and harvesting in rows that are at right angles to the natural direction of the slope or that are parallel to terrace grade.

Cover crops. Close-growing crops, grown primarily to improve the soil and protect it between periods of regular crop production; or crops grown between trees and vines in orchards and vineyards.

Crop residue. The part of a plant, or crop, left in the field after harvest.

Depth of soil. Thickness of soil over a specified layer, generally one that does not permit the growth of roots. Classes used in this survey are—

<i>Deep</i> -----	36 inches or more.
<i>Moderately deep</i> -----	20 to 36 inches.
<i>Shallow</i> -----	10 to 20 inches.
<i>Very shallow</i> -----	less than 10 inches.

Diversion, or diversion terrace. A ridge of earth, generally a terrace, that is built to divert runoff from its natural course and, thus, to protect areas downslope from the effects of such runoff.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Escarpment. A long, steep ridge of land or rock that resembles a cliff. It faces in one general direction and separates two areas of more nearly level land.

Fertility, soil. The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors such as light, moisture, temperature, and the physical condition of the soil are favorable.

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.

Green manure (agronomy). A crop grown for the purpose of being turned under in an early stage of maturity or soon after maturity for soil improvement.

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 matter 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 O 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.

Intake rate or infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. It may be limited either by the infiltration capacity of the soil or by the rate at which water is applied to the surface soil.

Leached soil. A soil from which most of the soluble constituents have been removed throughout the entire profile or removed from one part of the profile and accumulated in another part.

Loess. A uniform, silty material transported by wind and deposited on the land.

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.

Natural soil drainage. 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.

Organic-matter content. Ratings used in this survey have the following limits: low—below 2 percent of volume; moderate—2 to 4 percent; and high—more than 4 percent.

Percolation. The downward movement of water through soil.

Permeability. The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid, and very rapid*.

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 in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

pH		pH	
Extremely acid---	Below 4.5	Neutral -----	6.6 to 7.3
Very strongly acid_	4.5 to 5.0	Mildly alkaline-----	7.4 to 7.8
Strongly acid-----	5.1 to 5.5	Moderately alkaline---	7.9 to 8.4
Medium acid-----	5.6 to 6.0	Strongly alkaline---	8.5 to 9.0
Slightly acid-----	6.1 to 6.5	Very strongly alkaline -----	9.1 and higher

Sand. Individual rock or mineral fragments in a soil that 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. Degree of deviation of a surface from the horizontal, usually expressed in percent or degrees. For example, a slope of 10 percent is one that changes 10 feet in elevation for each 100 feet horizontal distance.

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.

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 particles 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.

Subsurface layer. The horizon between the surface layer and the subsoil. Technically the A2 horizon.

Surface layer. A term used in nontechnical soil descriptions for one or more layers above the subsoil.

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."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Upland. Land consisting of material unworked by water in recent geologic time and lying, in general, at a higher elevation than the alluvial plain or stream terrace. Land above the lowland along rivers.

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.

Weathering. All physical and chemical changes produced in rocks at or near the earth's surface by atmospheric agents. These changes result in more or less complete disintegration and decomposition of the rock.

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. In referring to a management group, a woodland suitability group, a wildlife group, or a recreation group, read the introduction to the section it is in for general information about its management. Other information is given in tables as follows:

Acres and extent, table 3, page 15.
 Estimated average yields, table 4, page 69.
 Woodland suitability of the soils, table 5,
 page 74.

Recreational uses of the soils, table 6,
 page 82.
 Engineering uses of the soils, tables 7, 8,
 and 9, pages 88 through 117.

Map symbol	Mapping unit	Page	Management group		Woodland suitability group		Wildlife group		Recreation group
			Symbol	Page	Symbol		Number	Page	Number
9	Sandstone rock land-----	50	VIIIs-1	68	3r3		5	81	6
70	Beaucoup silty clay loam-----	23	IIw-3	65	2w5		11	85	12
71	Darwin silty clay-----	31	IIIw-3	66	3w6		11	85	13
72	Sharon silt loam-----	53	I-2	63	1o4		9	85	9
108	Bonnie silt loam-----	26	IIIw-2	66	2w5		10	85	11
W108	Bonnie silt loam, wet-----	27	Vw-1	67	3w6		12	86	14
109	Racoon silt loam-----	48	IIIw-1	65	4w2		8	85	8
131A	Alvin fine sandy loam, 0 to 2 percent slopes---	19	I-1	62	2o1		1	79	1
131B	Alvin fine sandy loam, 2 to 4 percent slopes---	19	IIe-1	63	2o1		1	79	1
131C	Alvin fine sandy loam, 4 to 7 percent slopes---	19	IIIe-1	65	2o1		1	79	1
131D2	Alvin fine sandy loam, 7 to 12 percent slopes, eroded-----	19	IIIe-1	65	2o1		2	79	3
131E2	Alvin fine sandy loam, 12 to 18 percent slopes, eroded-----	19	IVe-1	66	2r2		3	80	4
131F	Alvin fine sandy loam, 18 to 30 percent slopes---	19	VIe-1	68	2r2		4	80	5
164A	Stoy silt loam, 0 to 2 percent slopes-----	54	IIw-1	64	3o1		6	85	7
164B	Stoy silt loam, 2 to 4 percent slopes-----	54	IIe-3	64	3o1		7	85	7
164C2	Stoy silt loam, 4 to 7 percent slopes, eroded-----	54	IIIe-2	65	3o1		7	85	7
165	Weir silt loam-----	56	IIIw-1	65	4w2		8	85	8
173B	McGary silt loam, 0 to 4 percent slopes-----	46	IIe-3	64	3o1		7	85	7
175B	Lamont fine sandy loam, 2 to 7 percent slopes--	43	IIIIs-1	66	3s2		1	79	1
175D2	Lamont fine sandy loam, 7 to 12 percent slopes, eroded-----	43	IIIIs-1	66	3s2		2	79	3
180	Dupo silt loam-----	32	IIw-2	64	2o4		10	85	10
214B	Hosmer silt loam, 2 to 4 percent slopes-----	38	IIe-2	64	2o1		1	79	2
214C2	Hosmer silt loam, 4 to 7 percent slopes, eroded-----	38	IIIe-2	65	2o1		1	79	2
214D2	Hosmer silt loam, 7 to 12 percent slopes, eroded-----	38	IIIe-2	65	2o1		2	79	3
214D3	Hosmer soils, 7 to 12 percent slopes, severely eroded-----	39	IVe-2	67	2o1		2	79	3
214E2	Hosmer silt loam, 12 to 18 percent slopes, eroded-----	39	IVe-2	67	2r2		3	80	4
214E3	Hosmer soils, 12 to 18 percent slopes, severely eroded-----	39	VIe-2	68	2r2		3	80	4
214F2	Hosmer silt loam, 18 to 30 percent slopes, eroded-----	39	VIe-2	68	2r2		4	80	5
288	Petrolia silty clay loam-----	47	IIw-3	65	2w5		11	85	12
W288	Petrolia silty clay loam, wet-----	47	Vw-1	67	3w6		12	86	14
301B	Grantsburg silt loam, 2 to 4 percent slopes----	35	IIe-2	64	3d2		1	79	2
301C2	Grantsburg silt loam, 4 to 7 percent slopes, eroded-----	35	IIIe-2	65	3d2		1	79	2
301D2	Grantsburg silt loam, 7 to 12 percent slopes, eroded-----	36	IIIe-2	65	3d2		2	79	3
301D3	Grantsburg soils, 7 to 12 percent slopes, severely eroded-----	36	IVe-2	67	3d2		2	79	3
301E2	Grantsburg silt loam, 12 to 18 percent slopes, eroded-----	36	IVe-2	67	3d2		3	80	4

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Page	Management group		Woodland suitability group	Wildlife group		Recreation group
			Symbol	Page	Symbol	Number	Page	Number
301E3	Grantsburg soils, 12 to 18 percent slopes, severely eroded-----	36	VIe-2	68	3d2	3	80	4
308B	Alford silt loam, 2 to 4 percent slopes-----	14	IIe-1	63	1o1	1	79	1
308C2	Alford silt loam, 4 to 7 percent slopes, eroded-----	14	IIe-1	63	1o1	1	79	1
308D2	Alford silt loam, 7 to 12 percent slopes, eroded-----	17	IIIe-1	65	1o1	2	79	3
308D3	Alford soils, 7 to 12 percent slopes, severely eroded-----	17	IVe-1	66	1o1	2	79	3
308E2	Alford silt loam, 12 to 18 percent slopes, eroded-----	17	IVe-1	66	1r2	3	80	4
308E3	Alford soils, 12 to 18 percent slopes, severely eroded-----	17	VIe-1	68	1r2	3	80	4
308F2	Alford silt loam, 18 to 30 percent slopes, eroded-----	18	VIe-1	68	1r2	4	80	5
331	Haymond silt loam-----	37	I-2	63	1o4	9	85	9
333	Wakeland silt loam-----	54	IIw-2	64	2o4	10	85	10
335B	Robbs silt loam, 1 to 4 percent slopes-----	50	IIe-3	64	3o1	7	85	7
339E	Wellston silt loam, 12 to 18 percent slopes----	57	VIe-3	68	2r2	3	80	4
339E3	Wellston soils, 12 to 18 percent slopes, severely eroded-----	57	VIIe-1	68	2r2	3	80	4
339F	Wellston silt loam, 18 to 30 percent slopes----	57	VIIe-1	68	2r2	4	80	5
340D2	Zanesville silt loam, 7 to 12 percent slopes, eroded-----	60	IIIe-2	65	3d2	2	79	3
340D3	Zanesville soils, 7 to 12 percent slopes, severely eroded-----	60	IVe-2	67	3d2	2	79	3
340E2	Zanesville silt loam, 12 to 18 percent slopes, eroded-----	61	IVe-2	67	3d2	3	80	4
340E3	Zanesville soils, 12 to 18 percent slopes, severely eroded-----	61	VIe-2	68	3d2	3	80	4
340F2	Zanesville silt loam, 18 to 30 percent slopes, eroded-----	61	VIe-2	68	3d2	4	80	5
382	Belknap silt loam-----	25	IIw-2	64	2o4	10	85	10
422	Cape silty clay loam-----	29	IIIw-3	66	2w5	11	85	12
422+	Cape silt loam, overwash-----	30	IIIw-3	66	2w5	11	85	12
W422	Cape silty clay loam, wet-----	30	Vw-1	67	3w6	12	86	14
426	Karnak silty clay-----	42	IIIw-3	66	3w6	11	85	13
426+	Karnak silt loam, overwash-----	42	IIIw-3	66	3w6	11	85	13
426#	Karnak silty clay loam, ashy-----	42	IIIw-3	66	3w6	11	85	13
W426	Karnak silty clay, wet-----	42	Vw-1	67	3w6	12	86	14
427	Burnside silt loam-----	29	II s-1	65	1o4	9	85	9
455	Alluvial land-----	18	IIw-2	64	1o4	12	86	14
460	Ginat silt loam-----	34	IIIw-1	65	4w2	8	85	8
461A	Weinbach silt loam, 0 to 2 percent slopes-----	55	IIw-1	64	3o1	6	85	7
461B	Weinbach silt loam, 2 to 4 percent slopes-----	55	IIe-3	64	3o1	7	85	7
461C2	Weinbach silt loam, 4 to 7 percent slopes, eroded-----	55	IIIe-2	65	3o1	7	85	7
462A	Sciotoville silt loam, 0 to 2 percent slopes----	51	IIw-1	64	2o1	1	79	2
462B	Sciotoville silt loam, 2 to 4 percent slopes----	51	IIe-2	64	2o1	1	79	2
462C2	Sciotoville silt loam, 4 to 7 percent slopes, eroded-----	51	IIe-2	64	2o1	1	79	2
462D2	Sciotoville silt loam, 7 to 12 percent slopes, eroded-----	52	IIIe-2	65	2o1	2	79	3
462D3	Sciotoville soils, 7 to 12 percent slopes, severely eroded-----	52	IVe-2	67	2o1	2	79	3
462E2	Sciotoville silt loam, 12 to 18 percent slopes, eroded-----	52	IVe-2	67	2r2	3	80	4
463A	Wheeling silt loam, 0 to 2 percent slopes-----	58	I-1	62	2o1	1	79	1
463B	Wheeling silt loam, 2 to 4 percent slopes-----	58	IIe-1	63	2o1	1	79	1

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Page	Management group		Woodland suitability group	Wildlife group		Recreation group
			Symbol	Page	Symbol	Number	Page	Number
463C2	Wheeling silt loam, 4 to 7 percent slopes, eroded-----	59	IIe-1	63	2o1	1	79	1
463D2	Wheeling silt loam, 7 to 12 percent slopes, eroded-----	59	IIIe-1	65	2o1	2	79	3
463E2	Wheeling silt loam, 12 to 25 percent slopes, eroded-----	59	VIe-1	68	2r2	3	80	4
467C2	Markland silt loam, 2 to 7 percent slopes, eroded-----	45	IIIe-1	65	2o1	1	79	2
467D2	Markland silt loam, 7 to 15 percent slopes, eroded-----	45	IVe-2	67	2o1	2	79	3
469A	Emma silty clay loam, 0 to 2 percent slopes-----	33	I-1	62	2o1	1	79	2
469B	Emma silty clay loam, 2 to 7 percent slopes-----	33	IIe-1	63	2o1	1	79	2
469D2	Emma silty clay loam, 7 to 18 percent slopes, eroded-----	33	IIIe-1	65	2o1	2	79	3
471F	Clarksville cherty silt loam, 20 to 30 percent slopes-----	30	VIIIs-1	68	3r2	5	81	6
471G	Clarksville cherty silt loam, 30 to 60 percent slopes-----	31	VIIIs-1	68	3r3	5	81	6
525	Darwin silty clay loam-----	32	IIIW-3	66	3w6	11	85	13
597	Armiesburg silty clay loam-----	20	I-2	63	1o4	9	85	9
598D	Bedford silt loam, 7 to 12 percent slopes-----	24	IIIe-2	65	3d2	2	79	3
598D3	Bedford soils, 7 to 12 percent slopes, severely eroded-----	24	IVe-2	67	3d2	2	79	3
598E2	Bedford silt loam, 12 to 18 percent slopes, eroded-----	24	IVe-2	67	3d2	3	80	4
598E3	Bedford soils, 12 to 18 percent slopes, severely eroded-----	24	VIe-2	68	3d2	3	80	4
598F2	Bedford silt loam, 18 to 30 percent slopes, eroded-----	25	VIe-2	68	3d2	4	80	5
599E	Baxter cherty silt loam, 12 to 18 percent slopes-----	21	VIe-3	68	3r2	5	81	4
599F	Baxter cherty silt loam, 18 to 30 percent slopes-----	21	VIIe-1	68	3r2	5	81	5
599G	Baxter cherty silt loam, 30 to 50 percent slopes-----	22	VIIe-1	68	3r3	5	81	5
600	Huntington silt loam-----	40	I-2	63	1o4	9	85	9
628E	Lax silt loam, 12 to 18 percent slopes-----	44	IVe-2	67	2r2	3	80	4
628E3	Lax soils, 12 to 18 percent slopes, severely eroded-----	44	VIe-2	68	2r2	3	80	4
628F2	Lax silt loam, 18 to 30 percent slopes, eroded-----	44	VIe-2	68	2r2	4	80	5
691E	Beasley silt loam, 12 to 18 percent slopes-----	22	VIe-3	68	2r2	3	80	4
691F	Beasley silt loam, 18 to 30 percent slopes-----	22	VIIe-1	68	2r2	4	80	5
691G	Beasley silt loam, 30 to 50 percent slopes-----	23	VIIe-1	68	3r3	5	81	5
693	Hurst silty clay loam-----	41	IIW-1	64	3o1	6	85	7
723	Reesville silt loam-----	49	IIW-1	64	2o1	6	85	7
953E2	Hosmer-Lax silt loams, 12 to 18 percent slopes, eroded-----	39	IVe-2	67	2r2	3	80	4
953E3	Hosmer-Lax complex, 12 to 18 percent slopes, severely eroded-----	40	VIe-2	68	2r2	3	80	4
953F2	Hosmer-Lax silt loams, 18 to 30 percent slopes, eroded-----	40	VIe-2	68	2r2	4	80	5
954E2	Alford-Baxter complex, 12 to 18 percent slopes, eroded-----	18	VIe-3	68	3r2	3	80	4
954F2	Alford-Baxter complex, 18 to 40 percent slopes, eroded-----	18	VIIe-1	68	3r2	4	80	5
955F	Muskingum and Berks soils, 15 to 30 percent slopes-----	46	VIIIs-1	68	3r2	5	81	6

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Page	Management group		Woodland suitability group	Wildlife group		Recreation group
			Symbol	Page	Symbol	Number	Page	Number
955G	Muskingum and Berks soils, 30 to 60 percent slopes-----	46	VIIIs-1	68	3r3	5	81	6
956B	Brandon and Saffell soils, 1 to 4 percent slopes-----	28	IIIIs-1	66	3s2	1	79	1
956C2	Brandon and Saffell soils, 4 to 12 percent slopes, eroded-----	28	IIIIs-1	66	3s2	1	79	1
956F	Brandon and Saffell soils, 12 to 30 percent slopes-----	28	VIIIs-1	68	3r2	5	81	5
986E	Wellston-Berks complex, 12 to 18 percent slopes-----	57	VIe-3	68	3r2	5	81	4
986F	Wellston-Berks complex, 18 to 30 percent slopes-----	58	VIIe-1	68	3r2	5	81	6
986G	Wellston-Berks complex, 30 to 60 percent slopes-----	58	VIIe-1	68	3r3	5	81	6

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