SOIL SURVEY OF

Benton County, Arkansas

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

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

Major fieldwork for this soil survey was completed in the period 1965-71. Soil names and descriptions were approved in 1973. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1972. This survey was made cooperatively by the Soil Conservation Service, the Forest Service, and the Arkansas Agricultural Experiment Station. It is part of the technical assistance furnished to the Benton County Conservation District.

HOW TO USE THIS SOIL SURVEY

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

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

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

Finding and Using Information

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

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

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

Ranchers and others can find, under "Range," groupings of the soils according to their suitability for range, and also the names of many of the plants that grow on each range site.

Community planners and others can read about soil properties that affect the choice of sites for dwellings, industrial buildings, and recreation areas in the sections "Town and Country Planning," and "Recreation."

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 the Soils."

Newcomers in Benton County 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 county given in the section "General Nature of the County."

Cover: **Scenic area of the Clarksville-Nixa-Noark association adjacent to Beaver Reservoir in Benton County.**

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SOIL SURVEY OF BENTON COUNTY, ARKANSAS

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

BENTON COUNTY is in northwestern Arkansas (fig. 1). It ranges from about 9 to 42 miles in width and from about 18 to 27 miles in length. It has a total land area of 544,640 acres, or 851 square miles.

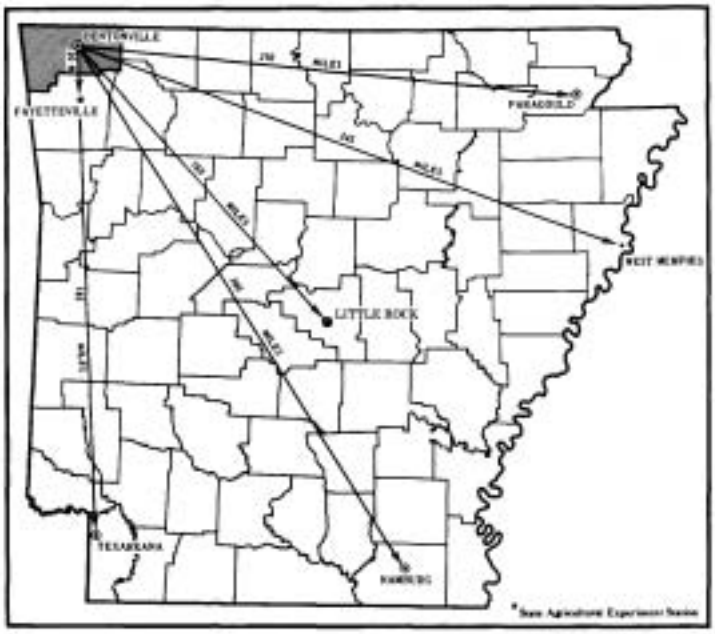

Figure 1.—**Location of Benton County in Arkansas.**

The topography ranges from broad upland divides separated by areas of rolling hills in the western and central parts of the county to rocky, rough, steeper hills in the east. Much of the eastern one-third of the county is covered by Beaver Reservoir.

In 1970 the population of the county was about 50,476. Bentonville, the county seat, had a population of 5,508; Rogers 11,050; and Siloam Springs 6,009. Most of the workers in the county, including more than half of the farmers, are employed in industries or supporting businesses in the general area.

General Nature of the County

This section discusses farming, physiography and drainage, and climate in Benton County. Statistics given in the discussion of farming are for 1969.

Farming

Early settlers in Benton County farmed the soils on the broad uplands and in valleys where natural drainage was good. General crop and livestock farming was practiced. Some farming was subsistence. Most of the better drained areas were cleared and farmed, but the steep, cherty, stony, or wet areas were generally left as woodland. Livestock, mainly cattle and hogs, ranged the woods and unfenced areas.

In the early part of this century, Benton County and adjacent areas became leading producers of fruit and vegetables. General livestock production was important, and feed crops, such as small grain and corn, were grown. Livestock production subsequently expanded and is now the major source of farm income. Benton County is within a major poultry-producing area, and raising broiler chickens is the main enterprise. Poultry litter, a byproduct of the poultry industry, is a major and relatively inexpensive source of fertilizer. Many hundreds of tons of litter are spread on pastures in the county each year. Cattle production has increased in recent years. Beef cattle production is dominant, and dairying is also important. Although the number of dairy cows has declined, increased milk production per cow has partly offset the drop in number.

Most of the cleared land in the county is used to grow forage for livestock. Although the acreage of cultivated crops and orchards has declined, a variety of fruit and vegetable crops, small grain, and field crops are grown. Table 1 shows the acreage of the principal crops and pasture plants grown in 1964 and in 1969, and table 2 gives the kinds and numbers of livestock for those years.

Most of the areas on the broad uplands and in the larger stream valleys are used for improved pasture and forage crops. A small acreage is used for crops. Hay production is especially important on the flood plains.

The more dissected hilly areas, dominantly in the northern and eastern parts of the county, are mainly in hardwoods or mixed hardwoods and pines. Narrow valleys are cleared and used chiefly for pasture and forage crops. Cleared ridgetops and less sloping parts of ridges are used for pasture. Most of the farm woodland is grazed. Some tracts have been converted to

TABLE 1.—*Acreage of principal crops and pasture for stated years*

Crops	1964	1969
	Acres	*Acres*
Orchards and vineyards	1,323	1,747
Truck crops (including potatoes)	1,410	2,738
Wheat grown for grain	1,940	1,871
Other small grain grown for grain	1,137	1,989
Soybeans grown for beans	467	1,255
Field corn grown for all purposes	2,704	1,128
Sorghum grown for all purposes except syrup	3,344	1,400
Hay	41,827	34,780
Cropland pastured [1]	71,604	113,044
Woodland (including woodland pasture) [1]	103,792	75,513

[1] A large acreage of grazed land is not differentiated and is included in the census category, "All other land."

TABLE 2.—*Number of livestock in stated years*

Livestock	1964	1969
All cattle and calves on farms and sold	106,283	131,609
Milk cows	11,987	9,797
Hogs and pigs on farms and sold	21,559	33,468
Sheep and lambs on farms and sold	4,653	1,181
Horses and ponies on farms and sold	(1)	1,808
Chickens 3 months old and older, on farms and sold	1,740,160	3,904,564
Broilers sold	44,971,500	50,893,274

[1] Data not available.

nonfarm uses such as recreation, hobby farms, and retirement housing, and others are being held for future nonfarm development.

In 1969 about 57 percent of the county was in farms. The rest was used mainly for cities and other built-up areas; transportation facilities; areas being developed for nonfarm uses, such as recreation or housing; and federally administered land within the Ozark National Forest and the Pea Ridge National Military Park. A significant loss in land area and an increase in water area resulted when Beaver Reservoir was filled in 1965. This reservoir inundates all of the White River flood plain in the county.

Farms in Benton County are decreasing in number and increasing in size. Between 1964 and 1969 the number of farms decreased from 3,217 to 2,650 and the average size increased from about 107 to 117 acres.

Farms larger than 500 acres increased from 63 in 1964 to 65 in 1969, and farms smaller than 500 acres decreased from 3,154 in 1964 to 2,585 in 1969. Of the net decrease of 567 farms, 477, or 84 percent of the decrease, were farms smaller than 100 acres. Of the farm operators in the county in 1969, 2,226 were full owners, 303 were part owners, and 121 were tenants. Of these operators, 1,657, or about 63 percent, held jobs off the farm and 1,089, or 41 percent of the operators, worked off-farm 200 days or more.

Physiography and Drainage

Benton County is in the Ozark Highland. Most of the county is on the Springfield Plateau, but small areas of the Salem Plateau are exposed. In addition, small outliers of the Boston Mountains are prominent in a few areas. These outliers rise about 150 to 200 feet above the Springfield Plateau.

About three-eighths of the county is on broad upland stream divides. These divides dominate areas in the central part of the county and along the western edge. Slopes on the broad divides are mainly from 1 to 8 percent, but the slopes that extend into the valleys are steeper. The elevation on the plateau divides is about 1,200 feet in the western part of the county with a general upward tilt toward the eastern part, where the elevation is about 1,400 feet.

More than half of the county is strongly dissected by streams. The dissected areas are characterized by gently sloping to moderately sloping, long, narrow, winding ridges that have side slopes as steep as 45 or 50 percent. They slope down to V-shaped valleys. In deeply entrenched areas, dissected areas of the Salem Plateau are exposed; for instance, in the vicinity of Beaver Reservoir.

Stream valleys are entrenched, and they are commonly less than one-half mile wide. Most flood plains in the county are 200 feet to three-eighths of a mile wide.

There are several small streams in the county but no large ones. The natural drainage system consists of many streams in a dendritic pattern in the upper reaches of several watersheds. Springs are common in some areas, and they contribute substantially to summer and fall streamflow for some streams.

The eastern part of the county drains into Beaver Reservoir, which was formed from White River. Beaver Reservoir has a surface area of about 20,000 acres in Benton County. This major multiple-purpose reservoir is important for water-related recreation and is a major source of water for municipal and industrial use. The southwestern part of the county is drained by the Illinois River. Its major tributary, Osage Creek, drains the central and south-central parts. The western part of the county is drained by Flint and Spavinaw Creeks. Flink Creek empties into the Illinois River, and Spavinaw Creek is part of the Grand River watershed. The northern part of the county is drained by Little Sugar Creek and smaller streams. They are part of the Elk River watershed.

The main soils on the broad uplands are the Captina, Tonti, Peridge, Jay, and Taloka soils. Clarksville, Nixa, and Noark soils are the main soils in the dissected hilly areas. In the stream valleys, Secesh, Elsah, Britwater, and Captina soils are dominant.

Ground water is insufficient for large-scale irrigation. Some of the larger streams furnish water for small-scale sprinkler irrigation. Domestic water supplies come mainly from drilled and dug wells and a few springs. Waterlines have been extended from urban areas into some rural areas. Livestock water supplies are mainly from ponds and creeks.

Climate [1]

Most of Benton County is 1,000 to 1,400 feet above sea level. Elevation increases from west to east. Because of the higher elevations to the east and south, the climate in Benton County is more nearly similar to that of adjacent parts of Missouri and Oklahoma than to that of other Arkansas counties.

In general, the county has relatively warm summers and mild winters. The climate is mainly continental, although warm, humid maritime air from the Gulf of Mexico covers the area at frequent intervals throughout the year. Occasional incursions of Arctic air during the winter account for the low temperature extremes. Table 3 is a summary of temperature and precipitation data kept at reporting stations in the county, and the data are considered representative for the county.

Winters are relatively free of severe cold, although lows below zero are not uncommon in January, the coldest month. The lowest temperature ever recorded in Arkansas was −29° F. at Pond, near Gravette, in February 1905. Extremely cold temperatures generally do not persist for more than a few days at a time. Snow falls every winter in Benton County and averages 8 to 9 inches per year. Heavy snowfall is experienced occasionally. The greatest seasonal total on record was 37.9 inches in the winter of 1917–18.

Summers are warm, and high temperatures are often accompanied by high humidity. In July and August the average daily temperature is about 78°, and the high often exceeds 100°. The highest temperature on record was 114° at Gravette in July 1936.

[1] By ELDEN V. JETTON, meteorologist in charge, National Weather Service, Department of Commerce.

The growing season averages slightly less than 200 days and ranges from 186 to 198 days throughout the county. It has been as short as 137 days at Gravette. Table 4 summarizes freeze data from reporting stations in the county for three critical temperatures. The last freezing temperature in spring generally occurs around the middle of April, and the first freeze in the fall occurs late in October.

Precipitation is fairly well distributed throughout the year and averages nearly 45 inches per year. About 16.2 inches, or about 36 percent of the annual total, generally falls in April, May, and June. May is the wettest month, averaging slightly more than 6¼ inches of rain. Winter is the dry season. December, January, and February have average precipitation of about 2½ inches.

Evaporation rates in summer can be as high as one-third inch per day. A 1-inch rain can be dissipated within 3 or 4 days. Thus, periods with high temperatures and abundant sunshine can result in large losses of soil moisture. Short periods of drought occur frequently, but severe or extreme drought is rare.

Thunderstorms occur in all months of the year but are more frequent in spring and early in summer. Severe local storms and tornadoes are infrequent. In a recent 10-year period only five tornadoes occurred in Benton County, none of which resulted in loss of life.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Benton County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had

TABLE 3.—*Temperature and precipitation data*

[Data summarized from reporting stations at Gravette, Rogers, and Siloam Springs for the period 1941–70]

Month	Temperature				Precipitation		
	Average daily high	Average daily low	Two years in 10 will have at least 4 days with—		Average total	One year in 10 will have—	
			High	Low		Less than—	More than—
			Equal to or higher than—	Equal to or lower than—			
	°F	°F	°F	°F	Inches	Inches	Inches
January	47.5	25.1	72	−4	2.16	0.73	4.53
February	53.1	28.8	75	5	2.64	1.01	4.04
March	58.6	34.7	82	10	3.44	1.46	5.92
April	71.1	47.0	88	25	4.80	1.41	8.80
May	77.6	54.8	90	35	6.27	2.39	10.73
June	85.1	63.0	95	47	5.12	1.40	8.29
July	90.1	66.6	101	52	3.54	.79	6.95
August	91.9	65.1	103	49	3.48	1.10	7.33
September	83.2	57.8	96	38	4.19	.68	7.47
October	73.4	47.5	89	26	3.67	.47	7.56
November	59.6	35.7	78	12	2.82	.74	4.57
December	49.7	28.4	74	2	2.48	.66	3.73
Year	70.1	46.2			44.61		

TABLE 4.—*Freeze threshold temperatures and dates of occurrence*

Station	Freeze threshold temperature	Average dates			Extreme dates		
		Last in spring	First in fall	Period between dates	Latest in spring	Earliest in fall	Period between dates
	°F			Days			Days
Gravette	32	April 18	October 22	187	May 13	September 27	137
	28	April 4	October 30	209	May 4	September 27	146
	24	March 25	November 7	227	April 19	October 8	172
Rogers	32	April 11	October 26	198	May 7	September 27	143
	28	March 31	November 3	217	April 22	October 16	177
	24	March 18	November 11	238	April 13	October 19	189
Siloam Springs	32	April 19	October 22	186	May 4	October 8	157
	28	April 6	October 30	207	April 20	October 8	171
	24	March 27	November 4	222	April 20	October 8	171

not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

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

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Captina and Enders, 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 undistributed 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, Enders gravelly loam, 3 to 12 percent slopes, is one of several phases within the Enders 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 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 Benton County: 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. Sogn-Clareson complex, 8 to 20 percent slopes, 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. Elsah soils is an undifferentiated soil group in this survey.

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. Limestone outcrop is a land type in this county.

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

experiments on the same kind of soil. Yields under defined management are estimated for all the soils.

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

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultations 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.

Benton County joins the published soil surveys of Washington County, Arkansas, and Adair and Delaware Counties, Oklahoma. The soil boundaries are joined, and in most cases the soil names are the same. Exceptions are due largely to changes in definitions of some soil series or because some soils mapped in adjoining counties were not extensive enough in Benton County to map in this survey.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Benton County. 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 county, who want to compare different parts of a county, 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 soil associations in Benton County are discussed in the following pages.

The terms for texture used in the title for several of the associations apply to the texture of the surface layer. For example, in the title of association 2, the word "loamy" refers to the texture of the surface layer.

1. Clarksville-Nixa-Noark association

Somewhat excessively drained to moderately well drained, gently sloping to steep, deep and moderately deep, cherty soils on hills and ridges

This association is mainly in the northern and eastern parts of the county. It is on a highly dissected plateau that is dominantly cherty limestone. The association is characterized by long, narrow ridges that have moderately steep to steep sides and are separated by narrow valleys. Slope ranges from 3 to 50 percent.

This association makes up about 55 percent of the county. Most of Beaver Reservoir is within this association, and it makes up about 6 percent of the area. Clarksville soils make up about 42 percent of the association, Nixa soils 33 percent, and Noark soils 12 percent. The remaining 13 percent is mainly Britwater, Captina, Elsah, Secesh, Tonti, and Waben soils.

Clarksville soils are mainly on the sides of ridges. These soils are somewhat excessively drained. They have a surface layer of dark grayish-brown cherty silt loam, a subsurface layer of pale-brown cherty silt loam, and a subsoil of yellowish-brown cherty silt loam.

Nixa soils are on ridgetops. These soils are moderately well drained. They have a surface layer of very dark grayish-brown cherty silt loam. The upper part of the subsoil is brown cherty silt loam, the middle part is a mottled, firm and brittle cherty silt loam fragipan, and the lower part is red clay in seams and fractures of chert beds.

Noark soils are mainly on the sides of ridges. These soils are well drained. Their surface and subsurface layers are brown cherty silt loam. The upper part of the subsoil is yellowish-red cherty silty clay loam, and the lower part is red cherty and very cherty clay.

Most of this association is wooded. Cleared strips on the tops of ridges and in the valleys are used chiefly for pasture and meadow. Some large tracts in the central and eastern parts of the association are being developed as retirement communities, as recreational areas, and for other nonfarm uses. Other tracts in the vicinity of Beaver Reservoir are being held for such uses. An area in the southwestern part of the county is in the Ozark National Forest.

The Nixa soils are suitable sites for dwellings. Generally, however, this association has moderate to severe limitations for dwellings and other buildings, roads and streets, and other nonfarm uses because of slope, a high content of coarse fragments, and local flooding in the valleys.

2. Jay-Taloka association

Moderately well drained and somewhat poorly drained, level and nearly level, deep, loamy soils on broad uplands

This association is in the western and central parts of the county. It is on broad upland divides. Slope ranges from 0 to 3 percent.

This association makes up about 5 percent of the county. Jay soils make up about 42 percent of the association, and Taloka soils 33 percent. The remaining 25 percent is mainly Carytown, Cherokee, Mayes, and Newtonia soils.

Jay soils are nearly level and are on low rises. These soils are moderately well drained. They have a surface layer of very dark grayish-brown silt loam. The upper part of the subsoil is yellowish-brown silty clay loam, the middle part is a fragipan of yellowish-brown, mottled, firm and brittle silty clay loam and silty loam, and the lower part is yellowish-brown, mottled gravelly silt loam. Depth to the fragipan is 18 to 28 inches. Depth to siltstone bedrock is more than 54 inches.

Taloka soils are on flats. These soils are somewhat poorly drained. They have a surface layer of very dark grayish-brown silt loam. The subsurface layer is grayish-brown and light brownish-gray, mottled silt loam. The upper part of the subsoil is dark-gray, mottled clay, and the lower part is light brownish-gray, mottled silty clay loam.

Most of this association is used for pasture and meadow. Corn, grain sorghum, winter small grain, truck crops, and other suited crops are grown on some tracts. Under good management that includes practices to control erosion in the nearly level areas and drainage in the level areas, most of the association is suited to cultivated crops. Most farms are 10 to 600 acres in size and are operated by the owners. Most operators of small farms have part-time jobs off the farm.

A part of this association in the vicinity of Rogers, and Bentonville is being developed for urban uses.

The association has moderate to severe limitations for dwellings, other buildings, and local roads and streets because of wetness, low strength, and restricted permeability. The limitations are severe for septic tank absorption fields and moderate to severe for other sewage and solid-waste disposal systems because of a slow percolation rate, wetness, and a seasonal high water table.

3. *Tonti-Nixa-Captina association*

Moderately well drained, nearly level to moderately sloping, deep and moderately deep, loamy and cherty soils on ridges and broad uplands

This association occurs throughout the county but is dominant in the central part. It is on top of a broad upland plateau that is rolling and slightly dissected (fig. 2). Typically it is bounded on at least one side by the more strongly dissected areas of association 1. Slope ranges from 1 to 12 percent.

This association makes up about 22 percent of the county. Tonti soils make up about 33 percent of the association, Nixa soils 25 percent, and Captina soils 17 percent. The remaining 25 percent is mainly Cherokee, Clarksville, Elsah, Noark, Peridge, and Secesh soils.

Figure 2.—A typical rolling landscape in the Tonti-Nixa-Captina association. Tall fescue is a pasture grass that is well suited to this association.

Tonti soils are gently sloping. They generally occupy positions between the Nixa and Captina soils. They have a surface layer of brown cherty silt loam. The upper part of the subsoil is strong-brown cherty silty clay loam, and the lower part is a firm, brittle fragipan of yellowish-brown, mottled cherty silty clay loam. The underlying material is cherty limestone bedrock that has thin seams of red clay in fractures.

Nixa soils are gently sloping to moderately sloping and are mainly on the narrower ridges and near the perimeter of broad uplands. They have a surface layer of very dark grayish-brown cherty silt loam. The upper part of the subsoil is brown cherty silt loam, the middle part is a mottled, firm and brittle, cherty fragipan, and the lower part is red clay in seams and fractures of chert beds.

Captina soils are nearly level and are on uplands. They have a surface layer of very dark grayish-brown and brown silt loam. The upper part of the subsoil is strong-brown silty clay loam. The lower part is a strong-brown, mottled, firm and brittle fragipan. The upper part of the fragipan is silty clay loam, and the lower part is cherty silty clay loam. The underlying material is chert bedrock that has mottled silty clay loam in fractures.

Most of this association is used for pasture or meadow. Some areas are used for cultivated crops, vineyards, and orchards. Suited crops include corn, grain sorghum, winter small grain, truck crops, apples, peaches, pears, and grapes. Under good management that includes practices to control erosion, the Tonti and Captina soils are suited to crops. Nixa soils are poorly suited to crops. All the soils are suited to pasture. Most farms are 20 to 400 acres in size and are operated by the owners. Most operators of the smaller farms have jobs off the farm.

Some areas of this association are being developed for urban use.

This association has slight to severe limitations for dwellings, other buildings, or roads and streets. The limitations are severe for septic tank absorption fields because of a slow percolation rate. The limitations are moderate to severe for solid-waste disposal systems because of soil depth.

4. *Secesh-Britwater-Captina association*

Well drained and moderately well drained, level to moderately sloping, deep, loamy soils on flood plains and terraces

This association is in valleys along the larger creeks and rivers in the county. Slope ranges from 0 to 12 percent.

This association makes up about 7 percent of the county. Secesh soils make up about 40 percent of the association, Britwater soils 20 percent, and Captina soils 12 percent. The remaining 28 percent is mainly Elsah, Fatima, Healing, Peridge, and Waben soils.

Secesh soils are level to nearly level and are on flood plains. These soils are well drained. They have a surface layer of dark-brown gravelly silt loam. The subsoil is brown gravelly silt loam.

Britwater soils are gently sloping to moderately sloping and occur on stream terraces higher than the flood plains, and commonly farther from the streams. These soils are well drained. They have a surface layer of brown gravelly silt loam. The upper part of the subsoil is yellowish-red gravelly silty clay loam; the middle part is yellowish-red and dark-red, mottled gravelly silty clay loam; and the lower part is yellowish-red, mottled gravelly silty clay.

Captina soils are nearly level and are on stream terraces higher than flood plains and generally farther from the streams. These soils are moderately well drained. They have a surface layer of very dark grayish-brown and brown silt loam. The upper part of the subsoil is strong-brown silty clay loam. The lower part is a strong-brown, mottled, firm and brittle fragipan. The upper part of the fragipan is silty clay loam, and the lower part is cherty silty clay loam. The underlying material is chert bedrock that has mottled silty clay loam in fractures.

Most of this association is used for pasture and meadow. A part is used for cultivated crops. Where a water supply is available, the association is generally suited to sprinkler irrigation.

The Britwater and Captina soils are suited to dwellings but have slight to moderate limitations for other buildings, roads, and other nonfarm uses. The Secesh and other included soils on flood plains have severe limitations for dwellings and most other nonfarm uses because of the flood hazard.

5. *Captina-Peridge association*

Moderately well drained and well drained, nearly level to gently sloping, deep, loamy soils on broad upland divides

This association is scattered over the western two-thirds of the county. The largest area is near U.S. Highway No. 71. The association is on broad, gently rolling upland divides. Slope ranges from 1 to 8 percent.

This association makes up about 7 percent of the county. Captina soils make up about 60 percent of the association, and Peridge soils 30 percent. The remaining 10 percent is mainly Cherokee, Johnsburg, Newtonia, and Tonti soils.

Captina soils are nearly level and are moderately well drained. They have a surface layer of very dark grayish-brown and brown silt loam. The upper part of the subsoil is strong-brown silty clay loam, and the lower part is a strong-brown, mottled, firm and brittle fragipan. The upper part of the fragipan is silty clay loam, and the lower part is cherty silty clay loam. The underlying material is chert bedrock that has mottled silty clay loam in fractures.

Peridge soils are nearly level to gently sloping and are well drained. They have a surface layer of brown silt loam. The upper part of the subsoil is red silty clay loam; the middle part is red, mottled silty clay loam and gravelly silty clay loam; and the lower part is red gravelly silty clay and yellowish-red, mottled silty clay.

Most of this association is used for pasture or meadow. Some areas are used for cultivated crops, vineyards, and orchards. Suited crops include corn, grain sorghum, winter small grain, truck crops,

apples, pears, peaches, and grapes. Under good management that includes practices to control erosion, this association is suited to cultivated crops. Where a water supply is available the association is suited to sprinkler irrigation. Most farms are 20 to 300 acres in size and are operated by the owners. Most operators of the smaller farms have jobs off the farm.

Some areas of this association are being developed for urban use.

The association has slight to moderate limitations for dwellings, other buildings, and roads and streets. Peridge soils generally have moderate limitations for septic tank absorption fields, but Captina soils have severe limitations because of a slow percolation rate.

6. *Linker-Enders-Mountainburg association*

Well-drained, gently sloping to steep, deep to shallow, stony and loamy soils on hills and mountains

This association is on isolated outliers of the Boston Mountains. Most areas are in the northeastern part of the county. A large part is federally administered; some areas are in the Ozark National Forest; and some are in the Pea Ridge National Military Park.

This association makes up about 2 percent of the county. Linker soils make up about 40 percent of the association, Enders soils 35 percent, and Mountainburg soils 15 percent. The remaining 10 percent is mainly Cane soils.

Linker soils are on the tops of hills and mountains. They have a surface layer of brown fine sandy loam. The upper part of the subsoil is yellowish-brown loam, the middle part is yellowish-red loam, and the lower part is yellowish-brown, mottled gravelly sandy clay loam. Sandstone bedrock is at a depth of 20 to 40 inches.

Enders soils are on side slopes and foot slopes. They are well drained and have a surface layer of very dark grayish-brown stony loam. The subsurface layer is dark grayish-brown stony loam. The upper part of the subsoil is yellowish-red silty clay loam; the middle part is red clay; and the lower part is red, mottled clay. Below this is weathered shale and yellowish-red, mottled clay. Shale bedrock is at a depth of 36 inches to 72 inches or more.

Mountainburg soils are on the top of hills and mountains. They have a surface layer of very dark grayish-brown gravelly sandy loam and a subsurface layer of brown gravelly sandy loam. The subsoil is yellowish-brown gravelly loam. Sandstone bedrock is at a depth of 12 to 20 inches. These soils are stony throughout the profile.

Some areas of this association are suited to cultivation, but others are too steep and too stony. Most of the areas are wooded, but some on mountaintops and foot slopes are cleared and used for pasture. Most wooded areas have stands of hardwood trees of poor quality. Most farms are 40 to 240 acres in size.

Some areas of this association are being developed for recreational or other nonfarm uses. The limitations are moderate to severe for dwellings and other buildings, roads and streets, and other nonfarm uses because of stoniness, slopes, shallow depth to bedrock, or slow percolation rate.

7. *Ventris-Sogn association*

Moderately well drained and somewhat excessively drained, moderately sloping to steep, moderately deep and shallow, stony and rocky soils on hillsides and foot slopes

This association is in the eastern part of the county. It is on hillsides and foot slopes around Beaver Reservoir. It is adjacent to and downslope from association 1. Slope ranges from 8 to 40 percent.

This association makes up about 2 percent of the county. Ventris soils make up about 48 percent of the area, and Sogn soils 15 percent. The remaining 37 percent is mainly Britwater, Clareson, Clarksville, Summit, and Waben soils and Limestone outcrop.

Ventris soils are on hillsides and foot slopes. These soils are moderately well drained. They have a surface layer of very dark grayish-brown cherty silt loam. The upper part of the subsoil is yellowish-brown clay, and the lower part is mottled silty clay. The underlying material is limestone bedrock. Many large stones are on the surface.

Sogn soils are intermingled with the Ventris soils, but they are dominantly on the less steep parts of the landscape and on points jutting into Beaver Reservoir. These soils are somewhat excessively drained. The soil material is very dark brown cobbly silt loam. Limestone bedrock is at a depth of 5 to 16 inches.

Most of this association is wooded. Most of the small cleared areas are idle or are used for nonfarm purposes. Many areas near Beaver Reservoir are undergoing lakeside development for recreation or housing. Other tracts are being held for such development. Several tracts are in federally administered public recreation areas.

This association has severe limitations for dwellings, other buildings, roads, and other nonfarm uses because of slope, shallow depth to bedrock, rockiness or stoniness, or the slow percolation rate.

Descriptions of the Soils

In this section the soils of Benton County are described in detail and their use and management are discussed. Each soil series is described in detail, and then, briefly, the mapping units 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 soil series is representative for mapping units in that series. If a

given mapping unit has a profile in some ways different from the one described in the series, these differences are stated in the description of the mapping unit, or they are apparent in the name of the mapping unit. Color terms are for moist soil unless otherwise stated. The description of each mapping unit contains suggestions on how the soil can be managed.

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

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit or other interpretative group in which the mapping unit has been placed. The page for the description of each range site 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 5. 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 (*12*).[2]

Britwater Series

The Britwater series consists of well-drained, gently sloping to moderately sloping soils on stream terraces. These soils formed in gravelly, loamy and clayey old alluvial sediment washed mainly from soils that formed in cherty limestone on uplands. The native vegetation was hardwood trees.

In a representative profile the surface layer is brown gravelly silt loam about 6 inches thick. The subsoil extends to a depth of 74 inches or more. The upper 16 inches is yellowish-red gravelly silty clay loam; the next 13 inches is yellowish-red, mottled gravelly silty clay loam; the next 25 inches is dark-red, mottled gravelly silty clay loam; and the lower part is yellowish-red, mottled gravelly silty clay.

Britwater soils have moderate fertility. Permeability is moderate, and available water capacity is medium. These soils respond well to fertilizer. Pebbles are a slight hinderance to tillage, but the soils can be tilled over a wide range of moisture content.

These soils are suited to most of the commonly grown crops if practices are used to control erosion and good management practices are used. Nearly all areas of these soils have been cultivated in the past, but most are now used for pasture and meadow. Some have been developed for nonfarm uses (fig. 3).

Representative profile of Britwater gravelly silt loam, 3 to 8 percent slopes, in a moist pasture, in SW¼NW¼NW¼ sec 20, T. 19 N., R. 30 W.:

Ap—0 to 6 inches, brown (10YR 4/3) gravelly silt loam; moderate, medium, granular structure; friable; some mixing of yellowish-red (5YR 4/6) silty clay loam from horizon below; many fine roots; about 15 percent, by volume, chert pebbles ⅛ inch to 2 inches in diameter; medium acid; abrupt, smooth boundary.

B21t—6 to 22 inches, yellowish-red (5YR 4/6) gravelly silty clay loam; moderate, medium, subangular blocky structure; firm; common fine roots; thin, patchy clay films on face of peds; about 20 percent, by volume, chert pebbles ⅛ inch to 2 inches in diameter; medium acid; clear, wavy boundary.

[2] Italic numbers in parentheses refer to Literature Cited, p. 81.

TABLE 5.—*Approximate acreage and proportionate extent of the soils*

Soil	Area	Extent	Soil	Area	Extent
	Acres	*Percent*		*Acres*	*Percent*
Britwater gravelly silt loam, 3 to 8 percent slopes	8,080	1.5	Mountainburg stony sandy loam, 12 to 40 percent slopes	770	0.1
Britwater gravelly silt loam, 8 to 12 percent slopes	640	.1	Newtonia silt loam, 1 to 3 percent slopes	2,950	.5
Cane loam, 3 to 8 percent slopes	1,000	.2	Nixa cherty silt loam, 3 to 8 percent slopes	91,870	16.9
Captina silt loam, 1 to 3 percent slopes	55,990	10.3	Nixa cherty silt loam, 8 to 12 percent slopes	40,860	7.5
Carytown silt loam	1,100	.2	Noark cherty silt loam, 8 to 12 percent slopes	2,900	.5
Cherokee silt loam	5,490	1.0	Noark cherty silt loam, 12 to 20 percent slopes	5,960	1.1
Clarksville cherty silt loam, 12 to 50 percent slopes	132,350	24.3	Noark cherty silt loam, 20 to 45 percent slopes	31,090	5.7
Elsah soils	16,050	3.0	Peridge silt loam, 1 to 3 percent slopes	11,150	2.1
Enders gravelly loam, 3 to 12 percent slopes	1,740	.3	Peridge silt loam, 3 to 8 percent slopes	12,710	2.3
Enders stony loam, 3 to 12 percent slopes	720	.1	Secesh gravelly silt loam, occasionally flooded	20,140	3.7
Enders stony loam, 12 to 30 percent slopes	2,020	.4	Sogn rocky silt loam, 12 to 40 percent slopes	990	.2
Fatima silt loam, occasionally flooded	1,680	.3	Sogn-Clareson complex, 8 to 20 percent slopes	1,460	.3
Healing silt loam	1,500	.3	Summit silty clay, 3 to 15 percent slopes, eroded	1,050	.2
Healing silt loam, occasionally flooded	5,970	1.1	Taloka silt loam, 0 to 1 percent slopes	8,920	1.6
Jay silt loam, 1 to 3 percent slopes	11,190	2.1	Tonti cherty silt loam, 3 to 8 percent slopes	45,360	8.3
Johnsburg silt loam	2,360	.4	Ventris stony silt loam, 15 to 40 percent slopes	5,660	1.0
Limestone outcrop	1,390	.3	Waben cherty silt loam, 3 to 8 percent slopes	4,040	.7
Linker fine sandy loam, 3 to 8 percent slopes	4,980	.9	Waben cherty silt loam, 8 to 12 percent slopes	940	.2
Mayes silty clay loam	740	.1			
Mountainburg stony sandy loam, 3 to 12 percent slopes	830	.2	Total	544,640	100.0

Figure 3.—**Golf course being constructed on Britwater gravelly silt loam, 3 to 8 percent slopes. The pebbles are a slight to moderate limitation for such use.**

B22t—22 to 35 inches, yellowish-red (5YR 4/6) gravelly silty clay loam; common, medium, distinct, brown (10YR 5/3) mottles; moderate, medium, subangular blocky structure; firm; common fine roots; continuous, thin clay films on face of peds; about 40 percent, by volume, chert pebbles ½ inch to 2 inches in diameter; strongly acid; clear, wavy boundary.

B23t—35 to 60 inches, dark-red (2.5YR 3/6) gravelly silty clay loam; common, medium, prominent, brown (10YR 5/3) mottles; moderate, fine, blocky structure; firm; few fine roots; continuous thin clay films on face of peds; about 50 percent, by volume, chert pebbles ½ inch to 2 inches in diameter; strongly acid; gradual, wavy boundary.

B24t—60 to 74 inches, yellowish-red (5YR 4/6) gravelly silty clay; common, medium, distinct, dark-red (2.5YR 3/6) and brown (10YR 5/3) mottles; moderate, fine, blocky structure; firm; continuous, thin clay films on face of peds; about 50 percent, by volume, chert pebbles ½ inch to 3 inches in diameter; strongly acid.

The B1 horizon, where present, is brown silt loam 3 to 7 inches thick. The B21t horizon is yellowish-red or red gravelly silt loam, gravelly silty clay loam, or gravelly clay loam. The B22t and B23t horizons are yellowish-red, red, or dark-red gravelly silty clay loam or gravelly clay loam. The B24t horizon is yellowish-red or red gravelly silty clay or gravelly silty clay loam. The gravel content, by volume, of the Ap horizon is 10 to 20 percent; of the B21t horizon is 15 to 30 percent; of the B22t horizon is 25 to 45 percent; of the B23t horizon is 35 to 60 percent; and of the B24t horizon is 35 to 70 percent. Reaction is medium acid or strongly acid throughout the profile.

Britwater soils are near Elsah, Peridge, Secesh, and Waben soils. They contain fewer coarse fragments than Elsah soils, and they have a B horizon, which Elsah soils lack. Britwater soils contain more coarse fragments than Peridge soils. They lack the thick, dark A horizon of Secesh soils, and they contain more clay in the B horizon. Britwater soils contain fewer coarse fragments and have a more clayey B horizon than Waben soils.

Britwater gravelly silt loam, 3 to 8 percent slopes (BtC).—This soil is on stream terraces. The areas range from about 5 to 40 acres in size. Included in mapping are spots of Elsah, Peridge, Secesh, and Waben soils. Also included are small eroded spots, narrow escarpments, and a few small areas of soils that have slopes of less than 3 percent.

This soil is suited to farming, but runoff is medium and the hazard of erosion is severe. If terraces and contour cultivation are used and the soil is otherwise well managed, clean-tilled crops that leave a large amount of residue can be safely grown year after year in the less sloping areas. Conservation treatment needs to be more intensive where slope length and gradient are greater.

This soil is used mainly for pasture or meadow. Some areas are cultivated. Suitable crops are corn, grain sorghum, winter small grain, and truck crops. Vineyards and fruit crops, such as apples, are suited to this soil. Suitable forage crops include bermudagrass, sorghum-sudangrass hybrids, tall fescue, white clover, and annual lespedeza. Capability unit IIIe–1; pasture and hayland group 8A; woodland group 3o7.

Britwater gravelly silt loam, 8 to 12 percent slopes (BtD).—This soil is on stream terraces. The areas range from about 5 acres to 15 acres in size. Included in mapping are spots of Waben soils, spots of eroded Britwater soils, small areas of soils that are less than 5 feet deep to bedrock, and narrow escarpments.

This soil is poorly suited to cultivated crops. Runoff is rapid, and the hazard of erosion is very severe. If contour cultivation is practiced and the soil is otherwise well managed, sown crops can be grown 1 year in 4 in a cropping system that includes close-growing cover plants the rest of the time.

This soil is used mainly for pasture or meadow. Suitable crops are small grain and sorghum-sudangrass hybrids. Suitable pasture plants are bermudagrass, tall fescue, white clover, and annual lespedeza. Capability unit IVe–1; pasture and hayland group 8A; woodland group 3o7.

Cane Series

The Cane series consists of moderately well drained, gently sloping upland soils on foot slopes. These soils formed in loamy colluvial material weathered from sandstone and shale uplands. The native vegetation was mixed hardwood trees.

In a representative profile the surface layer is brown loam about 5 inches thick. The subsoil extends to a depth of 68 inches or more. The upper 4 inches is yellowish-brown loam; the next 13 inches is strong-brown loam; the next 18 inches is a firm, brittle fragipan of mottled yellowish-brown clay loam; and the lower part is mottled red clay loam.

Cane soils have low fertility. Permeability is slow, and available water capacity is medium. The fragipan restricts root penetration and slows the movement of water through the soils. These soils respond well to fertilizer. They are easy to till and can be cultivated over a wide range of moisture content.

These soils are suited to farming. Most areas are cleared and were formerly cultivated, but nearly all are now used for pasture and meadow.

Representative profile of Cane loam, 3 to 8 percent slopes, in a moist pasture, in the SE¼NW¼SE¼ sec. 33, T. 17 N., R. 32 W.:

Ap—0 to 5 inches, brown (10YR 4/3) loam; moderate, fine and medium, granular structure; friable; many fine roots; about 3 percent, by volume, sandstone pebbles; medium acid; abrupt, smooth boundary.

B1—5 to 9 inches, yellowish-brown (10YR 5/4) loam; moderate, fine, subangular blocky structure; friable; few, thin, patchy clay films on faces of peds; about 3 percent, by volume, sandstone pebbles; medium acid; clear, wavy boundary.

B2t—9 to 22 inches, strong-brown (7.5YR 5/6) loam; moderate, fine and medium, subangular blocky structure; firm; common, thin and medium, clay films on face of peds; about 3 percent, by volume, sandstone pebbles; strongly acid; clear, wavy boundary.

Bx—22 to 40 inches, mottled yellowish-brown (10YR 5/4) and yellowish-red (5YR 5/6) clay loam; coarse, prismatic structure parting to moderate, medium, subangular blocky; firm; brittle; many thin and medium clay films on face of peds; prisms coated with light-gray (10YR 7/2) silt loam; common, medium, black concretions; about 3 percent, by volume, sandstone pebbles; very strongly acid; gradual, wavy boundary.

B3—40 to 68 inches, mottled red (2.5YR 4/6), yellowish-brown (10YR 5/6), and light-gray (10YR 7/2) clay loam; moderate, fine and medium, subangular blocky structure; firm; common, thin, patchy clay films on face of peds; few, fine, black concretions; about 5 percent, by volume, sandstone pebbles, increasing to about 10 percent below a depth of 54 inches; very strongly acid.

The content of coarse fragments is 2 to 10 percent, by volume, throughout the profile. The B2t horizon is strong-brown or yellowish-brown loam or clay loam. Depth to the Bx horizon is 18 to 26 inches. The Bx and B3 horizons are yellowish-red or red loam or clay loam mottled with yellowish brown or light gray, or mottled with about equal amounts of these colors. Depth to bedrock is 60 to more than 96 inches. Reaction is medium acid or strongly acid in the A and B1 horizons and strongly acid or very strongly acid below.

Cane soils are near Enders soils. They have a loamy, rather than clayey, B horizon, and they have a fragipan, which the Enders soils lack.

Cane loam, 3 to 8 percent slopes (CeC).—This soil is on colluvial foot slopes. The areas range from 5 to 50 acres in size. Included in mapping are spots of Enders soils, spots of gravelly and stony soils, spots of eroded soils, and small areas of soils that lack a fragipan.

This soil is suited to farming, but runoff is medium and the hazard of erosion is severe. If this soil is contour cultivated and terraced, clean-tilled crops that leave large amounts of residue can be safely grown on the less sloping areas year after year. Conservation practices need to be intensified as slope gradient increases.

This soil is used mainly for pasture or meadow. Suitable crops are corn, grain sorghum, winter small grain, and truck crops. Suited pasture plants are bermudagrass, tall fescue, white clover, and annual lespedeza. Capability unit IIIe–2; pasture and hayland group 8A; woodland group 3o7.

Captina Series

The Captina series consists of moderately well drained, nearly level soils on broad uplands and ridges, and on stream terraces. These soils formed in loamy material overlying cherty limestone or siltstone. The native vegetation was hardwood trees.

In a representative profile the surface layer is very dark grayish-brown and brown silt loam about 7 inches thick. The upper part of the subsoil is strong-brown silty clay loam about 14 inches thick. Below this is a firm, brittle fragipan about 27 inches thick. The upper 9 inches of the fragipan is strong-brown, mottled silty clay loam, and the lower part is strong-brown, mottled cherty silt clay loam. The underlying material is fractured chert that has strong-brown and yellowish-red silty clay loam in the cracks.

Captina soils have moderate fertility. Permeability is slow, and available water capacity is medium. The fragipan in the subsoil restricts root penetration and slows the movement of water through the soil. These soils respond well to fertilizer. They are easy to till and can be cultivated over a wide range of moisture content.

If practices are used to control erosion, these soils are well suited to cultivation. Most areas are cleared and used for pasture, meadow, vineyards, orchards, and a variety of cultivated crops.

Representative profile of Captina silt loam, 1 to 3 percent slopes, in a moist idle field in the SW¼SW¼SE¼ sec. 13, R. 33 W., T. 17 N.:

Ap1—0 to ½ inch, very dark grayish-brown (10YR 3/2) silt loam; moderate, medium, granular structure; very friable; many fine roots; few chert fragments; medium acid; abrupt, smooth boundary.

Ap2—½ inch to 7 inches, brown (10YR 5/3) silt loam; weak, medium, granular structure; friable; many fine roots; few chert fragments; medium acid; abrupt, smooth boundary.

B21t—7 to 21 inches, strong-brown (7.5YR 5/6) silty clay loam; moderate, medium, subangular blocky structure; friable; continuous thin clay films on face of peds and in pores; common fine roots; few tubular pores; common, fine, dark concretions; very strongly acid; clear, wavy boundary.

Bx1—21 to 30 inches, strong-brown (7.5YR 5/6) silty clay loam; coarse, prismatic structure parting to moderate, medium, subangular blocky; firm; brittle; prisms coated with gray (10YR 6/1) silt loam about ¼ inch thick; many thin and medium clay films on face of peds and in pores; few fine roots concentrated in gray prism coats; common tubular and vesicular pores; common, fine, dark concretions; few chert fragments; very strongly acid; clear, irregular boundary.

Bx2—30 to 48 inches, mottled strong-brown (7.5YR 5/6) and yellowish-red (5YR 4/8) cherty silty clay loam; coarse prismatic structure parting to moderate, fine, angular and subangular blocky; firm; brittle; prisms coated with gray (10YR 6/1) silt loam about ¼ inch; many medium clay films on face of peds and in pores; few roots concentrated in gray prism coats; few tubular and vesicular pores; common, fine, dark concretions; about 40 percent, by volume, chert fragments; very strongly acid; clear, wavy boundary.

R&B—48 to 58 inches, about 90 percent chert bedrock; cracks and crevices filled with strong-brown (7.5YR 5/6) and yellowish-red (5YR 4/8) silty clay loam; structure determined by shape of bedrock crevices; firm; continuous thin clay films on face of peds and lining rock crevice faces; very strongly acid.

The Ap1 horizon is very dark grayish brown or brown. The Ap2 horizon is brown or dark grayish brown. In many profiles the Ap horizon is a single layer. Some profiles have a B1 horizon of yellowish-brown or dark yellowish-brown silt loam that is 3 to 6 inches thick. The B2t horizon is yellowish-brown or strong-brown silt loam or silty clay loam. Depth to the Bx horizon ranges from 17 to 25 inches. The Bx1 horizon is yellowish-brown or strong-brown silt loam or silty clay loam. In some profiles it is mottled with gray and yellowish red. The Bx2 horizon is yellowish-brown or strong-brown silt loam, silty clay loam, cherty silt loam, or cherty silty clay loam that is mottled with gray and yellowish red. In some profiles a B3 horizon of yellowish-red and brown silty clay loam or cherty silty clay loam underlies the Bx horizon. Depth to cherty limestone or siltstone bedrock is 42 to 72 inches or more, and in most places the upper part contains red or brown clay to silty clay loam in cracks and fractures or as thin seams. The content of chert fragments in the Bx1 horizon is 0 to 20 percent, and in the Bx2 horizon it is 5 to 50 percent. The R&B horizon is 75 to 90 percent coarse fragments. Reaction in the Ap horizon is medium acid or strongly acid, and in the B horizon it is strongly acid or very strongly acid.

Captina soils are near Cherokee, Jay, Johnsburg, Nixa, Peridge, and Tonti soils. They lack the gray mottles in the upper part of the B horizon that is characteristic of Cherokee and Johnsburg soils, and they have more silt and less clay in the B horizon than Cherokee soils. They lack the thick dark A horizon of Jay soils. Captina soils contain fewer coarse fragments than the Nixa and Tonti soils. They are not so well drained as Peridge soils and have a fragipan, which the Peridge soils lack.

Captina silt loam, 1 to 3 percent slopes (CnB).—This soil is on broad uplands, ridges, and stream terraces. The areas range from about 10 to 100 acres in size. Included in mapping are spots of Cherokee, Johnsburg, Nixa, Peridge, and Tonti soils and a few spots of eroded soils. Areas of Nixa cherty silt loam that are ¼ acre to 2 acres in size are shown on the map by the symbol for chert. Areas of Johnsburg or Cherokee soils that are ¼ acre to 2 acres in size are shown on the map by the symbol for wet spot.

This soil is suited to farming, but runoff is slow to medium and the hazard of erosion is moderate. If contour cultivation and terraces are used, clean-tilled crops that leave large amounts of residue can be safely grown year after year.

This soil is used mainly for pasture and hay. Many tracts are used for cultivated crops, vineyards, and orchards. Suitable crops are corn, grain sorghum, winter small grain, truck crops (fig. 4), grapes, apples, pears, and peaches. Suited forage plants are bermudagrass, tall fescue (fig. 5), white clover, annual lespedeza, and sorghum-sudangrass hybrids. Capability unit IIe–1; pasture and hayland group 8A; woodland group 4o7.

Carytown Series

The Carytown series consists of poorly drained, level soils on flats within broad uplands. These soils formed in thin loamy deposits and the underlying clayey material. Native vegetation was scattered hardwoods and an understory of sedges and tall grasses.

In a representative profile the surface layer is very dark gray silt loam about 9 inches thick. The subsurface layer is mottled dark-gray and gray silt loam about 7 inches thick. The subsoil extends to a depth of 84 inches or more. The upper 2 inches is dark-gray, mottled silt loam; the next 9 inches is olive-gray, mottled clay; the next 33 inches is olive, mottled clay; and the lower part is light-gray, mottled clay.

Carytown soils have moderate fertility. Permeability is very slow, and available water capacity is medium. These soils respond fairly well to fertilizer. They are easy to till but are wet for long periods after rains.

These soils have a high content of sodium in the clayey subsoil, and this layer restricts root penetration. When they are drained and well managed, these soils are fairly suited to shallow-rooted crops. Most of the areas are used for pasture and meadow.

Figure 4.—**Green beans in an area of Captina silt loam, 1 to 3 percent slopes, for processing in local canneries.**

Representative profile of Carytown silt loam in a moist pasture, in the SE¼NE¼SE¼ sec. 27, T. 20 N., R. 34 W.:

A1—0 to 9 inches, very dark gray (10YR 3/1) silt loam; moderate, medium, granular structure; friable; many fine roots; medium acid; clear, wavy boundary.

A2g—9 to 16 inches, mottled dark-gray (10YR 4/1) and gray (10YR 5/1) silt loam; weak, fine, subangular blocky structure; friable; common fine roots; medium acid; abrupt, wavy boundary.

B1g—16 to 18 inches, dark-gray (10YR 4/1) silt loam; many, medium, distinct, olive-brown (2.5Y 4/4) mottles; moderate, fine, subangular blocky structure; firm; few fine roots; common, fine, dark concretions; slightly acid; abrupt, wavy boundary.

B21t—18 to 27 inches, olive-gray (5Y 4/2) clay; many, medium, distinct, olive (5Y 4/4) mottles; weak, prismatic structure parting to moderate, medium, subangular blocky; very firm; plastic; clay films or pressure faces on face of peds; gray silt coatings on some peds; slightly acid; gradual, wavy boundary.

B22t—27 to 49 inches, olive (5Y 5/3) clay; many, medium, distinct, light brownish-gray (10YR 6/2) mottles; moderate, medium, subangular blocky structure; very firm; plastic; clay films or pressure faces on face of peds; gray silt coatings on some peds; about 2 percent, by volume, fine chert pebbles; neutral; gradual, wavy boundary.

B23t—49 to 60 inches, olive (5Y 4/3) clay; many, medium, distinct, light-gray (10YR 6/1) mottles; weak, medium, subangular blocky structure; very firm; plastic; clay films or pressure faces on face of peds; about 10 percent, by volume, hollow nodules 1 to 2 inches in diameter; about 2 percent, by volume, fine chert pebbles; strongly alkaline; clear, wavy boundary.

B3tg—60 to 84 inches, light-gray (10YR 6/1) clay; many, coarse, prominent, olive (5Y 5/4) mottles; weak, fine and medium, subangular blocky structure; very firm; plastic; many, irregular, dark accretions; about 5 percent, by volume, fine chert pebbles; mildly alkaline.

The Ap or A1 horizon is very dark gray, very dark grayish brown, or dark grayish brown. The A2g horizon is dark gray, gray, light brownish gray, or grayish brown. The B1g horizon, where present, is silt loam or silty clay loam. The B2t horizon is olive, olive-gray, dark-gray, or gray clay or silty clay. Depth to bedrock is 72 to 120 inches or more. Reaction in the A horizon is medium acid or slightly acid, in the B1 horizon is medium acid to neutral, in the B21tg horizon is medium acid to strongly alkaline, and below this horizon is neutral to strongly alkaline.

These soils have silt coatings on peds in the upper part of the B2t horizon, which is outside the defined range of the series. This difference, however, does not alter their usefulness and behavior.

Carytown soils are near Cherokee and Taloka soils. They have a high content of exchangeable sodium in the B horizon, which is lacking in Cherokee and Taloka soils.

Carytown silt loam [Co].—This soil is in slight depressions on broad uplands. Slopes are less than 1 percent. The areas range from 20 to 100 acres in size. Included in mapping are a few spots of Cherokee and Taloka soils, a few areas that have low rounded mounds, and a few small slick spots where the clayey layer is exposed at the surface.

Figure 5.—**Tall fescue in area of Captina silt loam, 1 to 3 percent slopes. The grove of trees in the middle is on a spot of Johnsburg silt loam, which was included in mapping.**

This soil is only fairly suited to farming. Runoff is slow, and excess water is a severe hazard. Farming operations are delayed several days after rains unless surface drains are installed. Wetness and the high sodium content in the subsoil limit the choice of plants that can be grown. If this soil is adequately drained and otherwise well managed, clean-tilled crops that leave large amounts of residue can be safely grown year after year.

This soil is used mainly for pasture and meadow. Suitable crops include grain sorghum and sorghum-sudangrass hybrids. Winter small grain can be grown where surface drainage is adequate. Suited pasture plants are bermudagrass, tall fescue, white clover, and annual lespedeza. Capability unit IIIw-1; pasture and hayland group 8F; woodland group 5w6; Claypan Prairie range site.

Cherokee Series

The Cherokee series consists of somewhat poorly drained, level soils on broad uplands. These soils formed in thin loamy deposits and the underlying clayey material. The native vegetation was hardwood trees.

In a representative profile the surface layer is very dark grayish-brown and dark grayish-brown, mottled silt loam about 5 inches thick. The subsurface layer is grayish-brown and light brownish-gray, mottled silt loam about 9 inches thick. The subsoil extends to a depth of 84 inches or more. It is dark grayish-brown and grayish-brown, mottled clay and silty clay.

Cherokee soils have low fertility. Permeability is very slow, and available water capacity is high. These soils respond fairly well to fertilizer. They are easy to till but are wet for long periods following rains. The clayey subsoil restricts root penetration.

If they are drained and well managed, these soils are suitable for cultivated crops. Most of the areas are used for pasture or meadow, but some are used for nonfarm purposes (fig. 6).

Representative profile of Cherokee silt loam in a moist pasture, in the SE¼NE¼SE¼ sec. 14, T. 18 N., R. 34 W.:

A11—0 to 1 inch, very dark grayish-brown (10YR 3/2) silt loam; many, medium, distinct, grayish-brown (10YR 5/2) mottles; weak, medium, granular structure; friable; many fine roots; many fine pores; many, fine, dark concretions; strongly acid; abrupt, smooth boundary.

A12—1 to 5 inches, dark grayish-brown (10YR 4/2) silt loam; many, fine, faint, dark yellowish-brown mottles; weak, coarse, platy structure; firm; many fine roots; many, fine, tubular pores; common, fine, dark concretions; very strongly acid; clear, smooth boundary.

A21g—5 to 11 inches, grayish-brown (10YR 5/2) silt loam; many, coarse, distinct, yellowish-brown (10YR

Figure 6.—**A housing development in an area of Cherokee silt loam, a soil that has severe limitations for such use because of wetness and low bearing capacity.**

5/6) mottles; weak, coarse, subangular blocky structure; friable; common fine roots; many tubular and few vesicular pores; few, fine, dark concretions; very strongly acid; clear, smooth boundary.

A22g—11 to 14 inches, light brownish-gray (10YR 6/2) silt loam; many, coarse, distinct, yellowish-brown (10YR 5/4) mottles; massive; firm; few fine roots; many vesicular pores; common, medium, dark concretions; few fine, chert pebbles; strongly acid; abrupt, smooth boundary.

B21t—14 to 44 inches, dark grayish-brown (10YR 4/2) clay; common, coarse, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, coarse, angular blocky structure; plastic; few roots; few tubular pores; few, thin, patchy clay films on face of peds; upper 3 inches has few, fine, dark concretions; light-gray silt coatings on peds; very strongly acid; gradual, smooth boundary.

B22t—44 to 54 inches, dark grayish-brown (10YR 5/2) mottles and common, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; few, small, dark-gray clay masses; weak, medium, subangular blocky structure; firm; few tubular pores; few fine chert fragments; common, thin, patchy clay films on face of peds; strongly acid; gradual, wavy boundary.

B23t—54 to 66 inches, dark grayish-brown (2.5Y 4/2) silty clay; common, medium, distinct, dark yellowish-brown (10YR 4/4) mottles and common, medium, faint, grayish-brown (10YR 5/2) mottles; weak, medium, subangular blocky structure; firm; few, fine, tubular pores; few fine chert pebbles; continuous, thin to medium clay films on face of peds; tongues of mottled gray and brown silty clay loam 3 inches or less across; strongly acid; gradual, wavy boundary.

B3—66 to 84 inches, grayish-brown (2.5Y 5/2) clay; many, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; massive; very firm; few, fine, tubular pores; strongly acid.

The A1 horizon is very dark grayish brown or dark grayish brown. Where present, the Ap horizon is dark grayish brown or grayish brown. The A2g horizon is grayish brown or light brownish gray mottled with yellowish brown or brown. Depth to the B2t horizon is 12 to 18 inches. The B2t horizon is dark gray or dark grayish brown mottled with grayish brown, yellowish brown, dark yellowish brown, or red. The B21t horizon is clay or silty clay, and the lower part of the B2 horizon is silty clay or silty clay loam. The B3 horizon is grayish-brown or light brownish-gray clay to silty clay loam that is mottled with shades of brown. Depth to bedrock is more than 6 feet. Reaction is strongly acid to very strongly acid throughout the profile, but in limed areas the Ap horizon is medium acid to slightly acid.

Cherokee soils are near Captina, Carytown, Johnsburg, Taloka, and Tonti soils. They are more poorly drained and are grayer than Captina and Tonti soils, and their B horizon contains more clay. They lack the high content of sodium in the B horizon that is characteristic of Carytown soils. Cherokee soils have more clay in the B horizon than Johnsburg soils, and they lack the fragipan of those soils. They lack the thick, dark A horizon of the Taloka soils.

Cherokee silt loam (Cs).—This soil is in slight depressions on broad uplands. Slopes are less than 1 percent. The areas range from about 5 to 25 acres in

size. Included in mapping are a few spots of Captina, Carytown, Johnsburg, Taloka, and Tonti soils.

This soil is fairly suited to farming. Runoff is slow, and excess water is a severe hazard. Farming operations are delayed several days after rains unless surface drains are installed. If this soil is adequately drained and otherwise well managed, clean-tilled crops that leave large amounts of residue can be safely grown year after year.

This soil is used mainly for pasture and meadow. Suitable crops are grain sorghum and sorghum-sudangrass hybrids (fig. 7). Winter small grain can be grown where surface drainage is adequate. Suited pasture plants are bermudagrass, tall fescue, white clover, and annual lespedeza. Capability unit IIIw–1; pasture and hayland group 8F; woodland group 5w6; Claypan Prairie range site.

Clareson Series

The Clareson series consists of well-drained, moderately sloping to moderately steep soils, mainly on the foot slopes of hills around Beaver Reservoir. These soils formed in material weathered from limestone or dolomite. The native vegetation was hardwood and cedar trees.

In a representative profile the surface layer is very dark grayish-brown silt loam about 9 inches thick. The upper part of the subsoil is dark-red clay about 6 inches thick. The middle part of the subsoil is reddish-brown clay about 5 inches thick, and the lower part is mottled clay about 6 inches thick. Beneath this is limestone bedrock. Stones are throughout the profile.

Clareson soils have high fertility. Permeability is slow, and available water capacity is low.

These soils are unsuited to cultivated crops. They are suited to pasture, but surface stones make pasture management difficult. Most of the areas are wooded or are idle. Many tracts are being developed for recreation, homesites, and other nonfarm uses. A large part of the acreage is federally administered. In this survey area, Clareson soils are mapped only in a complex with Sogn soils.

Representative profile of Clareson silt loam, in Sogn-Clareson complex, 8 to 20 percent slopes, in a moist, wooded area, in the SE¼SE¼SE¼ sec. 13, T. 20 N., R. 28 W.:

A1—0 to 9 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, medium, granular structure; friable; many fine and medium roots; many fine pores; 50 percent, by volume, chert and limestone

Figure 7.—Sorghum-sudangrass hybrids produce large amounts of forage on Cherokee silt loam.

fragments ½ inch to 3 feet in diameter; neutral; gradual, smooth boundary.

B21t—9 to 15 inches, dark-red (2.5YR 3/6) clay; moderate, fine, angular blocky structure; firm; plastic; continuous clay films or pressure faces on peds; common fine roots; few medium pores; 50 percent, by volume, limestone and chert fragments ½ inch to 18 inches in diameter; slightly acid; clear, smooth boundary.

B22t—15 to 20 inches, reddish-brown (5YR 5/4) clay; many, coarse, faint, strong-brown (7.5YR 5/6) mottles; moderate, fine, angular blocky structure; firm; plastic; continuous clay films or pressure faces on peds; few fine pores; many, fine, dark concretions; black coatings on some ped faces; 30 percent, by volume, chert and limestone fragments ½ inch to 18 inches in diameter; neutral; clear, smooth boundary.

B23t—20 to 26 inches, mottled reddish-brown (5YR 5/4), light olive-brown (2.5Y 5/4), and light brownish-gray (10YR 6/2) clay; moderate, medium, subangular blocky structure; firm; plastic; continuous clay films or pressure faces on peds; few fine roots; 50 percent, by volume, limestone fragments 1 to 18 inches in diameter; few, fine, dark concretions; neutral; abrupt, irregular boundary.

R—26 inches, limestone bedrock.

The A1 horizon is very dark brown, dark brown, or very dark grayish brown. The B21t horizon is dark-red, yellowish-red, or dark reddish-brown stony or cherty clay or silty clay. The B22t and B23t horizons are reddish brown or dark reddish brown. They lack mottling in many profiles. Texture is stony or cherty clay or silty clay. Limestone and chert fragments make up 35 to 70 percent of the mass, by volume. Reaction is slightly acid to mildly alkaline throughout the profile. Depth to bedrock is 20 to 30 inches.

In this survey area, reaction in more than half of these soils is slightly higher than is defined as within the range of the series, but this difference does not alter the usefulness and behavior of the soils.

Clareson soils are near Sogn, Summit, and Ventris soils. They are deeper over bedrock than Sogn soils and have a B horizon, which those soils lack. They have more coarse fragments in the B horizon, have less clay in the A horizon, and are shallower to bedrock than Summit soils. Clareson soils have more coarse fragments and less mottling in the B horizon than Ventris soils.

Clarksville Series

The Clarksville series consists of excessively drained, moderately steep to steep soils on hillsides. These soils formed in residuum derived from very cherty limestone. The native vegetation was hardwoods or mixed hardwood and pine trees.

In a representative profile the surface layer is dark grayish-brown cherty silt loam about 1 inch thick. The subsurface layer is pale-brown cherty silt loam about 23 inches thick. The subsoil extends to a depth of 72 inches or more. The upper part is yellowish-brown cherty silt loam about 16 inches thick, and the lower part is weathered chert beds with yellowish brown silt loam in cracks and crevices.

Clarksville soils have low fertility. Permeability is moderately rapid. Because of the high content of chert, available water capacity is low and the soils are droughty (fig. 8).

Figure 8.—**A high content of chert in Clarksville soils causes these soils to be droughty.**

These soils are better suited to pasture, range, woodland, or wildlife habitat than to most other uses. Most of the areas are cutover woodland, but some tracts are used for pasture or for range.

Representative profile of Clarksville cherty silt loam, 12 to 50 percent slopes, in a moist wooded area, in the NW¼SE¼SE¼ sec. 5, T. 19 N., R. 29 W.:

O1—½ inch to 0, hardwood leaves and twigs.

A1—0 to 1 inch, dark grayish-brown (10YR 4/2) cherty silt loam; weak, medium, granular structure; very friable; many fine and medium roots; about 70 percent, by volume, angular chert fragments; strongly acid; abrupt, smooth boundary.

A2—1 to 24 inches, pale-brown (10YR 6/3) cherty silt loam; moderate, medium, granular structure; friable; many fine and medium roots; about 50 percent, by volume, angular chert fragments; strongly acid; gradual, wavy boundary.

B21t—24 to 40 inches, yellowish-brown (10YR 5/4) cherty silt loam; moderate, medium, blocky structure determined by spacing of chert fragments; friable; many roots; common thin clay films in pores and few patchy clay films on face of peds; about 75 percent, by volume, angular chert fragments; very strongly acid; clear, wavy boundary.

B22t—40 to 72 inches, weathered chert beds; cracks and crevices filled with yellowish-brown (10YR 5/4) silt loam that makes up about 10 percent of volume; structure determined by chert spacing; friable; patchy clay films on face of chert; few roots; very strongly acid.

The A1 horizon is very dark grayish brown or dark grayish brown. The A2 horizon is grayish brown, brown, or pale brown. Some profiles have a B1 horizon of brown or yellowish-brown cherty silt loam that is 5 to 15 inches thick. The B21t horizon is yellowish-brown or strong-brown cherty silt loam or cherty silty clay loam. It is mottled with brown or pale brown in some profiles. The B22t horizon is beds of partly weathered chert with yellowish-brown or strong-brown silt loam or silty clay loam in cracks, crevices, and fractures. In some profiles the soil material in the B22t horizon is red clay or silt clay. The B22t horizon grades into cherty limestone bedrock at depths below 72 inches. Depth to the B22t horizon is 36 to 60 inches or more. The chert content of the A and B21t horizons is 50 to 80 percent, and of the B22t horizon is 75 to 90 percent. The A1 horizon is medium acid or strongly acid, and the A2 and B horizons are strongly acid or very strongly acid.

Clarksville soils are near Nixa, Noark, and Waben soils. They lack the fragipan of Nixa soils. They contain less clay and more silt in the B horizon than Noark soils. Clarksville soils have lower base saturation in the B horizon than Waben soils.

Clarksville cherty silt loam, 12 to 50 percent slopes (CvF).—This moderately steep to steep soil is on hillsides. The areas range from about 20 to 500 acres in size. Included in mapping are a few spots of Nixa, Noark, and Waben soils; very narrow flood plains of Elsah soils; a few small rock outcrops; and small spots where cherty limestone bedrock is within 3 feet of the surface.

This soil is unsuited to cultivation. Slopes and the high content of chert fragments severely restrict the use of farm equipment. Moderately steep areas are fairly suited to pasture, and steep areas are poorly suited. The soil is better suited to pasture, range, wildlife habitat, or woodland than to most other uses.

Most areas are wooded, but some have been cleared and are used for pasture or range. Suitable pasture plants are bermudagrass, tall fescue, white clover, and annual lespedeza. Capability unit VIIs–1; pasture and hayland group 8H; woodland group 4f9; Chert Hills range site.

Elsah Series

The Elsah series consists of somewhat excessively drained, level to nearly level soils on narrow flood plains. These soils formed in sediment washed from predominantly cherty upland soils (fig. 9). The native vegetation was hardwood trees.

In a representative profile the surface layer is dark-brown cherty silt loam about 7 inches thick. The underlying material is brown cherty silt loam that extends to a depth of 60 inches or more.

Elsah soils have low fertility. Permeability is moderately rapid. Because of the high content of coarse fragments, available water capacity is low, but deep-rooted plants absorb seepage water. These soils respond moderately to fertilizer.

Elsah soils are only fairly to poorly suited to row crops because of droughtiness and the variable flood hazard. These soils are better suited to pasture or woodland than to most other uses. Most areas have been cleared, but some remain in woodland.

Representative profile of Elsah cherty silt loam, in a moist wooded area of Elsah soils, in the SE¼NW¼NE¼ sec. 1, T. 19 N., R. 34 W.:

A1—0 to 7 inches, dark-brown (10YR 3/3) cherty silt loam; moderate, fine, granular structure; friable; about 75 percent, by volume, chert fragments; many fine and medium roots; medium acid; abrupt, wavy boundary.

C—7 to 60 inches, brown (10YR 4/3) cherty silt loam; weak, fine, granular structure; friable; about 75 percent, by volume, chert fragments; very faintly stratified; many fine and medium roots; slightly acid.

The A horizon is very dark grayish brown, dark brown, or very dark brown. Texture is cherty silt loam or very cherty silt loam. The C horizon is brown or yellowish brown. Content of coarse fragments ranges from 40 to 85 percent throughout the profile. Some profiles have thin strata of silt loam, and others have thin strata of gravel. Depth to bedrock is 60 to 96 inches or more. Reaction is slightly acid or medium acid throughout the profile.

Elsah soils are adjacent to Britwater, Healing, Secesh, and Waben soils. They lack the B horizon of those soils. They also have more coarse fragments than the Britwater, Healing, and Secesh soils.

Elsah soils (Eg).—This undifferentiated group is on flood plains of small streams. Slope is 0 to 3 percent. The areas are long and narrow, and they range from 10 to 100 acres in size. Elsah soils have a surface layer of both cherty and very cherty silt loam. Included in mapping are small spots of Britwater, Healing, Secesh, and Waben soils and areas of a soil that is similar to Elsah soils but has a thick, dark-colored surface layer. Narrow overflow channels and gravel bars are also included.

This unit is poorly suited to fairly well suited to farming. The high content of coarse fragments hinders the use of tillage equipment. Most areas are flooded either occasionally or frequently for very brief periods, commonly in winter and in spring. The fre-

Figure 9.—**Elsah soils are on narrow flood plains that meander among wooded hills where soils, such as Clarksville cherty silt loam, 12 to 50 percent slopes, have formed. The Elsah soils formed in sediments washed from these hills, and they have a high content of chert.**

quency of flooding varies from one area to another and often within the same tract. In areas that flood occasionally, clean-tilled, warm-season crops that leave large amounts of residue can be safely grown in most years. Frequently flooded areas are generally unsuitable for tilled crops.

This unit is used mainly for pasture or meadow. Suitable crops are corn, grain sorghum, and such truck crops as green beans and tomatoes. Suited forage plants are bermudagrass, tall fescue, annual lespedeza, white clover, and sorghum-sudangrass hybrids. Occasionally flooded part, capability unit IIIw–2; frequently flooded part, capability unit Vw–1; pasture and hayland group 2A; woodland group 3f8.

Enders Series

The Enders series consists of well-drained, gently sloping to steep uplands soils on sides of hills, mountains, and knolls. These soils formed in a thin layer of loamy material and the underlying clayey material that has weathered from shale. The native vegetation was hardwood trees or mixed hardwoods and pines.

In a representative profile the surface layer is very dark grayish-brown loam about 4 inches thick and the subsurface layer is dark grayish-brown loam about 3 inches thick. These layers are stony. The upper 4 inches of the subsoil is yellowish-red silty clay loam; the middle 17 inches is red clay and the lower part is red, mottled clay that extends to a depth of about 33 inches. Beneath this is about 15 inches of soft, weathered shale and yellowish-red, mottled clay. Shale bedrock is at a depth of 48 inches.

Enders soils have low fertility. The surface layer is thin, and root penetration into the subsoil is restricted. Permeability is very slow, and available water capacity is high. These soils respond fairly well to fertilizer.

These soils are generally unsuited to cultivation. They are better suited to pasture, wildlife habitat, and woodland than to most other uses. About one-third of the acreage is cleared, and the rest is woodland.

Representative profile of Enders loam in a moist, wooded area of Enders stony loam, 12 to 30 percent slopes, in the SE¼SW¼SE¼ sec. 33, T. 17 N., R. 32 W.:

A1—0 to 4 inches, very dark grayish-brown (10YR 3/2) loam; moderate, fine, granular structure; friable; 45 percent, by volume, sandstone fragments ¼ inch to 12 inches in diameter; medium acid; abrupt, smooth boundary.

A2—4 to 7 inches, dark grayish-brown (10YR 4/2) loam; moderate, fine, granular structure; friable; 30 percent, by volume, sandstone fragments ¼ inch

to 12 inches in diameter; strongly acid; clear, wavy boundary.

B1—7 to 11 inches, yellowish-red (5YR 4/6) silty clay loam; weak, medium, subangular blocky structure; friable; 10 percent, by volume, sandstone fragments ¼ inch to 4 inches in diameter; strongly acid; clear, wavy boundary.

B21t—11 to 28 inches, red (2.5YR 4/6) clay; moderate, fine and medium, angular blocky structure; continuous, thick clay films on face of peds; very firm; plastic; very strongly acid; clear, wavy boundary.

B22t—28 to 33 inches, red (2.5YR 4/6) clay; common, medium, prominent, pale-brown (10YR 6/3) mottles; very firm; plastic; weak, fine, angular blocky structure; many medium and thick clay films on face of peds; very strongly acid; gradual, wavy boundary.

C—33 to 48 inches, about 70 percent soft, partly weathered clay shale and 30 percent yellowish-red (5YR 5/6) clay; many, medium, prominent, light brownish-gray (10YR 6/2) mottles; platy rock structure relict of shale beds; very firm; very strongly acid; clear, wavy boundary.

R—48 inches, black shale bedrock.

The A1 horizon is dark-brown or very dark grayish-brown loam that is gravelly or stony. The A2 horizon is brown to dark grayish-brown loam that is gravelly or stony. In cultivated areas there is an Ap horizon, 4 to 7 inches thick, of brown loam that is gravelly or stony. The B1 horizon is yellowish-brown, strong-brown, or yellowish-red loam or silty clay loam. The B21t horizon is yellowish-red or red silty clay or clay. The B22t horizon is yellowish-red or red clay or clay mottled with shades of brown and gray. The C horizon is silty clay or clay. Depth to shale bedrock is 40 to 60 inches or more. Reaction is medium acid or strongly acid in the A horizon and strongly acid or very strongly acid below.

Enders soils are near Cane, Linder, and Mountainburg soils. They have more clay in the B horizon than any of the associated soils, and they are underlain by shale rather than sandstone, as are the Linker and Mountainburg soils. They lack the fragipan horizon of Cane soils.

Enders gravelly loam, 3 to 12 percent slopes (EnD).—This gently sloping to moderately sloping soil is on knolls and toe slopes of hills. The areas range from about 10 to 30 acres in size. This soil has a profile similar to the one described as representative of the series, but it is gravelly rather than stony in the surface and subsurface layers. Included in mapping are a few spots of Cane, Linker, and Mountainburg soils; eroded spots that have rills and shallow gullies in the surface layer; and spots where shale bedrock is less than 24 inches below the surface.

This soil is poorly suited to cultivated crops. Runoff is rapid, and the hazard of erosion is very severe. Sown crops can be safely grown occasionally in a cropping system that includes close-growing cover plants most of the time. The soil is better suited to pasture or range, wildlife habitat, and woodland than to most other crops. Suited pasture plants are bermudagrass, tall fescue, and annual lespedeza. Capability unit IVe–2; pasture and hayland group 8C; woodland group 4o1; Clay Break, Shale, range site.

Enders stony loam, 3 to 12 percent slopes (EoD).—This gently sloping to moderately sloping soil is on knolls and toe slopes of hills and mountains. The areas range from 10 to 40 acres in size. Included in mapping are a few spots of Cane soils, spots where shale bedrock is less than 24 inches below the surface, shale outcrops, and spots of limestone outcrop.

This soil is unsuitable for cultivated crops. Runoff is rapid, and the hazard of erosion is severe. This soil is better suited to pasture or range, wildlife habitat, and woodland than to most other uses. Suited pasture plants are bermudagrass, tall fescue, and annual lespedeza. Capability unit VIs–1; pasture and hayland group 8K; woodland group 4x2; Clay Break, Shale, range site.

Enders stony loam, 12 to 30 percent slopes (EoF).—This moderately steep to steep soil is on hillsides and mountainsides. The areas range from about 20 to 200 acres in size. This soil has the profile described as representative of the series. Included in mapping are a few spots of Mountainburg soils, shale outcrop, sandstone ledges, and spots of a well-drained soil that has a loamy subsoil.

This soil is unsuited to cultivation and is poorly suited to pasture. Runoff is rapid, and the hazard of erosion is very severe. This soil is better suited to woodland or to wildlife habitat than to most other uses. A few small areas are cleared and used for pasture. Surface stones and the slopes make pasture management difficult. Suited pasture plants are bermudagrass, tall fescue, and annual lespedeza. Capability unit VIIs–2; pasture and hayland group 8D; woodland group 4x2; Clay Break, Shale, range site.

Fatima Series

The Fatima series consists of moderately well drained, level soils on flood plains. These soils formed in sediment washed from material weathered from predominantly limestone, cherty limestone, and siltstone uplands. The native vegetation was bottom-land hardwoods.

In a representative profile the surface layer is dark-brown and very dark grayish-brown silt loam about 12 inches thick. The subsoil extends to a depth of 68 inches or more. The upper 20 inches is brown, mottled silt loam; the middle 16 inches is light brownish-gray, mottled silt loam; and the lower part is dark yellowish-brown, mottled silt loam.

Fatima soils have high fertility. Permeability is moderate, and available water capacity is high. These soils respond well to fertilizer and are easy to till.

This soil is suited to farming, but most tracts are subject to occasional flooding. Nearly all of the areas have been cleared and are used mainly for pasture and meadow.

Representative profile of Fatima silt loam, occasionally flooded, in a moist pasture in the SW¼SW¼NW¼ sec. 20, T. 19 N., R. 30 W.:

Ap—0 to 8 inches, dark-brown (10YR 3/3) silt loam; common, fine, faint, dark grayish-brown mottles; strong, medium, granular structure; very friable; few, fine, chert pebbles; many fine roots; medium acid; abrupt, smooth boundary.

A1—8 to 12 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, medium, granular structure; friable; common roots and wormcasts; medium acid; gradual, wavy boundary.

B1—12 to 32 inches, brown (10YR 5/3) silt loam; many, medium, distinct, light brownish-gray (10YR 6/2) and dark yellowish-brown (10YR 4/4) mottles; weak and moderate, fine, subangular blocky structure; friable; common, fine, dark concretions; com-

mon wormcasts; slightly acid; gradual, wavy boundary.

B21tg—32 to 48 inches, light brownish-gray (10YR 6/2) silt loam; many, coarse, distinct, dark yellowish-brown (10YR 4/4) mottles; moderate, medium, subangular blocky structure; friable; few, patchy clay films on face of peds; many, fine, dark concretions; few, fine, chert pebbles; few wormcasts; slightly acid; clear, wavy boundary.

B22t—48 to 68 inches, dark yellowish-brown (10YR 4/4) silt loam; many, coarse, distinct, gray (10YR 6/1) mottles; weak, medium, subangular blocky structure; firm; few patchy clay films on face of peds; many, fine, dark concretions; about 5 percent, by volume, chert pebbles; slightly acid.

The Ap and A1 horizons are dark brown or very dark grayish brown. The B1 horizon is brown or dark grayish brown. Mottles range from few to many. The B21tg horizon is light brownish gray, dark gray, or grayish brown mottled with shades of gray and brown. The B22t horizon is dark yellowish-brown, yellowish-brown, or light brownish-gray silt loam or silty clay loam mottled with shades of gray or brown. In some profiles the B22t horizon is gravelly. Depth to bedrock is more than 60 inches. Reaction is medium acid to slightly acid throughout the profile.

More than half of these soils have a very weakly expressed B horizon of clay accumulation and are therefore outside the defined range of the series, but this difference does not alter the usefulness and behavior of the soils.

Fatima soils are near Healing and Secesh soils. They are more poorly drained than Healing and Secesh soils, and they have gray mottles in the upper part of the B horizon. Fatima soils have fewer coarse fragments than Secesh soils.

Fatima silt loam, occasionally flooded (Ft).—This soil is on flood plains of the larger creeks and rivers. Slopes are less than 1 percent. The areas range from about 5 to 30 acres in size. Included in mapping are a few spots of Healing and Secesh soils. Also included are narrow overflow channels and small, poorly drained spots where the soils are gray throughout.

This soil is suited to farming. It is flooded occasionally for very brief periods in winter or in spring. If this soil is well managed, clean-tilled, warm-season crops that leave large amounts of residue can be grown year after year.

This soil is used mainly for meadow and pasture. Suitable crops are corn, grain sorghum, and truck crops. Winter small grain can be grown, but the crops are subject to damage by floods in some years. Suited forage plants are bermudagrass, johnsongrass, tall fescue, sorghum-sudangrass hybrids, and white clover. Capability unit IIw–1; pasture and hayland group 2A; woodland group 2o7.

Healing Series

The Healing series consists of well-drained, level to nearly level soils on flood plains and low terraces. These soils formed in local sediment washed from soils predominantly of limestone and cherty limestone uplands. The native vegetation was bottom-land hardwoods.

In a representative profile the surface layer is very dark grayish-brown silt loam about 15 inches thick. The subsoil extends to a depth of 68 inches or more. The upper 12 inches is brown silt loam; the next 23 inches is reddish-brown silt loam; and the lower part is reddish-brown, mottled gravelly silt loam.

Healing soils have high fertility. Permeability is moderate, and available water capacity is high. These soils respond well to fertilizer. They are easy to till and can be cultivated over a wide range of moisture content.

Most tracts are subject to occasional flooding. Other tracts are subject to rare flooding. Nearly all the acreage has been cleared and is used for pasture and meadow or is cultivated.

Representative profile of Healing silt loam, in a moist pasture, in the SW¼SW¼NE¼ sec. 32, T. 17 N., R. 33 W.:

A1—0 to 15 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, medium, granular structure; friable; about 1 percent sandstone and chert pebbles; many fine roots; medium acid; clear, wavy boundary.

B21t—15 to 27 inches, brown (7.5YR 4/4) silt loam; weak, fine and medium, subangular blocky structure; friable; thin, patchy clay films on face of peds and in pores; many fine roots; many, fine and medium, tubular pores; medium acid; gradual, wavy boundary.

B22t—27 to 50 inches, reddish-brown (5YR 4/4) silt loam; moderate, fine and medium, subangular blocky structure; firm; common, thin, patchy clay films on face of peds and in pores; few fine roots; many fine and medium tubular pores; about 1 percent, by volume, sandstone and chert pebbles; medium acid; clear, wavy boundary.

B23t—50 to 68 inches, reddish-brown (5YR 4/4) gravelly silt loam; common, medium, distinct, yellowish-brown (10YR 5/4) and pale-brown (10YR 6/3) mottles; weak, medium, subangular blocky structure; firm; continuous clay films in pores; thin, patchy clay films on face of peds; few fine roots; many, medium and coarse, tubular and vesicular pores; few, soft, dark accretions; about 20 percent, by volume, chert and sandstone pebbles; medium acid.

The A1 horizon is dark brown or very dark grayish brown. Some profiles have a B1 horizon of reddish-brown or dark-brown silt loam that is 4 to 8 inches thick. The B21t horizon is brown, reddish brown, or dark brown. The B22t and B23t horizons are brown or reddish brown. In some profiles the B23t horizon lacks mottling. The gravel content in and below the B23t horizon ranges from about 5 to 45 percent, by volume. In the horizons above the B23t horizon, the gravel content ranges from 0 to about 5 percent. Depth to bedrock is more than 5 feet. Reaction is slightly acid to medium acid throughout the profile.

Healing soils are near Elsah, Fatima, Secesh, and Waben soils. They have fewer coarse fragments in the upper part of the profile than Elsah, Secesh, and Waben soils. Healing soils lack the gray mottles in the B horizon that are characteristic of Fatima soils.

Healing silt loam (He).—This level to nearly level soil is on low terraces along the larger streams. Slope ranges from 0 to 2 percent. The areas are 10 to 80 acres in size. This soil has the profile described as representative of the series. Included in mapping are spots of Elsah, Secesh, and Waben soils; small areas of soils that are occasionally subject to overflow; and very narrow strips of soils that have slopes up to 4 percent.

This soil is well suited to farming and is easy to till. It is subject to flooding for very brief periods in winter and in spring, but flooding is rare. If this soil is well managed, clean-tilled crops that leave large amounts of residue can be safely grown year after year.

Most of the acreage is used for pasture, meadow, and other forage crops or for such cultivated crops as corn, grain sorghum, and truck crops. Winter small grain is suited, but the crop is subject to damage by flooding in some years. Suited forage plants are alfalfa, bermudagrass, johnsongrass, sorghum-sudangrass hybrids, tall fescue, red clover, and white clover. Capability unit I–1; pasture and hayland group 2A; woodland group 2o7.

Healing silt loam, occasionally flooded (Hf).—This soil is on flood plains of the larger creeks and rivers. Slope is 0 to 2 percent. The areas are long and narrow and range from 20 to 200 acres in size. Included in mapping are small spots of Elsah, Fatima, Secesh, and Waben soils. Also included are narrow overflow channels, small areas of soils that are frequently subject to overflow, and areas of soils that contain more sand than this soil throughout the profile.

This soil is suited to farming. It is occasionally flooded for very brief periods, generally in winter and in spring. If this soil is well managed, clean-tilled warm-season crops that leave large amounts of residue can be grown year after year.

This soil is used mainly for pasture or meadow. Suitable crops are corn, grain sorghum, and truck crops. Winter small grain can be grown, but the crop is subject to damage by floods in some years. Suited forage plants are alfalfa, bermudagrass (fig. 10), johnsongrass, tall fescue, sorghum-sudangrass hybrids, and white clover. Capability unit IIw–1; pasture and hayland group 2A; woodland group 2o7.

Jay Series

The Jay series consists of moderately well drained, nearly level soils on broad uplands. These soils formed in loamy material overlying cherty limestone or siltstone. The native vegetation was tall prairie grasses.

In a representative profile the surface layer is very dark grayish-brown silt loam about 11 inches thick. The upper part of the subsoil is yellowish-brown silty clay loam about 11 inches thick. The middle part, about 32 inches thick, is a firm, brittle fragipan. Its upper 14 inches is yellowish-brown, mottled silty clay loam, and its lower 18 inches is yellowish-brown, mottled silt loam. The lower part of the subsoil is yellowish-brown, mottled gravelly silt loam that extends to a depth of about 62 inches. Below this is siltstone bedrock.

Figure 10.—**Angus cattle grazing Midland bermudagrass on Healing silt loam, occasionally flooded.**

Jay soils have moderate fertility. Permeability is slow, and available water capacity is medium. These soils respond well to fertilizer. They are easy to till and can be cultivated over a wide range of moisture content.

If erosion control measures are used, these soils are well suited to cultivation. Most areas are used for pasture, meadow, or other forage crops, but some areas are cultivated.

Representative profile of Jay silt loam, 1 to 3 percent slopes, in a moist pasture, in the NW¼SW¼NW¼ sec. 5, T. 20 N., R. 30 W.:

A1—0 to 11 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, medium, granular structure; friable; many fine roots; slightly acid; clear, wavy boundary.

B2t—11 to 22 inches, yellowish-brown (10YR 5/4) silty clay loam; few, fine, distinct, strong-brown mottles; moderate, medium, subangular blocky structure; firm; few, thin, patchy clay films on face of peds; strongly acid; clear, wavy boundary.

Bx1—22 to 36 inches, yellowish-brown (10YR 5/4) silty clay loam; common, medium, prominent, yellowish-red (5YR 4/8) mottles; coarse, prismatic structure parting to moderate, medium, blocky; firm; brittle; prisms coated with light brownish-gray (10YR 6/2) silt loam about ¼ inch thick; common, thin, patchy clay films on faces of peds; common vesicular pores lined with clay; strongly acid; gradual, wavy boundary.

Bx2—36 to 54 inches, yellowish-brown (10YR 5/4) silt loam; common, medium, prominent, yellowish-red (5YR 4/8) mottles; coarse, prismatic structure parting to moderate, medium, blocky; firm; brittle, prisms coated about ¼ inch thick with light brownish gray (10YR 6/2); common, thin, patchy clay films on face of peds; common vesicular pores lined with clay; few fine concretions; 2 percent, by volume, siltstone fragments; strongly acid; clear, wavy boundary.

B3t—54 to 62 inches, yellowish-brown (10YR 5/4) gravelly silt loam; common, medium, distinct, light brownish-gray (10YR 6/2) mottles and common, medium, prominent, yellowish-red (5YR 4/8) mottles; weak, fine, subangular blocky structure; firm; common, thin clay films lining pores; 25 percent, by volume, siltstone fragments ⅛ inch to 3 inches in diameter; strongly acid; abrupt, wavy boundary.

R—62 inches, brown siltstone.

The A1 or Ap horizon is dark brown, very dark grayish brown, or very dark brown. The B2t horizon is yellowish-brown or strong-brown silt loam or silty clay loam. Depth to the Bx horizon is 18 to 28 inches. The Bx horizon is yellowish-brown or strong-brown silt loam or silty clay loam mottled with light brownish gray, gray, and yellowish red. In some profiles the Bx horizon is 15 to 40 percent coarse fragments, by volume. The B3t horizon is gravelly silt loam, gravelly silty clay loam, silt loam, or silty clay loam. Content of coarse fragments in the B3t horizon is 5 to 40 percent, by volume. Depth to siltstone or cherty limestone bedrock is 54 to 84 inches or more. Reaction is slightly acid or medium acid in the A horizon and strongly acid or very strongly acid in the B horizon.

Jay soils are near Captina, Mayes, and Taloka soils. They have a darker, thicker A horizon that contains more organic matter than Captina soils. They are better drained and not so gray as Mayes and Taloka soils. Jay soils have less clay throughout the profile than Mayes soils, have less clay in the B horizon than Taloka soils, and they have a fragipan that Mayes and Taloka soils lack.

Jay silt loam, 1 to 3 percent slopes (JaB).—This soil is in broad areas on uplands. The areas range from 15 to 400 acres in size. Included in mapping are small spots of Captina, Mayes, and Taloka soils, a few spots of soils that have a gravelly surface, and a few small areas of soils that have slopes steeper than 3 percent.

This soil is well suited to farming, but runoff is medium and the hazard of erosion is moderate. If this soil is contour cultivated, terraced on long slopes, and otherwise well managed, clean-tilled crops that leave large amounts of residue can be safely grown year after year.

This soil is used mainly for pasture and meadow. Suitable crops are corn, grain sorghum, winter small grain, truck crops, vineyards, and orchards. Suited forage plants are bermudagrass, tall fescue, orchardgrass, sorghum-sundangrass hybrids, white clover, and annual lespedeza. Capability unit IIe–1; pasture and hayland group 8A; woodland group 4o7; Loamy Prairie range site.

Johnsburg Series

The Johnsburg series consists of somewhat poorly drained, level soils on broad uplands and on stream terraces. These soils formed in loamy material over cherty limestone, siltstone, or fine-grained sandstone bedrock. The native vegetation was hardwood trees.

In a representative profile the surface layer is grayish-brown, mottled silt loam about 8 inches thick. The subsoil extends to a depth of 72 inches or more. The upper 14 inches is yellowish-brown, mottled silty clay loam. The next 34 inches is a firm, brittle fragipan that is light brownish-gray, mottled silty clay loam in the upper 9 inches and gray, mottled silty clay loam in the lower 25 inches. Below the fragipan is yellowish-brown, mottled gravelly silty clay loam.

Johnsburg soils have low fertility. Permeability is very slow, and available water capacity is medium. The fragipan in the subsoil restricts root penetration and slows the movement of water through the soil. These soils respond well to fertilizer. They are easy to till, but they contain excess water during periods of seasonally high rainfall.

If they are drained and well managed, these soils are suited to most crops grown in the county. Most of the areas are used for pasture or meadow.

Representative profile of Johnsburg silt loam, in a moist pasture, in the NE¼SE¼SW¼ sec. 23, T. 19 N., R. 30 W.:

Ap—0 to 8 inches, grayish-brown (10YR 5/2) silt loam; common, medium, distinct, brown (10YR 4/3) mottles; moderate, medium, subangular blocky structure; friable; many fine roots; common fine, dark concretions; few fine pebbles; strongly acid; abrupt, smooth boundary.

B2t—8 to 22 inches, yellowish-brown (10YR 5/4) silty clay loam; common, medium, distinct, light brownish-gray (10YR 6/2) mottles; moderate, medium, subangular blocky structure; firm; common, thin, patchy clay films on face of peds; common fine roots; strongly acid; clear, wavy boundary.

Bx1g—22 to 31 inches; light brownish-gray (10YR 6/2) silty clay loam; many, medium, distinct, yellowish-brown (10YR 5/4) mottles and few, medium, prominent, yellowish-red (5YR 4/6) mottles; moderate, coarse, prismatic structure parting to fine subangular blocky; firm; brittle; common, thin, patchy clay films on face of peds; prisms coated with grayish-brown (10YR 5/2) silt loam; few fine

pebbles; few, fine, dark concretions; strongly acid; clear, irregular boundary.

Bx2g—31 to 43 inches, gray (N 6/0) silty clay loam; many, medium, prominent, yellowish-brown (10YR 5/8) mottles; moderate, medium and coarse, subangular blocky structure; firm; brittle; many, thin and medium, patchy clay films on face of peds; common fine pebbles; strongly acid; clear, wavy boundary.

Bx3g—43 to 56 inches, gray (N 6/0) silty clay loam; many, medium, prominent, strong-brown (7.5YR 5/6) and yellowish-brown (10YR 5/4) mottles; moderate, medium and coarse, subangular blocky structure; firm; brittle; many, thin and medium, patchy clay films on face of peds; about 10 percent, by volume, fine pebbles; strongly acid; gradual, wavy boundary.

B3t—56 to 72 inches, yellowish-brown (10YR 5/6) gravelly silty clay loam; many, medium and coarse, distinct, light-gray (10YR 6/1) mottles; weak, fine, subangular blocky structure; firm; common, thin, patchy clay films on face of peds; about 30 percent, by volume, fine pebbes; strongly acid.

The Ap horizon is dark grayish brown, grayish brown, or brown. Some profiles have a B1 horizon of mottled yellowish-brown and grayish-brown silt loam that is 4 to 7 inches thick. The B2t horizon is silt loam or silty clay loam. Mottles are light brownish gray or grayish brown. Depth to the Bx horizon is 18 to 28 inches. The Bx horizon is light brownish-gray or gray silt loam or silty clay loam. The B3t horizon is gravelly silty clay loam or silty clay. The B3t horizon is 10 to 40 percent pebbles, by volume. In many profiles the B3t horizon is lacking, and the Bx horizon extends to a depth of 72 inches or more. Depth to bedrock is 6 to 8 feet or more. Reaction is medium acid or strongly acid in the A horizon and strongly acid or very strongly acid in the B horizon.

Johnsburg soils are near Cherokee, Captina, and Tonti soils. They are more poorly drained than Captina and Tonti soils and have mottling in the upper part of the B horizon that those soils lack. Johnsburg soils contain less clay in the B horizon than Cherokee soils, and they have a fragipan that those soils lack.

Johnsburg silt loam [Jo].—This soil is in broad areas on uplands and on stream terraces. Slopes are less than 1 percent. The areas range from 5 to 30 acres in size. Included in mapping are a few spots of Captina, Cherokee, and Tonti soils; a few small areas of soils that have slopes up to 3 percent; and a few small areas of soils that have low, rounded mounds scattered over the surface.

This soil is suited to cultivated crops if it is drained and well managed. Runoff is slow to very slow, and wetness is a severe limitation. Farming operations are delayed several days after a heavy rain unless surface drains are installed. If this soil is adequately drained and otherwise well managed, clean-tilled crops that leave large amounts of residue can be safely grown year after year.

This soil is used mainly for pasture and meadow. Suitable crops are grain sorghum and sorghum-sudangrass hybrids. Suited pasture plants are bermudagrass tall fescue, white clover, and annual lespedeza. Capability unit IIIw–3; pasture and hayland group 8F; woodland group 4w8.

Limestone Outcrop

Limestone outcrop [Lm] is made up of limestone outcrops, limestone ledges, and talus. Most areas are 5 to 15 acres in size. Slope ranges from about 12 to 40 percent, but the ledges are nearly verticle bluffs 25 to 80 feet high. At the top of the ledges are the limestone outcrops, which are 35 to 100 feet wide and moderately steep. At the base are the areas of talus, which are 50 to 100 feet wide and moderately steep or steep. The talus is made up mainly of limestone boulders and slabs 1 to 20 feet in diameter. It is less than 5 percent very dark brown, neutral silt loam or silty clay loam. Included in mapping are spots of Sogn and Clareson soils and spots where the soil material is less than 4 inches thick over the limestone.

Runoff is very rapid, and available water capacity is very low. This mapping unit is very droughty except in seep spots at the base of bluffs. Most areas support little vegetation other than lichens and other such plants. The included spots of soils support scattered redcedar and other drought-resistant trees and a sparse understory of native grasses. Trees such as redcedar, elm, and oak grow fairly well on the seep spots. Capability unit VIIIs–1.

Linker Series

The Linker series consists of well-drained, gently sloping soils on mountaintops and broad areas of uplands. These soils formed in loamy material weathered from sandstone. The native vegetation was hardwood trees or mixed hardwoods and pines.

In a representative profile the surface layer is brown fine sandy loam about 6 inches thick. The upper part of the subsoil is yellowish-brown loam about 3 inches thick. The middle part, about 10 inches thick, is yellowish-red loam. The lower part is yellowish-brown, mottled gravelly sandy clay loam that extends to a depth of about 26 inches. Below is sandstone bedrock.

Linker soils have low fertility. Permeability is moderate, and available water capacity is medium. The soils respond fairly well to well to fertilizer. The surface layer is easy to till and can be cultivated over a wide range of moisture content.

If erosion control measures are used, these soils are suitable for cultivation. Most areas are cleared and were formerly cultivated, but they are now used mainly for pasture and meadow.

Representative profile of Linker fine sandy loam, 3 to 8 percent slopes, in a moist, idle field, in the NW¼NE¼SE¼ sec. 26, T. 21 N., R. 29 W.:

Ap—0 to 6 inches, brown (10YR 4/3) fine sandy loam; moderate, medium, granular structure; friable; many fine roots; 10 percent, by volume, sandstone fragments ¼ inch to 3 inches in diameter; strongly acid; abrupt, smooth boundary.

B1—6 to 9 inches, yellowish-brown (10YR 5/4) loam; moderate, fine, subangular blocky structure; friable; common fine roots; 10 percent, by volume, sandstone fragments ¼ inch to 3 inches in diameter; strongly acid; abrupt, wavy boundary.

B2t—9 to 19 inches, yellowish-red (5YR 5/6) loam; moderate, fine, subangular blocky structure; firm, common, thin, patchy clay films on face of peds; few fine roots; 10 percent, by volume, sandstone fragments ¼ inch to 3 inches in diameter; strongly acid; clear, wavy boundary.

B3—19 to 26 inches, yellowish-brown (10YR 5/4) gravelly sandy clay loam; common, medium, distinct, pale-brown (10YR 6/3) mottles and common, medium, prominent, yellowish-red (5YR 5/6) mottles; weak,

fine, subangular blocky structure; friable; few, thin, patchy clay films on face of peds; 50 percent, by volume, sandstone fragments ½ inch to 4 inches in diameter; strongly acid; abrupt, wavy boundary.

R—26 inches, brown sandstone.

The content of coarse fragments in the Ap horizon ranges from 0 to 15 percent. The B1 horizon is yellowish-brown to reddish-brown loam or fine sandy loam. The B2t horizon is yellowish-red or red loam or clay loam. The B3 horizon is yellowish-red to yellowish-brown gravelly loam or gravelly sandy clay loam. Depth to bedrock ranges from 20 to 40 inches. Reaction is medium acid or strongly acid in the A horizon and strongly acid or very strongly acid in the B horizon.

Linker soils are near Enders and Mountainburg soils. They have more sand and less clay in the B horizon than Enders soils. Linker soils contain fewer sandstone fragments and are deeper over bedrock than Mountainburg soils.

Linker fine sandy loam, 3 to 8 percent slopes (LrC).—This soil is on mountaintops and in areas on uplands. The areas range from about 10 to 80 acres in size. Included in mapping are spots of Enders and Mountainburg soils, eroded spots of soils that have rills and shallow gullies in the surface layer, small spots of soils that have a gravelly or stony surface layer, and a few spots of soils that have more silt and less sand in the subsoil than this soil. A few small areas of soils are deeper than 40 inches over bedrock.

This soil is suited to farming, but runoff is medium and the hazard of erosion is severe. If this soil is contour cultivated, terraced, and otherwise well managed, clean-tilled crops that leave large amounts of residue can be safely grown on the less sloping areas year after year. Conservation practices need to be intensified as slope increases.

This soil is used mainly for pasture or meadow. Some areas are idle. Suitable crops are corn, grain sorghum, winter small grain, and truck crops. Suitable pasture plants are bermudagrass, tall fescue, white clover, and annual lespedeza. Capability unit IIIe–2; pasture and hayland group 8A; woodland group 4o1; Loamy Upland range site.

Mayes Series

The Mayes series consists of somewhat poorly drained, level soils in slight depressions in broad areas on uplands and stream terraces. The soils formed in a thin layer of loamy alluvial material and the underlying clayey material. The native vegetation was scattered hardwood trees and an understory of tall grasses.

In a representative profile the surface layer is very dark brown, mottled silty clay loam about 11 inches thick. The subsoil extends to a depth of 72 inches or more. The upper 17 inches is very dark brown, mottled silty clay and clay; the middle 30 inches is gray, mottled clay; and the lower part is gray, mottled silty clay.

Mayes soils have high fertility and organic matter content. When dry, these soils shrink and crack; and when wet, they expand and the cracks seal. Permeability is very slow, but when the soils crack, water enters rapidly until the cracks seal. Available water capacity is high. These soils respond well to fertilizer. They are somewhat difficult to till and can be tilled only within a narrow range of moisture content. They are wet for long periods after rains.

If they are drained and well managed, these soils are suitable for farming. Most of the areas are used for pasture or meadow.

Representative profile of Mayes silty clay loam, in a moist pasture, in the SW¼SW¼SW¼ sec. 30 T. 18 N., R. 33 W.:

Ap—0 to 11 inches, very dark brown (10YR 2/2) silty clay loam; few, medium, faint, grayish-brown (10YR 5/2) mottles; weak, fine, subangular blocky structure; firm; many fine roots; many pores; slightly acid; gradual, wavy boundary.

B21t—11 to 19 inches, very dark brown (10YR 2/2) silty clay; many, medium, faint, dark-brown (10YR 4/3) mottles; weak, fine, subangular blocky structure; firm; plastic; common fine roots; few pores; common, fine dark concretions; slightly acid; gradual, wavy boundary.

B22t—19 to 28 inches, very dark brown (10YR 2/2) clay; many, medium, faint, dark-brown (10YR 4/3) mottles; moderate, medium, angular blocky structure; firm; plastic; common fine roots; few pores; thin, continuous clay films or pressure face on peds; common, fine, dark concretions; slightly acid; gradual, wavy boundary.

B23tg—28 to 58 inches, gray (5Y 5/1) clay; many, coarse, prominent, yellowish-brown (10YR 5/8) mottles; weak, coarse, angular blocky structure; firm; plastic; few fine roots; few pores; thin, patchy clay films or pressure face on peds; common, fine, dark concretions; few, fine, chert fragments; common slickensides several inches wide that do not intersect; neutral; gradual, wavy boundary.

B24tg—58 to 72 inches, gray (10YR 5/1) silty clay; many, coarse, distinct, yellowish-brown (10YR 5/8) and very dark grayish-brown (10YR 3/2) mottles; weak, medium, subangular blocky structure; firm; plastic; few fine roots; few pores; thin, patchy clay films or pressure face on peds; common dark concretions; few, fine, chert fagments; neutral.

The Ap or A1 horizon is very dark brown, very dark gray, or very dark grayish brown. The B21t and B22t horizons are very dark brown to dark-gray silty clay or clay mottled with shades of brown or gray. The B23tg and B24tg horizons are dark-gray or gray silty clay or clay. Depth to bedrock is more than 72 inches. Reaction is slightly acid to mildly alkaline throughout the profile.

Mayes soils are near Jay and Taloka soils. They are less acid than those soils. They have more clay throughout the profile than Jay soils and more clay in the A horizon than Taloka soils.

Mayes silty clay loam (Mo).—This soil is in slight depressions in broad areas on uplands and in low areas on stream terraces. Slopes are less than 1 percent. The areas range from 10 to 80 acres in size. Included in mapping are a few spots of Jay and Taloka soils. Also included are a few small areas of soils that have low, rounded mounds and a few spots that have a surface layer of silt loam.

This soil is suited to cultivated crops, but runoff is very slow, and wetness is a moderate to severe limitation. Farming operations are commonly delayed several days after rains unless surface drains are installed. If this soil is adequately drained and otherwise well managed, clean-tilled crops that leave large amounts of residue can be safely grown year after year.

This soil is used mainly for pasture and meadow. Suitable crops are grain sorghum and sorghum-sudangrass hybrids. Suited pasture plants are bermudagrass, tall fescue, white clover, and annual lespedeza. Capability group IIw–2; pasture and hayland group 8F; woodland group 5w6; Claypan Prairie range site.

Mountainburg Series

The Mountainburg series consists of well-drained, gently sloping to steep soils. Most areas are on the top of hills and mountains. These soils formed in stony, loamy material weathered from sandstone. The native vegetation was mixed hardwood trees.

In a representative profile the surface layer is very dark grayish-brown gravelly sandy loam about 3 inches thick. The subsurface layer is brown gravelly sandy loam about 3 inches thick. The subsoil is yellowish-brown gravelly loam about 13 inches thick, overlying sandstone bedrock. The soil is stony throughout the profile.

Mountainburg soils have low fertility. Permeability is moderately rapid, available water capacity is low, and the soils are droughty. The soils respond poorly to fertilizer. They are shallow to bedrock.

Mountainburg soils are unsuited to tilled crops. Stones on the surface and moderately steep to steep slopes in some areas severely restrict the use of farm equipment. These soils are better suited to pasture or range, woodland, or wildlife habitat than to most other uses. Most of the areas are in woodland of poor quality.

Representative profile of Mountainburg gravelly sandy loam in a moist, wooded area of Mountainburg stony sandy loam, 3 to 12 percent slopes, in the SE¼NE¼NE¼ sec. 14, T. 20 N., R. 28 W.:

A1—0 to 3 inches, very dark grayish-brown (10YR 3/2) gravelly sandy loam; strong, medium, granular structure; friable; many fine and medium roots; 40 percent, by volume, sandstone fragments ¼ inch to 14 inches in diameter; medium acid; clear, smooth boundary.

A2—3 to 6 inches, brown (10YR 4/3) gravelly sandy loam; moderate, medium, granular structure; friable; many fine and medium roots; 40 percent, by volume, sandstone fragments ¼ inch to 10 inches in diameter; very strongly acid; clear, smooth boundary.

B2t—6 to 19 inches, yellowish-brown (10YR 5/4) gravelly loam; moderate, fine, subangular blocky structure; friable; common, thin, patchy clay films on face of peds and on face of some coarse fragments; medium roots; 40 percent, by volume, sandstone fragments ¼ inch to 10 inches in diameter;

R—19 inches, brown sandstone.

The A1 horizon is very dark grayish brown or dark brown. In cultivated areas the Ap horizon is brown and is 4 to 7 inches thick. The B2t horizon is yellowish brown, brown, or strong brown. The content of coarse fragments ranges from 20 to 50 percent in the A horizon and from 35 to 70 percent in the B2t horizon. Depth to bedrock is 12 to 20 inches. Reaction is medium acid to very strongly acid in the A horizon and strongly acid or very strongly acid in the B horizon.

Mountainburg soils are near Enders and Linker soils. They are shallower to bedrock and contain more coarse fragments than Enders and Linker soils. They contain less clay in the B horizon than Enders soils and are underlain by sandstone rather than shale.

Mountainburg stony sandy loam, 3 to 12 percent slopes (MuD).—This soil is mainly on the top of hills and mountains. The areas range from about 5 to 40 acres in size. This soil has the profile described as representative of the series. Included in mapping are a few spots of Enders and Linker soils and outcrops of sandstone bedrock.

This soil is unsuitable for cultivation and is poorly suited to improved pasture. Surface stones limit the use of farm equipment, and the soil is droughty. This soil is better suited to native pasture or to wildlife habitat than to most other purposes. Many areas are used for pasture or are idle. The rest is in woodland of poor quality. Capability unit VIs–2; pasture and hayland group 14C; woodland group 5x3; Sandstone Ridge range site.

Mountainburg stony sandy loam, 12 to 40 percent slopes (MuE).—This soil is on hillsides and mountainsides. The areas range from about 5 to 20 acres in size. Included in mapping are small spots of Enders and Linker soils, sandstone ledges, and a few small areas of soils that have shale bedrock.

This soil is unsuited to cultivation or to improved pasture. Surface stones, rock ledges, and slope limit the use of farm equipment, and the soil is droughty. The soil is better suited to native pasture or wildlife habitat than to most other purposes. Most of this soil is in woodland of poor quality. Capability unit VIIs–3; pasture and hayland group 14B; woodland group 5x3; Sandstone Ridge range site.

Newtonia Series

The Newtonia series consists of well-drained, nearly level soils in broad areas on uplands. Thees soils formed in material weathered from fine-grained sandstone or limestone. The native vegetation was mainly hardwood trees, although some areas were tall grass prairie or in a prairie-forest transition.

In a representative profile the surface layer is dark-brown silt loam about 10 inches thick. The subsoil extends to a depth of 72 inches or more. The upper 7 inches is dark reddish-brown silt loam; the next 9 inches is red silty clay loam; the next 35 inches is dark-red silty clay loam; and the lower part is dark-red, mottled silty clay.

Newtonia soils have high fertility. Permeability is moderate, and available water capacity is high. These soils respond well to fertilizer. They are easy to till and can be cultivated over a wide range of moisture content.

If erosion control measures are installed, these soils are well suited to cultivation. Most areas are used for meadow or pasture, but a large acreage is cultivated.

Representative profile of Newtonia silt loam, 1 to 3 percent slopes, in a moist cultivated field, in the NW¼NE¼NE¼ sec. 28 T., 20 N., R. 34 W.:

Ap—0 to 6 inches, dark-brown (10YR 3/3) silt loam; moderate, fine and medium, granular structure; friable; fresh crop residue at lower boundary; neutral; abrupt, smooth boundary.

A1—6 to 10 inches, dark-brown (10YR 3/3) silt loam; moderate, medium, granular structure; friable;

common wormcasts; common fine roots; neutral; abrupt, smooth boundary.

B1—10 to 17 inches, dark reddish-brown (5YR 3/4) silt loam; moderate, fine, subangular blocky structure; friable; few thin, patchy clay films on face of peds; common wormcasts; neutral; clear, wavy boundary.

B21t—17 to 26 inches, red (2.5YR 4/6) silt clay loam; moderate, medium, subangular blocky structure; firm; common, thin, patchy clay films on face of peds; neutral; clear, wavy boundary.

B22t—26 to 61 inches, dark-red (2.5YR 3/6) silty clay loam; moderate, fine and medium, subangular and angular blocky structure; firm; many thin to thick clay films on face of peds; few fine pebbles; slightly acid; wavy boundary.

B23t—61 to 72 inches, dark-red (2.5YR 3/6) silty clay; common, medium, prominent, yellowish-brown (10YR 5/6) mottles; moderate, fine, subangular blocky structure; firm; many, thin to thick clay films on face of peds; common, small to medium, dark concretions; 10 percent, by volume, fine pebbles; medium acid.

The Ap or A1 horizon is very dark grayish brown or dark brown. The B1 horizon is dark reddish brown or reddish brown. The B2t horizon is yellowish red, red, or dark red. The B23t horizon is silty clay or silty clay loam. Depth to bedrock is more than 72 inches. Reaction is commonly medium acid to slightly acid throughout the profile, but in limed areas the A horizon and the upper part of the B horizon are slightly acid to neutral.

Newtonia soils are near Peridge soils. They have a dark, thick A horizon, which Peridge soils lack.

Newtonia silt loam, 1 to 3 percent slopes (Ne8).—This soil is in broad areas on uplands. The areas range from 20 to 400 acres in size. Included in mapping are a few spots of Peridge soils, small eroded spots, and a few areas of soils that have slopes of less than 1 percent.

This soil is well suited to farming, but runoff is medium, and the hazard of erosion is moderate if it is cultivated. If this soil is contour cultivated, terraced on long slopes, and otherwise well managed, clean-tilled crops that leave large amounts of residue can be safely grown year after year.

This soil is used mainly for meadow and pasture, but a large acreage is cultivated. Suitable crops are corn, grain sorghum, winter small grain, truck crops, grapes, apples, peaches, and pears. Suited forage crops are alfalfa, bermudagrass, tall fescue, sorghum-sudangrass hybrids, white clover, and annual lespedeza. Capability unit IIe–2; pasture and hayland group 8A; woodland group 3o7.

Nixa Series

The Nixa series consists of moderately well drained, gently sloping to moderately sloping soils on long, narrow ridgetops. These soils formed in material weathered from cherty limestone. The native vegetation was hardwood trees or mixed hardwood and pine trees.

In a representative profile the surface layer is very dark grayish-brown cherty silt loam about 3 inches thick. The upper part of the subsoil is brown cherty silt loam about 14 inches thick. The middle part is a firm, brittle fragipan. It is yellowish-brown, mottled cherty silt loam about 13 inches thick. The lower part is red clay that is in seams and fractures in the chert beds.

Nixa soils have low fertility. Permeability is very slow, and available water capacity is low. The fragipan layer restricts root penetration and slows the movement of water through the soils. These soils respond fairly well to fertilizer. They are difficult to till because of the high content of chert.

These soils are poorly suited to cultivated crops. Most areas that have been cleared are used chiefly for pasture or range. A large acreage is wooded (fig. 11). Several tracts of this soil have been developed for housing and other nonfarm uses.

Representative profile of Nixa cherty silt loam, 3 to 8 percent slopes, in a moist wooded area, in the NE¼SW¼SE¼ sec. 23, T. 21 N., R. 31 W.:

A1—0 to 3 inches, very dark grayish-brown (10YR 3/2) cherty silt loam; moderate, medium, granular structure; friable; 50 percent, by volume, chert fragments ¼ inch to 5 inches in diameter; medium acid; abrupt, wavy boundary.

B2—3 to 17 inches, brown (10YR 5/3) cherty silt loam; weak, fine, subangular blocky structure; friable; 50 percent, by volume, chert fragments ¼ inch to 5 inches in diameter; strongly acid; clear, wavy boundary.

Bx—17 to 30 inches, yellowish-brown (10YR 5/6) cherty silt loam; common, medium, distinct, light brownish-gray (10YR 6/2) mottles; moderate, fine, subangular blocky structure; firm; brittle; common, thin, patchy clay films in pores and on peds; 65 percent, by volume, chert fragments ¼ inch to 5 inches in diameter; strongly acid; clear, irregular boundary.

C&B2t—30 to 50 inches, bedded chert that is 15 percent red (2.5YR 4/6) clay in seams and fractures between beds; strong, angular, blocky structure; firm; continuous clay films on face of peds; very strongly acid.

The A1 horizon is very dark grayish brown or dark grayish brown. In cultivated areas the Ap horizon is brown or dark grayish brown. Some profiles have an A2 horizon of pale-brown or brown cherty silt loam 4 to 12 inches thick. The B2 horizon is brown, yellowish brown, or light yellowish brown. Depth to the Bx horizon is 14 to 24 inches. The Bx horizon is yellowish-brown or strong-brown cherty silt loam or cherty silty clay loam. Chert content of the A and B2 horizons is 35 to 70 percent, by volume. The Bx horizon has 40 to 80 percent chert. The C&B2t horizon is 10 to 25 percent yellowish red or red silty clay or clay in seams and fractures between chert beds. Chert bedrock is at a depth between 40 and 60 inches. Reaction is strongly acid or medium acid in the A1 or Ap horizon and strongly acid or very strongly acid in the A2 and B horizons.

Nixa soils are near Captina, Clarksville, Noark, and Tonti soils. They contain more coarse fragments than Captina and Tonti soils. They have a fragipan, which the Clarksville and Noark soils lack.

Nixa cherty silt loam, 3 to 8 percent slopes (NfC).—This soil is on ridgetops. The areas range from about 10 to 200 acres in size. This soil has the profile described as representative for the series. Included in mapping are spots of Captina, Clarksville, Noark, and Tonti soils and small areas of soils that have slopes of less than 3 percent.

Runoff is medium, and the hazard of erosion is moderate. The high content of coarse fragments is a severe limitation. The fragments make the soil droughty, and tillage operations are difficult. The root-

Figure 11.—A typical cutover woodland of mixed hardwood and pine trees on Nixa cherty silt loam, 3 to 8 percent slopes.

ing zone is shallow. The soil is poorly suited to cultivated crops. If this soil is contour cultivated and terraced and otherwise well managed, crops that leave large amounts of residue can be grown year after year in the less sloping areas. Conservation treatment needs to be intensified as slope length and gradient increase.

Grain sorghum and winter small grain are suitable crops. This soil is suited to vineyards. Suited pasture plants are bermudagrass, tall fescue, white clover, and annual lespedeza. Capability unit IIIs–1; pasture and hayland group 8G; woodland group 4f8; Chert Hills range site.

Nixa cherty silt loam, 8 to 12 percent slopes (NfD). —This soil is on ridgetops. The areas range from about 10 to 80 acres in size. Included in mapping are spots of Clarksville, Noark, and Tonti soils.

Runoff is medium to rapid, and the hazard of erosion is severe. The high content of coarse fragments is a severe limitation. The fragments make the soil droughty, and tillage operations are difficult. The rooting zone is shallow. These limitations, along with slope, make the soil unsuited to most crops. Sown crops that leave a large amount of residue can be grown occasionally in a cropping system that includes close-growing cover plants most of the time. Most areas are used for pasture, but many tracts are wooded.

Winter small grain is better suited than other crops. Suitable pasture plants are bermudagrass, tall fescue, white clover, and annual lespedeza. Capability unit IVs–1; pasture and hayland group 8G; woodland group 4f8; Chert Hills range site.

Noark Series

The Noark series consists of well-drained, moderately sloping to steep soils on hillsides and narrow ridgetops. These soils formed in material weathered from cherty limestone. The native vegetation was hardwood trees or mixed hardwood and pine trees.

In a representative profile the surface and subsurface layers, which have a combined thickness of 10 inches, are brown cherty silt loam. The subsoil extends to a depth of 72 inches or more. The upper part is yellowish-red cherty silty clay loam about 7 inches thick, and the lower part is red cherty and very cherty clay.

Noark soils have low fertility. Permeability is moderate, and available water capacity is medium. These soils respond moderately well to fertilizer. They are difficult to till because of the high content of chert.

These soils are poorly suited to tilled crops because of slope and the high chert content. Most of the areas are wooded, but some tracts are cleared and used for pasture.

Representative profile of Noark cherty silt loam, 12 to 20 percent slopes, in a moist wooded area, in the SE¼SE¼NW¼ sec. 27, T. 19 N., R. 28 W.:

A1—0 to 2 inches, brown (10YR 4/3) cherty silt loam; moderate, medium, granular structure; friable; many fine roots; 40 percent, by volume, angular chert fragments ⅛ inch to 3 inches in diameter; strongly acid; abrupt, smooth boundary.

A2—2 to 10 inches, brown (10YR 5/3) cherty silt loam; moderate, medium, subangular blocky structure; friable; many fine roots; 40 percent, by volume, angular chert fragments ⅛ inch to 3 inches in diameter; very strongly acid; clear, wavy boundary.

B1—10 to 17 inches, yellowish-red (5YR 4/6) cherty silty clay loam; pockets and streaks of brown (10YR 5/3) silt loam; moderate, medium, subangular blocky structure; friable; many fine roots; common fine pores coated with clay films; about 45 percent, by volume, chert fragments ⅛ inch to 3 inches in diameter; very strongly acid; clear, wavy boundary.

B21t—17 to 30 inches, red (2.5YR 4/6) cherty clay; strong, medium, subangular blocky structure; firm; common fine roots; common fine pores; about 45 percent, by volume, chert fragments ⅛ inch to 4 inches in diameter; continuous clay films on face of peds; patchy clay films on chert fragments; very strongly acid; gradual, wavy boundary.

B22t—30 to 72 inches, red (2.5YR 4/6) very cherty clay; strong, medium, subangular blocky structure; very firm; few fine roots; 70 percent, by volume, chert fragments ⅛ inch to 4 inches in diameter; continuous thick clay films on face of peds, patchy clay films on chert fragments; very strongly acid.

The A1 or Ap horizon is brown to very dark grayish brown. The A2 horizon is brown or pale brown. The B1 horizon is yellowish-red to yellowish-brown cherty silt loam or cherty silty clay loam. The B2t horizon is red, dark red, or yellowish red. It is cherty or very cherty, and the fine-earth fraction is clay or silty clay. Depth to chert bedrock is 60 inches or more. The content of chert fragments in the profile is 35 to 70 percent, by volume, in the A through the B21t horizons, and 50 to 85 percent in the B22t horizon. Reaction is very strongly acid to medium acid in the A horizon and extremely acid to strongly acid in the B horizon.

Noark soils are near Clarksville, Nixa, and Waben soils. They have a more clayey B horizon than the associated soils, and they lack the fragipan of Nixa soils.

Noark cherty silt loam, 8 to 12 percent slopes (NoD).—This soil is on narrow ridgetops and side slopes. The areas range from about 5 to 30 acres in size. Included in mapping are a few spots of Nixa and Clarksville soils.

This soil is suited to pasture but is poorly suited to cultivation because of the slopes. In addition, it is difficult to till. The high content of coarse fragments makes the soil somewhat droughty and difficult to manage. Sown crops can be safely grown occasionally in a cropping system that includes close-growing cover plants most of the time. Runoff is medium to rapid, and the hazard of erosion is severe.

Most areas of this soil are used for pasture (fig. 12), but some areas remain in woodland. Suited pasture plants are bermudagrass, tall fescue, white clover, and annual lespedeza. Capability unit IVe–3; pasture and hayland group 8A; woodland group 4f8; Chert Hills range site.

Noark cherty silt loam, 12 to 20 percent slopes (NoE).—This soil is on narrow ridgetops and hillsides. The areas range from about 10 to 40 acres in size. This soil has the profile described as representative for the series. Included in mapping are a few spots of Elsah, Clarksville, and Nixa soils.

This soil is unsuitable for cultivation. It is suited to pasture but is better suited to woodland or wildlife habitat.

About half of the acreage is in pasture, and the rest is wooded. Suited pasture plants are bermudagrass, tall fescue, white clover, and annual lespedeza. Capability unit VIe–1; pasture and hayland group 8B; woodland group 4f8; Chert Hills range site.

Noark cherty silt loam, 20 to 45 percent slopes (NoF).—This soil is on hillsides. The areas range from 10 to 100 acres in size. Included in mapping are a few spots of Clarksville, Elsah, Nixa, and Waben soils, a few small areas of limestone outcrop, and spots where bedrock is less than 60 inches deep.

This soil is unsuitable for cultivation. It is poorly suited to pasture because of steep slopes, but it is suited to woodland or to wildlife habitat.

Most areas are wooded, but a few small tracts are cleared and used for pasture. Suited pasture plants are bermudagrass, tall fescue, white clover, and annual lespedeza. Capability unit VIIe–1; pasture and hayland group 8B; woodland group 4r9; Chert Hills range site.

Peridge Series

The Peridge series consists of well-drained, nearly level to gently sloping soils in broad areas on uplands and on stream terraces. These soils formed in material weathered from limestone or siltstone or in material washed from uplands.

In a representative profile the surface layer is brown silt loam about 9 inches thick. The subsoil extends to a depth of 74 inches or more. The upper 17 inches is red silty clay loam; the next 16 inches is mottled red, dark-red, and pale-brown silty clay loam; the next 12 inches is red, mottled gravelly silty clay loam; the next 16 inches is red gravelly silty clay; and the lower part is yellowish-red, mottled silty clay.

Peridge soils have medium fertility. Permeability is moderate, and available water capacity is high. The soils respond well to fertilizer. The surface layer is easy to till and can be cultivated over a wide range of moisture content.

If erosion control measures are used these soils are suited to farming. Nearly all areas were formerly cultivated, but now many tracts are used for meadow and pasture.

Representative profile of Peridge silt loam, 1 to 3 percent slopes, in a moist orchard, in the SE¼SW¼SW¼ sec. 12, T. 18 N., R. 30 W.:

Ap—0 to 9 inches, brown (10YR 4/3) silt loam; moderate, medium, granular structure; friable; many fine and few medium roots; few dark concretions; medium acid; abrupt, smooth boundary.

B21t—9 to 26 inches, red (2.5YR 4/6) silty clay loam; moderate, fine and medium, subangular blocky structure; firm; continuous thin clay films on face of peds; few sandstone pebbles; strongly acid; clear, irregular boundary.

Figure 12.—**Ponds furnish water for livestock the year around on pastures growing on Noark cherty silt loam, 8 to 12 percent slopes.**

B22t—26 to 42 inches, mottled red (2.5YR 4/6), dark-red (2.5YR 3/6), and pale-brown (10YR 6/3) silty clay loam; moderate, fine and medium, angular and subangular blocky structure; firm; continuous thin clay films on face of peds; strongly acid; clear, wavy boundary.

B23t—42 to 54 inches, red (2.5YR 4/8) gravelly silty clay loam; common, medium, prominent, pale-brown (10YR 6/3) mottles; moderate, fine, subangular blocky structure; firm; continuous thin clay films on face of peds; about 25 percent, by volume, sandstone pebbles ½ inch to 3 inches in diameter; strongly acid; clear, wavy boundary.

B24t—54 to 60 inches, red (2.5YR 4/8) gravelly silty clay; moderate, medium, angular blocky structure; firm; continuous clay films on face of peds; about 20 percent, by volume, yellowish-brown weathered siltstone fragments; strongly acid; clear, wavy boundary.

B25t—60 to 74 inches, mottled yellowish-red (5YR 5/6) and light olive-brown (2.5Y 5/6) silty clay; moderate, medium, angular blocky structure; firm; continuous thick clay films on face of peds; strongly acid.

A B1 horizon of reddish-brown or strong-brown silt loam 3 to 6 inches thick is in some profiles. The B2t horizon is red or yellowish red. Horizons below the B21t horizon are mottled or variegated in shades of brown or red. The B24t and B25t horizons are silty clay loam or silty clay. In some profiles the B25t horizon is lacking. The gravel content of the A horizon through the B22t horizon is less than 5 percent, by volume. Below this, the gravel content ranges from 0 to 35 percent, by volume. Depth to bedrock is more than 60 inches. Reaction is slightly acid to strongly acid in the Ap horizon and strongly acid or very strongly acid in the B horizon.

Peridge soils are near Britwater, Captina, Newtonia, and Tonti soils. They have a lower content of coarse fragments than the Britwater soils. Peridge soils lack the fragipan of the Captina and Tonti soils, and they lack the thick, dark-colored A horizon of the Newtonia soils.

Peridge silt loam, 1 to 3 percent slopes (PeB).—This soil is in broad areas on uplands and on stream terraces. The areas are 10 to 150 acres in size. This soil has the profile described as representative for the series. Included in mapping are spots of Captina and Newtonia soils, small eroded spots, and a few small areas of soils in which slopes are steeper than 3 percent.

This soil is well suited to farming, but runoff is medium and the hazard of erosion is moderate. If this soil is contour cultivated, terraced on long slopes, and otherwise well managed, clean-tilled crops that leave large amounts of residue can be safely grown year after year.

This soil is used mainly for meadow and pasture, but a large acreage is used for cultivated crops, orchards, and vineyards. Suitable crops are corn, grain sorghum, winter small grain, and truck crops. Vineyards and such fruit crops as apples, peaches, and pears are suited to this soil (fig. 13). Suited forage crops are alfalfa, bermudagrass, tall fescue, sorghum-

Figure 13.—**Apple orchards are well suited to Peridge silt loam, 1 to 3 percent slopes.**

sudangrass hybrids, white clover, and annual lespedeza. Capability unit IIe–2; pasture and hayland group 8A; woodland group 3o7.

Peridge silt loam, 3 to 8 percent slopes (PeC).—This soil is in broad areas on uplands and on stream terraces. The areas are 10 to 30 acres in size. This soil has a profile similar to the one described as representative for the series, but the surface layer is a few inches thinner. Included in mapping are spots of Britwater, Captina, and Tonti soils, eroded spots, a few shallow gullies, small areas of soils that have a gravelly surface layer, and some areas of soils that are less than 60 inches deep over bedrock.

This soil is suited to farming, but runoff is medium, and the hazard of erosion is severe if it is cultivated. If this soil is contour cultivated, terraced, and otherwise well managed, clean-tilled crops that leave large amounts of residue can be safely grown in the less sloping areas year after year. Conservation measures must be intensified as slope gradient increases.

This soil is used mainly for pasture and meadow, but some tracts are cultivated or are used for orchards and vineyards. Suitable crops are corn, grain sorghum, winter small grain, and truck crops. Vineyards and such fruit crops as apples, peaches, and pears are suited to this soil. Suitable forage plants are alfalfa, bermudagrass, sorghum-sudangrass hybrids, tall fescue, white clover, and annual lespedeza. Capability unit IIIe–1; pasture and hayland group 8A; woodland group 3o7.

Secesh Series

The Secesh series consists of well-drained, level to nearly level soils on flood plains. These soils formed in gravelly, loamy sediment washed from predominantly cherty upland soils. The native vegetation was hardwood trees.

In a representative profile the surface layer is dark-brown gravelly silt loam about 10 inches thick. The subsoil is brown gravelly silt loam.

Secesh soils have moderate fertility. Permeability is moderate. Available water capacity is medium, but deep-rooted plants can absorb seepage water. These soils respond well to fertilizer. Gravel in the surface layer is a slight hindrance to tillage operations, and these soils can be cultivated over a wide range of moisture content.

Most tracts are subject to occasional flooding. Nearly all of the areas have been cleared and are used for pasture (fig. 14) and meadow or are cultivated.

Representative profile of Secesh gravelly silt loam, occasionally flooded, in a moist pasture, in the SW¼SW¼SE¼ sec. 19, T. 19 N., R. 31 W.:

A1—0 to 10 inches, dark-brown (10YR 3/3) gravelly silt loam; moderate, medium, granular structure; friable; many fine roots; about 15 percent, by volume, chert pebbles ¼ inch to 3 inches in diameter; medium acid; clear, wavy boundary.

B21t—10 to 24 inches, brown (10YR 4/3) gravelly silt loam; moderate, fine, subangular blocky structure; friable; common, thin, patchy clay films on face of

Figure 14.—**Black walnut trees produce both nuts and logs of high value. They supplement the income from this bermudagrass pasture on Secesh gravelly silt loam, occasionally flooded.**

peds; common fine roots; about 15 percent, by volume, chert pebbles ½ inch to 3 inches in diameter; medium acid; clear, wavy boundary.

B22t—24 to 44 inches, brown (10YR 4/3) gravelly silt loam; moderate, fine, subangular blocky structure; friable; common, thin, patchy clay films on face of peds; about 60 percent, by volume, chert pebbles ½ inch to 3 inches in diameter; strongly acid; clear, wavy boundary.

B23t—44 to 55 inches, brown (10YR 4/3) gravelly silt loam; weak, fine, subangular blocky structure; friable; slightly brittle; many, medium, patchy clay films on face of peds; about 20 percent, by volume, chert pebbles ½ inch to 3 inches in diameter; strongly acid; clear, wavy boundary.

B24t—55 to 74 inches, brown (10YR 5/3) gravelly silt loam; moderate, fine, subangular blocky stucture; friable; common, thin, patchy clay films on face of peds; about 80 percent, by volume, chert pebbles ½ inch to 3 inches in diameter; strongly acid.

The A horizon is dark brown or very dark grayish brown. A B1 horizon, 3 to 6 inches thick, of brown silt loam is in places. The B2t horizons are brown or reddish brown. The gravel content of the A and B21t horizons is 15 to 30 percent, and below these horizons the gravel content ranges from 25 to 80 percent. Some profiles have thin lenses that are free of gravel. Depth to bedrock is more than 60 inches. Reaction is slightly acid or medium acid in the A horizon and medium acid or strongly acid in the B horizon.

Secesh soils are near Britwater, Elsah, Fatima, Healing, and Waben soils. They have a thicker, darker A horizon than Britwater soils, and they have less clay in the B horizon. They have fewer coarse fragments than Elsah soils, and they have a B horizon, which the Elsah soils lack. Secesh soils have more coarse fragments than the Fatima and Healing soils and lack gray mottling in the upper part of the B horizon, which is characteristic of Fatima soils. They have fewer coarse fragments and a thick, dark A horizon, which Waben soils lack.

Secesh gravelly silt loam, occasionally flooded (Se).—This soil is on flood plains. Slope is 0 to 2 percent. The areas are generally long and narrow and range from 10 to 200 acres in size. Included in mapping are spots of Britwater, Elsah, Fatima, Healing, and Waben soils. Also included are narrow overflow channels, small narrow areas of soils that have slopes of more than 2 percent, and spots that are frequently subject to flooding.

This soil is suited to farming. Gravel is a slight hindrance to tillage. This soil is occasionally flooded for brief periods, commonly in winter and in spring, but this limitation does not seriously affect farming operations or the choice of crops. If this soil is well managed, clean-tilled crops that leave large amounts of residue can be grown year after year.

This soil is used mainly for pasture or meadow. Suitable crops are corn, grain sorghum, and truck crops. Winter small grain can be grown, but the crop is likely to be damaged by floods in some years. Suited forage plants are alfalfa, bermudagrass, johnsongrass,

tall fescue, sorghum-sudangrass hybrids (fig. 15), and white clover. Capability unit IIw–1; pasture and hayland group 2A; woodland group 3o7.

Sogn Series

The Sogn series consists of somewhat excessively drained, moderately sloping to steep soils that are mainly on the lower part of hillsides around Beaver Reservoir. These soils formed in loamy material weathered from limestone. The native vegetation was redcedar and hardwood trees and an understory of tall grasses.

In a representative profile the soil is very dark brown cobbly silt loam about 8 inches thick over limestone bedrock.

Sogn soils have moderate fertility. Permeability is moderate, and available water capacity is low. These soils are droughty and respond poorly to fertilizer. They are shallow or very shallow to bedrock.

These soils are unsuited to cultivated crops or to improved pasture. Limestone outcrop, surface stones, shallow depth to bedrock, and, in some areas, moderately steep to steep slopes restrict the use of farm equipment. These soils are better suited to range, wildlife habitat, or recreation than to most other uses. Most of the areas are in woodland of poor quality. Many tracts are being developed for recreation and other nonfarm uses. A large acreage is federally administered.

Representative profile of Sogn cobbly silt loam, in a moist, wooded area of Sogn-Clareson complex, 8 to 20 percent slopes, in the SE¼SE¼SE¼ sec. 13, T. 20 N., R. 28 W.:

A1—0 to 8 inches, very dark brown (10YR 2/2) cobbly silt loam; weak, fine, subangular blocky structure; friable; slightly plastic; many roots; about 50 percent, by volume, limestone and chert fragments ½ inch to 10 inches in diameter; mildly alkaline; abrupt, irregular boundary.

R—8 inches, limestone bedrock.

The A1 horizon is very dark grayish brown, very dark brown, or black. Coarse fragments make up 35 to 75 percent of the profile. Depth to limestone bedrock is 5 to 16 inches. The bedrock has few to common cracks that are filled with soil material similar to that in the A horizon. Reaction ranges from neutral to moderately alkaline throughout the profile.

In this survey area, the content of coarse fragments in these soils exceeds 35 percent, which is outside the range defined for the series. The difference does not alter significantly the usefulness and behavior of the soils.

Sogn soils are near Clareson, Summit, and Ventris soils and areas of Limestone outcrop. They are shallower to bedrock than Clareson, Summit, and Ventris soils and lack the B horizon of those soils. Sogn soils are more than 5 inches thick over bedrock, whereas bedrock is exposed at the surface in areas of Limestone outcrop.

Figure 15.—**Dairy cattle grazing on regrowth of a sorghum-sudangrass hybrid following a silage harvest on this Secesh gravelly silt loam, occasionally flooded.**

Sogn rocky silt loam, 12 to 40 percent slopes (SoF).—This soil is mainly on hillsides. The areas range from about 5 to 30 acres in size. Limestone outcrop makes up from 3 to 15 percent of most areas. Included in mapping are a few spots of Clareson and Ventris soils and small areas of soils that have slopes of less than 12 percent.

This soil is unsuited to cultivated crops or to improved pasture. Runoff is rapid, and the hazard of erosion is very severe. Surface stones, limestone outcrop, and moderately steep to steep slopes limit the use of farm equipment. This soil is droughty. It is better suited to range, wildlife habitat, production of cedar posts, and extensive recreation areas than to most other uses. Most of the areas are in woodland of poor quality. Some areas are being developed for recreational uses and for housing. Capability unit VIIs–4; pasture and hayland group 17A; woodland group 5d9; Limestone Ledge range site.

Sogn-Clareson complex, 8 to 20 percent slopes (SrE).—This complex is on foot slopes of hills. The areas range from about 10 to 40 acres in size. Small areas of the Clareson and Sogn soils are intermingled. The areas of each soil are ¼ acre to 3 acres in size and are generally less than 150 feet wide.

Sogn rocky silt loam makes up 45 to 60 percent of each area, and Clareson stony silt loam and cherty silt loam make up 25 to 35 percent. The rest is spots of Ventris, Waben, and Summit soils, limestone ledges, small areas of soils that have slopes of less than 8 percent, and areas of soils that are free of stones. The Sogn and Clareson soils in this complex have the profile described as representative for their respective series.

This complex is unsuited to cultivated crops or to improved pasture because of stones on the surface, shallow depth to bedrock, and limestone outcrops. Runoff is rapid, and the hazard of erosion is very severe. These soils are droughty. They are better suited to wildlife habitat, range, production of cedar posts, or extensive recreational areas than to most other uses. Most of this complex is in cedar trees and drought-resistant hardwoods, but small areas of Clareson soils have been cleared. Because this complex is adjacent to Beaver Reservoir, many tracts are being developed for recreational uses and for housing. Capability unit VIIs–4; pasture and hayland group 17A; woodland group 5d9; Limestone Ledge range site.

Summit Series

The Summit series consists of somewhat poorly drained, gently sloping to moderately steep soils on foot slopes. These soils formed in clayey material weathered from limestone and calcareous shale. The native vegetation was dominantly hardwoods or mixed hardwood and redcedar trees.

In a representative profile the surface layer is very dark brown silty clay about 11 inches thick. The subsoil extends to a depth of 72 inches or more. The upper 15 inches is olive-brown, mottled silty clay, and the lower part is dark yellowish-brown, mottled clay.

Summit soils have high fertility and organic-matter content. These soils shrink and crack when they are dry. When wet, they expand and the cracks seal. Permeability is generally slow, but when the soils crack, water enters rapidly until the cracks seal. Available water capacity is high. These soils respond well to fertilizer. They can be tilled only within a narrow range of moisture content.

Most areas of these soils are unsuited to tilled crops. The areas are used chiefly for pasture and meadow.

Representative profile of Summit silty clay, 3 to 15 percent slopes, eroded, in a moist pasture, in the NE¼NE¼NW¼ sec. 27, T. 21 N., R. 33 W.:

Ap—0 to 6 inches, very dark brown (10YR 2/2) silty clay; moderate, fine, subangular blocky structure; firm; many fine roots; many pores; many, fine, dark concretions; about 15 percent, by volume, angular chert fragments less than 1 inch in diameter; slightly acid; abrupt, smooth boundary.

A1—6 to 11 inches, very dark brown (10YR 2/2) silty clay; moderate, fine, subangular blocky structure; firm; common fine roots; common pores; many, fine, dark concretions; about 10 percent, by volume, angular chert fragments less than 1 inch in diameter; slightly acid; clear, irregular boundary.

B21t—11 to 26 inches, olive-brown (2.5Y 4/4) silty clay; many, coarse, faint, dark grayish-brown (2.5Y 4/6) mottles; moderate, fine, angular blocky structure; firm; plastic; few fine roots; few pores; thin, patchy clay films or pressure faces on peds; common streaks of very dark brown (10YR 2/2) silty clay; few, fine, dark concretions; about 1 percent, by volume, angular chert fragments less than 1 inch in diameter; neutral; gradual, wavy boundary.

B22t—26 to 40 inches, dark yellowish-brown (10YR 4/4) clay; many, medium, distinct, gray (10YR 5/1) and yellowish-brown (10YR 5/4) mottles; moderate, fine, angular blocky structure; firm; plastic; few fine roots; few pores; thin, patchy clay films or pressure faces on peds; few tongues of very dark brown (10YR 2/2) silty clay; many, fine, dark concretions; about 15 percent, by volume, angular chert fragments less than 1 inch in diameter; mildly alkaline; gradual, smooth boundary.

B23t—40 to 72 inches, dark yellowish-brown (10YR 4/4) clay; many, medium, distinct, grayish-brown (10YR 5/2) mottles and common, medium, distinct, dark reddish-brown (5YR 3/4) mottles; weak, fine, angular blocky structure; firm; plastic; few fine roots; few, fine, tubular pores; thin, patchy clay films or pressure faces on peds; many fine dark concretions; about 15 percent, by volume, angular chert fragments less than 1 inch in diameter; mildly alkaline.

The Ap and A1 horizons are very dark brown or very dark grayish brown. In some places the A1 horizon is lacking. The B2t horizon is dark yellowish-brown, olive, or olive-brown silty clay or clay. The content of coarse fragments is 0 to 15 percent, by volume, in the A and B21t horizons and 5 to 20 percent below. Reaction is medium acid to neutral in the A and B21t horizons and slightly acid to mildly alkaline below. Depth to shale or limestone bedrock is 5 to 8 feet or more.

Summit soils are near Clareson and Sogn soils. They are deeper over bedrock and have a more clayey A horizon than those soils.

Summit silty clay, 3 to 15 percent slopes, eroded (SsD2).—This soil is on foot slopes. The areas are 10 to 200 acres in size. There are common rills and shallow gullies, and between the gullies are spots where the plow layer is a mixture of the material originally in

the surface layer and that in the subsoil. Included in mapping are a few spots of Clareson and Sogn soils, gravelly spots, and a few small areas of soils that are not eroded, which have a surface layer of silty clay loam.

Most areas of this soil are unsuited to cultivated crops but are well suited to pasture. Runoff is rapid, and most areas receive runoff from upslope positions. The hazard of erosion is severe, and this soil is especially susceptible to gully erosion. Less sloping areas can be safely used occasionally for sown crops in a cropping system that includes close-growing cover plants most of the time.

Most areas of this soil are used for pasture and meadow. Suitable pasture plants are bermudagrass, tall fescue, white clover, and annual lespedeza. Capability unit VIe–2; pasture and hayland group 7C; woodland group 5c8; Clay Break, Shale, range site.

Taloka Series

The Taloka series consists of somewhat poorly drained, level soils in broad areas on uplands. These soils formed in loamy material high in content of silt and the underlying clayey material. The native vegetation was tall grasses.

In a representative profile the surface layer is very dark grayish-brown silt loam about 12 inches thick. The subsurface layer is grayish-brown and light brownish-gray, mottled silt loam about 10 inches thick. The upper 14 inches of the subsoil is dark-gray, mottled clay, and the lower part is light brownish-gray, mottled silty clay loam.

Taloka soils have moderate fertility. Permeability is very slow, and available water capacity is high. These soils respond fairly well to fertilizer. They are easy to till, but they are wet for long periods after rains. Root penetration into the subsoil is restricted.

If drained and well managed, these soils are suitable for most crops grown in the county. Most of the areas are used for pasture or meadow.

Representative profile of Taloka silt loam, 0 to 1 percent slopes, in a moist, idle field, in the SW¼NE¼SW¼ sec. 34, T. 21 N., R. 34 W.:

A1—0 to 12 inches, very dark grayish-brown (10YR 3/2) silt loam; common, fine, distinct, dark yellowish-brown mottles; moderate, medium, granular structure; friable; many roots; strongly acid; gradual, smooth boundary.

A21g—12 to 29 inches, grayish-brown (10YR 5/2) silt loam; common, medium, distinct, yellowish-brown (10YR 5/4) mottles; weak, fine, subangular blocky structure; friable; few fine concretions; few small pebbles; strongly acid; clear, wavy boundary.

A22g—19 to 22 inches, light brownish-gray (10YR 6/2) silt loam; common, medium, distinct, yellowish-brown (10YR 5/4) mottles; weak, fine, subangular blocky structure; firm; many vesicular pores; few small pebbles; medium acid; abrupt, smooth boundary.

B21tg—22 to 36 inches, dark gray (10YR 4/1) clay; many, medium and coarse, prominent, dark-red (2.5YR 3/6) mottles; moderate, medium, prismatic structure, becoming blocky with depth; very firm; plastic; light-gray (10YR 7/2) silt coatings on peds; few small pebbles; medium acid; clear, wavy boundary.

B22tg—36 to 72 inches, light brownish-gray (10YR 6/2) silty clay loam; many, medium, distinct, yellowish-brown (10YR 5/8) mottles and few, medium, faint, grayish-brown (10YR 5/2) mottles; weak, fine, subangular blocky structure; firm; common, thin, patchy clay films on face of peds; few, small, clayey masses; few small pebbles; medium acid.

The Ap or A1 horizon is very dark grayish brown or very dark brown. The A2g horizon is grayish brown or light brownish gray. Depth to the B2tg horizon is 16 to 24 inches. The B21tg horizon is clay or silty clay. The B22tg horizon is light brownish-gray, grayish-brown, or yellowish-brown silty clay loam or silty clay mottled with shades of brown or gray. Depth to bedrock is more than 72 inches. Reaction is medium acid to strongly acid throughout the profile. Areas that have been limed have an Ap horizon that is slightly acid or neutral.

Taloka soils are near Carytown, Cherokee, Jay, and Mayes soils. They lack the high sodium content of the B horizon of Carytown soils. They have a darker, thicker A horizon than the Cherokee soils. Taloka soils are more poorly drained, grayer, are more clayey in the upper part of the B horizon than Jay soils, and they lack the fragipan of those soils. They contain less clay in the A horizon and are more acid than the Mayes soils.

Taloka silt loam, 0 to 1 percent slopes [ToA].—This soil is in broad areas on uplands. The areas range from about 40 to 600 acres in size. Included in mapping are a few spots of Carytown, Cherokee, Jay, and Mayes soils and a few small areas of soils that have low, rounded mounds.

This soil is suited to cultivated crops if it is drained and well managed. Runoff is slow, and wetness is a moderate to severe limitation. The clayey subsoil restricts the movement of water and the penetration of roots into the soil. Farming operations are delayed several days after rains unless surface drains are installed. If this soil is adequately drained and otherwise well managed, clean-tilled crops that leave large amounts of residue can be safely grown year after year.

This soil is used mainly for pasture and meadow. Suitable crops include winter small grain, grain sorghum, and sorghum-sudangrass hybrids. Suitable pasture plants are bermudagrass, tall fescue, white clover, and annual lespedeza. Capability unit IIs–1; pasture and hayland group 8A; woodland group 5w6; Claypan Prairie range site.

Tonti Series

The Tonti series consists of moderately well drained, gently sloping soils on ridges, broad uplands, and stream terraces. These soils formed in loamy material overlying cherty limestone. The native vegetation was hardwood trees.

In a representative profile the surface layer is brown cherty silt loam about 6 inches thick. The upper part of the subsoil is strong-brown cherty silty clay loam about 13 inches thick. The lower part is a firm, brittle fragipan of yellowish-brown, mottled cherty silty clay loam about 23 inches thick. The underlying material is cherty limestone bedrock that has thin seams of red clay in fractures.

Tonti soils have moderate fertility. Permeability is slow, and available water capacity is medium. The fragipan restricts root penetration and slows the movement of water through the soils. The soils respond

well to fertilizer. Chert hinders some tillage operations, but these soils can be tilled over a wide range of moisture content.

If erosion control measures are installed, these soils are suited to clean-tilled crops. Most areas are cleared and are used chiefly for pasture and meadow. Some tracts are used for vineyards, apples, peaches, pears, and a variety of cultivated crops.

Representative profile of Tonti cherty silt loam, 3 to 8 percent slopes, in a moist, idle field, in the NW¼SE¼SE¼ sec. 6, T. 18 N., R. 29 W.:

Ap—0 to 6 inches, brown (10YR 5/3) cherty silt loam; some mixing of strong-brown (7.5YR 5/6) silty clay loam from horizon below; moderate, medium, granular structure; friable; many fine roots; about 15 percent, by volume, angular chert fragments ⅛ inch to 4 inches in diameter; strongly acid; abrupt, smooth boundary.

B2t—6 to 19 inches, strong-brown (7.5YR 5/6) cherty silty clay loam; moderate, fine, subangular blocky structure; firm; common fine roots; thin patchy clay films on face of peds; about 15 percent, by volume, angular chert fragments ½ inch to 4 inches in diameter; very strongly acid; clear, wavy boundary.

Bx1—19 to 29 inches, yellowish-brown (10YR 5/4) cherty silty clay loam; few, medium, prominent, yellowish-red (5YR 4/6) mottles; moderate, coarse, prismatic structure parting to moderate, fine, subangular blocky; firm; brittle; light brownish-gray (10YR 6/2) silt loam between prisms; thin, patchy clay films on face of blocky peds; common fine roots in silt loam between prisms; about 25 percent, by volume, angular chert fragments ½ inch to 4 inches in diameter; very strongly acid; clear, irregular boundary.

Bx2—29 to 42 inches, yellowish-brown (10YR 5/4) cherty silty clay loam; common, medium, prominent, yellowish-red (5YR 4/6) mottles; moderate, coarse, prismatic structure parting to moderate, fine, subangular blocky; firm; brittle; light brownish-gray (10YR 6/2) silt loam between prisms; thin clay films on face of blocky peds; many fine pores; about 70 percent, by volume, angular chert fragments ½ inch to 4 inches in diameter; very strongly acid; abrupt, wavy boundary.

R—42 inches, cherty limestone bedrock, thin seams of red clay in fractures.

The Ap horizon is 15 to 25 percent chert fragments. Some profiles have a B1 horizon, 2 to 4 inches thick, of brown or yellowish-brown cherty silt loam that is 10 to 20 percent chert fragments. The B2t horizon is strong-brown or yellowish-brown cherty silty clay loam or cherty silt loam that is 10 to 35 percent chert fragments. Depth to the Bx horizon is 15 to 24 inches. This horizon is yellowish-brown or strong brown. Prisms are coated with light brownish gray or light gray, and in some profiles the interior of prisms is mottled in these colors. Few to common roots are in the prism coatings, but no roots are in the interior of prisms. The Bx horizon is 20 to 45 percent chert fragments in the upper part and 45 to 75 percent in the lower part. Depth to bedrock is 40 to 60 inches. Reaction is commonly strongly acid or very strongly acid throughout the profile, but where the soil has been limed, the Ap horizon is medium acid to neutral.

Tonti soils are near Captina, Cherokee, Johnsburg, Nixa, and Peridge soils. They have more coarse fragments than the Captina, Cherokee, Johnsburg, and Peridge soils. They lack the gray mottling that is in the upper part of the B horizon of Cherokee and Johnsburg soils, and they are better drained than those soils. Tonti soils are more poorly drained than Peridge soils, and they have a fragipan that Cherokee and Peridge soils lack. They contain fewer coarse fragments in the A horizon and the upper part of the B horizon than Nixa soils.

Tonti cherty silt loam, 3 to 8 percent slopes (TsC). This gently sloping soil is on ridges, in broad areas on uplands, and on stream terraces. The areas range from about 10 to 80 acres in size. Included in mapping are small spots of Captina, Cherokee, Johnsburg, Nixa, and Peridge soils, small areas of soils that have slopes of less than 3 percent, small eroded spots, and a few shallow gullies.

This soil is suited to farming, but runoff is medium, and the hazard of erosion is severe if it is cultivated. If this soil is contour cultivated, terraced, and otherwise well managed, clean-tilled crops that leave large amounts of residue can be safely grown on the less sloping areas year after year. Conservation treatment measures will need to be intensified as slope length and gradient increase.

This soil is used mainly for pasture and meadow. Some areas of soils are used for vineyards, orchards, and a variety of cultivated crops. Suitable crops are corn, grain sorghum, winter small grain, truck crops, vineyards, and such fruit crops as apples, pears, and peaches. Suitable forage crops are bermudagrass, tall fescue, white clover, annual lespedeza, and sorghum-sudangrass hybrids. Capability unit IIIe–2; pasture and hayland group 8A; woodland group 4o7.

Ventris Series

The Ventris series consists of moderately well drained, moderately steep to steep upland soils on foot slopes of hills. Most areas border Beaver Reservoir. The soils formed in material weathered from limestone and calcareous shale. The native vegetation was hardwood and redcedar trees.

In a representative profile the surface layer is very dark grayish-brown cherty silt loam about 4 inches thick; the upper 10 inches of the subsoil is yellowish-brown clay; the middle 17 inches is mottled brown, yellowish-brown, and gray silty clay; and the lower 5 inches is mottled strong-brown, yellowish-brown, and gray silty clay. This is underlain by limestone bedrock. Many large stones are on the surface.

Ventris soils have high fertility. Permeability is very slow, and available water capacity is medium.

These soils are unsuited to cultivation. Operation of farm equipment is difficult because of the steep slopes and the stones on the surface (fig. 16). The soils are better suited to woodland or wildlife habitat than to most other uses. Most areas are wooded, but a few areas have been cleared. Because of the nearness of these soils to Beaver Reservoir, some areas are being developed for recreational or other nonfarm uses. A large acreage is federally administered.

Representative profile of Ventris cherty silt loam, in a moist, wooded area of Ventris stony silt loam, 15 to 40 percent slopes, in the NW¼SE¼SE¼ sec. 13, T. 20 N., R. 28 W.:

A1—0 to 4 inches, very dark grayish-brown (10YR 3/2) cherty silt loam; moderate, medium, granular structure; friable; many fine roots; about 40 percent, by volume, chert fragments ¼ inch to 3 inches in diameter; about 5 percent of surface is covered with stones and boulders of sandstone and

Figure 16.—**Slopes and stones limit the suitability of this Ventris soil for intensive uses.**

limestone up to several feet in diameter; neutral; clear, wavy boundary.

B21t—4 to 14 inches, yellowish-brown (10YR 5/4) clay; moderate, medium and fine, angular blocky structure; firm; plastic; common fine roots; few fine pores; thin, patchy clay films on faces of peds; about 15 percent, by volume, chert fragments ¼ inch to 3 inches in diameter; slightly acid; clear, irregular boundary.

B22t—14 to 31 inches, mottled brown (10YR 5/3), yellowish-brown (10YR 5/6), and gray (10YR 5/1) silty clay; moderate, medium and fine, angular blocky structure; firm; plastic; few fine roots; few fine pores; faces of peds have shiny surfaces; few slickensides; moderately alkaline; gradual, wavy boundary.

B3—31 to 36 inches, mottled strong-brown (7.5YR 5/6), yellowish-brown (10YR 5/6), and gray (10YR 5/1) silty clay; moderate, medium, angular blocky structure; firm; plastic; few roots; faces of peds have shiny surfaces; about 5 percent, by volume, chert fragments ¼ inch to 3 inches in diameter; mildly alkaline; abrupt, wavy boundary.

R—36 inches, limestone bedrock.

The A horizon is very dark grayish brown, very dark brown, or dark brown. Some profiles have an A2 horizon 1 to 4 inches thick that is dark yellowish-brown or yellowish-brown. The A horizon is cherty silt loam or silt loam. The B21t horizon is yellowish-brown, light olive-brown, or olive-brown clay or silty clay. The B22t and B3 horizons are brown, yellowish-brown, strong-brown, or light olive-brown clay or silty clay mottled with gray or light brownish gray. In places the horizons are mottled in these shades of brown and gray and have no dominant color. The A horizon is 5 to 45 percent chert or shale fragments, and the B horizon has few to 15 percent. Reaction is medium acid to neutral in the A and B21t horizons and slightly acid to moderately alkaline below.

Ventris soils are near Clareson and Sogn soils. Their B horizon contains fewer coarse fragments and is more mottled than that of Clareson soils. Ventris soils are deeper over bedrock and have a B horizon, which Sogn soils lack.

Ventris stony silt loam, 15 to 40 percent slopes (VsF).—This soil is on hillsides and foot slopes. The areas range from about 20 to 500 acres in size. Included in mapping are spots of Clareson and Sogn soils, small areas of shale or limestone outcrop, small areas of soils that are not stony, and spots of soils that are more than 40 inches deep over bedrock.

This soil is unsuitable for cultivation and is poorly suited to pasture. Stones on the surface and slope severely limit the use of farm equipment. Runoff is rapid, and the hazard of erosion is very severe. This soil is better suited to woodland or to wildlife habitat than to most other purposes. Most areas are woodland of poor quality. Some areas have been cleared, but most of these are now idle. Some areas are being developed for recreation and housing. The suited pasture plants are bermudagrass, tall fescue, white clover, and annual lespedeza. Capability unit VIIs–5; pasture and hayland group 8D; woodland group 5x3; Clay Break, Limestone, range site.

Waben Series

The Waben series consists of well-drained, gently sloping to moderately sloping soils on fans, foot slopes, and narrow terraces. These soils formed in cherty and very cherty alluvium and colluvium. The native vegetation was hardwood trees or mixed hardwood and pine trees.

In a representative profile the surface layer is dark grayish-brown cherty silt loam about 5 inches thick. The subsurface layer is pale-brown cherty silt loam about 10 inches thick. The subsoil extends to a depth of 66 inches or more. Its upper 25 inches is brown and pale-brown very cherty silt loam, and the lower part is yellowish-brown and pale-brown, very cherty silt loam.

Waben soils have low fertility. Permeability is moderately rapid, and available water capacity is medium to low. Where these soils are on foot slopes, deep-rooted plants can reach and absorb seepage water. These soils respond moderately well to fertilizer. They are difficult to till because of the high content of chert.

These soils are suited to poorly suited to clean-tilled crops. Most areas have been cleared and are used mainly for pasture.

Representative profile of Waben cherty silt loam, 8 to 12 percent slopes, in a moist, wooded area, in the SE¼NE¼SW¼ sec. 18, T. 17 N., R 32 W.:

A1—0 to 5 inches, dark grayish-brown (10YR 4/2) cherty silt loam; strong, fine, granular structure; friable; many fine roots; about 45 percent, by volume, chert fragments ⅛ inch to 3 inches in diameter; slightly acid; clear, wavy boundary.

A2—5 to 15 inches, pale-brown (10YR 6/3) cherty silt loam; moderate, medium, granular structure; friable; common fine roots; about 40 percent, by volume, chert fragments ⅛ inch to 3 inches in diameter; strongly acid; gradual, wavy boundary.

B2t—15 to 40 inches, brown (7.5YR 5/4) very cherty silt loam; about 25 percent is pale brown (10YR 6/3); moderate, fine, subangular blocky structure; friable; common, thin, patchy clay films on face of peds and chert fragments; about 60 percent, by volume, chert fragments ⅛ inch to 3 inches in diameter; strongly acid; gradual, wavy boundary.

B3—40 to 66 inches, yellowish-brown (10YR 5/4) and pale-brown (10YR 6/3) very cherty silt loam; weak, fine, subangular blocky structure; friable; few, thin, patchy clay films on face of peds and chert fragments; about 70 percent, by volume, chert fragments ⅛ inch to 3 inches in diameter; medium acid.

The A1 horizon is dark grayish brown or very dark grayish brown. Where present, the Ap horizon is 5 to 8 inches thick and is brown. The A2 horizon is pale brown or brown. Some profiles have a B1 horizon of yellowish-brown cherty silt loam 3 to 12 inches thick. The B2t horizon is yellowish brown, brown, or strong brown and in most profiles is streaked or splotched with pale brown or brown. It is cherty or very cherty silt loam or silty clay loam. The B3 horizon is brown or yellowish brown splotched or streaked with pale brown. Depth to bedrock is more than 60 inches. The content of chert fragments is 35 to 75 percent throughout the profile. Unlimed areas are strongly acid to slightly acid throughout the profile.

Waben soils are near Britwater, Clarksville, Elsah, Noark, and Secesh soils. They have more coarse fragments than Britwater soils, and their B horizon is less clayey. They have a higher base saturation in the lower part of the B horizon than Clarksville soils. Waben soils have a B horizon that Elsah soils lack. Their B horizon is brown, rather than red as that in Noark soils, and they are less clayey than those soils. They have fewer coarse fragments in the A horizon and in the upper part of the B horizon than Secesh soils, and they lack the thick, dark A horizon of those soils.

Waben cherty silt loam, 3 to 8 percent slopes (WeC).—This soil is on foot slopes, alluvial fans, and narrow terraces. The areas range from about 5 to 20 acres in size. Included in mapping are a few spots of Britwater, Elsah, and Secesh soils and a few areas of soils that have slopes of less than 3 percent.

This soil is suited to cultivated crops and is well suited to pasture. It is somewhat difficult to till and somewhat droughty because of the high content of chert. Runoff is medium, and the hazard of erosion is moderate to severe. If this soil is contour cultivated and otherwise well managed, clean-tilled crops that leave large amounts of residue can be safely grown on the less sloping areas year after year. Conservation measures need to be intensified as slope length and gradient increase.

Most areas of this soil are used for pasture and meadow, but some are wooded. Suitable crops are grain sorghum and winter small grain. Suitable forage crops are bermudagrass, tall fescue, white clover, annual lespedeza, and sorghum-sudangrass hybrids. Capability unit IIIs–1; pasture and hayland group 8G; woodland group 3f8.

Waben cherty silt loam, 8 to 12 percent slopes (WeD).—This soil is on foot slopes and alluvial fans. The areas range from about 5 to 20 acres in size. This soil has the profile described as representative for the series. Included in mapping are a few spots of Britwater, Clarksville, Elsah, and Noark soils.

This soil is poorly suited to cultivation. Slope and the high content of chert fragments make tillage operations difficult, and the soil is somewhat droughty. Sown crops can be safely grown occasionally in a cropping system that includes close-growing cover plants most of the time. Runoff is medium, and the hazard of erosion is severe. This soil is well suited to pasture and to woodland.

Most areas of this soil are used for pasture, but some are wooded. A suitable crop is winter small grain. Suited pasture plants are bermudagrass, tall fescue, white clover, and annual lespedeza. Capability unit IVs–1; pasture and hayland group 8G; woodland group 3f8.

Use and Management of the Soils

In this section the soils are discussed in relation to their use, suitability, and limitations for crops, pasture and hay, wildlife, woodland, range, engineering, town and country planning, and recreation.

Crops [3]

This section discusses the management of soils in Benton County for crops and explains the system of capability grouping used by the Soil Conservation

[3] W. WILSON FERGUSON, conservation agronomist, Soil Conservation Service, helped to prepare this section.

Service. A table showing predicted yields under improved management is provided.

In the rural part of the county, most of the cleared areas are used for forage for livestock, chiefly beef cattle. Scattered throughout the county are farms that grow truck crops, orchard crops, and grapes; small grain; and small acreages of other crops, such as soybeans, field corn, and sorghum.

In general, the soils in this county are low in nitrogen, potassium, phosphorus, calcium, and organic matter. Many of those suitable for cultivation are erodible. Poor surface or internal drainage or susceptibility to flooding limit the use of some soils. Many soils are poorly suited to unsuited to intensive use because of stoniness or rockiness, shallowness to bedrock, high content of coarse fragments, or combinations of these features.

Contour cultivation and grassed waterways, along with terraces in many fields, are needed on sloping soils that are used for tilled crops. Row arrangement and surface drains are needed for good growth of crops in wet areas.

Annual cover crops or grasses and legumes should be grown regularly in the cropping system if the hazard of erosion is severe or if the crops grown leave only small amounts of residue. Crop residue should be shredded and spread evenly to provide protective cover and active organic matter to the soils. Minimum tillage should be practiced to the extent practical for the soil conditions and requirements of the crop.

The amount of fertilizer to be applied is generally determined by soil tests, the kinds of crops to be grown, and past experiences with fertilization and crops on the various fields. On most of the soils, periodic applications of lime, according to needs indicated by soil tests, help most crops and are generally necessary for satisfactory production of such crops as alfalfa and white clover.

Chicken and egg production are major enterprises in this county. The large amount of manure and litter from the chickenhouses is a relatively inexpensive source of fertilizer. Operators need to exercise caution in applying large amounts of this material to their fields to avoid creating imbalances among the various plant nutrients.

If left bare, many of the soils tend to pack and crust over after heavy rains. Growing cover crops and managing crop residue help to preserve tilth.

Capability grouping

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

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

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

In the capability system, the kinds of soils are grouped at three levels: the capability class, subclass, and unit. These 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.

CAPABILITY SUBCLASSES indicate major kinds of limitations within the classes. Within most of the classes there can be up to 4 subclasses. The subclasses are indicated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter "e" shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; "w" means 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" indicates 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 or no limitations. Class V can contain, at the most, only subclasses *w*, *s*, and *c*, because the soils are subject to little or no erosion but have other limitations that confine their use largely to pasture, range, or wildlife.

CAPABILITY UNITS are soil groups within the subclasses. These are groups of soils that are so much alike that they are suited to the same crops and pasture plants, they require about the same management, and have generally similar productivity and other response to management. Capability units are generally identified by numbers assigned locally, for example, IIe–2 or IIIs–1.

The eight classes in the capability system and the subclasses and units in Benton County are described in the list that follows. The unit designation is given in the Guide to Mapping Units.

Class I.—Soils that have few limitations that restrict their use.
  (No subclasses.)
    Unit I–1.—Level to nearly level, well-drained, deep, loamy soils on low terraces.

Class II.—Soils that have moderate limitations that reduce the choice of plants or that require moderate conservation practices.
  Subclass IIe.—Soils subject to moderate erosion unless protected.
    Unit IIe–1.—Nearly level, moderately well drained, deep, loamy soils that have a fragipan, on uplands and terraces.

Unit IIe–2.—Nearly level, well-drained, deep, loamy soils on uplands and terraces.

Subclass IIw.—Soils moderately limited by excess water.

Unit IIw–1.—Level to nearly level, moderately well drained and well drained, deep, loamy soils on occasionally flooded flood plains.

Unit IIw–2.—Level, somewhat poorly drained, deep, loamy soils on uplands and terraces.

Subclass IIs.—Soils moderately limited by a claypan in the subsoil.

Unit IIs–1.—Level, somewhat poorly drained, deep, loamy soils on uplands.

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

Subclass IIIe.—Soils subject to severe erosion if they are cultivated and not protected.

Unit IIIe–1.—Gently sloping, well-drained, deep, loamy soils on uplands and terraces.

Unit IIIe–2.—Gently sloping, moderately well drained and well drained, moderately deep and deep, loamy soils, some that have a fragipan, on uplands and terraces.

Subclass IIIw.—Soils severely limited for cultivation by excess water.

Unit IIIw–1.—Level, poorly drained and somewhat poorly drained, deep, loamy soils on uplands.

Unit IIIw–2.—Level to nearly level somewhat excessively drained, deep, loamy soils that have a high content of chert, on occasionally flooded flood plains.

Unit IIIw–3.—Level, somewhat poorly drained deep, loamy soils that have a fragipan, on uplands and terraces.

Subclass IIIs.—Soils severely limited by a high content of chert that makes tillage difficult and reduces the available water capacity.

Unit IIIs–1.—Gently sloping, moderately well drained and well drained, moderately deep and deep, loamy soils with a high content of chert, some with fragipans, on uplands.

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

Subclass IVe.—Soils subject to very severe erosion if they are cultivated and not protected.

Unit IVe–1.—Moderately sloping, well-drained, deep, loamy soils on terraces.

Unit IVe–2.—Gently sloping and moderately sloping, well-drained, moderately deep and deep, loamy soils on uplands.

Unit IVe–3.—Moderately sloping, well-drained, deep, loamy soils on uplands.

Subclass IVs.—Soils very severely limited by slope and a high content of chert that makes tillage difficult and reduces the available water capacity.

Unit IVs–1.—Moderately sloping, moderately well drained and well drained, moderately deep and deep, loamy soils that have a high content of chert, some that have a fragipan, on uplands.

Class V.—Soils that are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife.

Subclass Vw.—Soils too wet for cultivation; protection from flooding not feasible.

Unit Vw–1.—Level to nearly level, somewhat excessively drained, deep, loamy soils that have a high content of chert, on frequently flooded flood plains.

Class VI.—Soils that have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife.

Subclass VIe.—Soils severely limited, chiefly by risk of erosion unless protective cover is maintained.

Unit VIe–1.—Moderately steep, well-drained, deep, loamy soils on uplands.

Unit VIe–2.—Gently sloping to moderately steep, somewhat poorly drained, deep, clayey soils on uplands.

Subclass VIs.—Soils severely limited by surface stones, low available water capacity, and risk of erosion unless protective cover is maintained.

Unit VIs–1.—Gently sloping and moderately sloping, well-drained, moderately deep and deep, stony, loamy soils on uplands.

Unit VIs–2.—Gently sloping and moderately sloping, well-drained, shallow, stony, loamy soils on uplands.

Class VII.—Soils that have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife.

Subclass VIIe.—Soils very severely limited, chiefly by risk of erosion, unless protective cover is maintained.

Unit VIIe–1.—Steep, well-drained, deep, loamy soils on uplands.

Subclass VIIs.—Soils very severely limited, chiefly by low available water capacity, stones, and risk of erosion unless protective cover is maintained.

Unit VIIs–1.—Moderately steep and steep, somewhat excessively drained, deep, loamy soils that have a high content of chert, on uplands.

Unit VIIs–2.—Moderately steep and steep, well-drained, moderately deep and deep, stony, loamy soils on uplands.

Unit VIIs–3.—Moderately steep and steep, well-drained, shallow, stony, loamy soils on uplands.

Unit VIIs–4.—Moderately sloping to steep, well drained and somewhat excessively drained, shallow and moderately deep, rocky and stony, loamy soils on uplands.

Unit VIIs–5.—Moderately steep and steep, moderately well drained, moderately deep, stony, loamy soils on uplands.

Class VIII.—Soils and landforms that have limitations that preclude their use for commercial crop production and restrict their use to recreation, wildlife habitat, water supply, or esthetic purposes.

Subclass VIIIs.—Landforms extremely limited by lack of soil material.

Unit VIIIs–1.—Moderately steep and steep limestone outcrops, ledges, and talus.

Pasture and Hay [4]

General guidelines for managing soils for pasture and hay are described in this section. Then the soils in the county are placed in 13 pasture and hayland suitability groups and each group is described. Those who wish to know the pasture and hayland suitability group of a soil can refer to the "Guide to Mapping Units" at the back of this survey. Those desiring detailed information about the management of the soils for these uses can refer to the section "Descriptions of the Soils."

A large part of the land in Benton County is used for pasture and hay. The trend is to convert cropland to forage crops, and more tracts of woodland are being cleared each year for production of forage.

Tall fescue is the principal base grass. It is well suited to most of the soils in the county. On many farms this is the only permanent grass grown. Orchardgrass and smooth bromegrass, which are also cool-season perennials, are grown to a limited extent. Common bermudagrass and Midland bermudagrass are the warm-season perennial grasses most commonly grown. Wilmington bahiagrass, a warm-season perennial grass that can be established from seed, is suited to the soils in this county and is grown to a limited extent. The growing of this grass can be expected to increase.

Annual lespedeza and white clover are the commonly grown legumes. They are commonly grown in combination with grasses, but some pure stands of annual lespedeza are grown for hay. Alfalfa is also grown for hay.

Sorghum-sudangrass hybrids are grown for supplemental grazing in summer, when the tall fescue is dormant. Fall-sown small grain is sometimes used for supplemental cool-season grazing.

Benton County is in one of the major poultry-producing areas in the United States. The litter from the poultry houses is applied to the pastures and hayfields. In addition to the manure, commercial fertilizer is used extensively. Unusually large amounts of these fertilizing materials result in higher forage yields than are normally obtained.

Management and maintenance

Proper grazing is essential for the production of high-quality forage, stand survival, and erosion control. Proper grazing includes maintaining sufficient topgrowth on the plants during the growing season to provide for vigorous, healthy growth. It also excludes or restricts grazing of tall fescue in summer. Brush control is essential, and weed control is often needed.

Fertilization with poultry litter on tall fescue, orchardgrass, and bromegrass pastures should not exceed an annual rate of 4 tons per acre. Higher rates are likely to cause nutritional problems and disease. Larger amounts can be used on bermudagrass and bahiagrass pastures. Grass pastures respond well to nitrogen fertilizer, and those of grass and legume mixtures may require phosphate and potash fertilizers and lime according to needs indicated by soil tests.

Rotation grazing and renovation are also important in a good pasture and hay management program.

Pasture and hayland suitability groups

Pasture and hayland suitability groups of soils have been made to assist land users in the selection of suitable forage plants. These groups are described in the following pages. The soils included in each group will grow similar kinds of forage plants and require similar treatment and management. Forage production for one soil in the group is essentially the same as that for other soils in the group when management and treatment are the same. Soils that formed under woodland cover require repeated brush control. Failure to control brush in these areas eventually results in a stand of trees and a gradual reduction of forage production.

Yields of pasture and hay for each soil are given in the section "Estimated Yields."

PASTURE AND HAYLAND SUITABILITY GROUP 2A

This group consists of deep soils that are loamy throughout. These soils are moderately permeable to moderately rapidly permeable and are moderately well drained to somewhat excessively drained. Some are gravelly. Most of these soils are on flood plains and are subject to occasional or frequent flooding. These soils have a high potential for growing forage plants, such as bermudagrass, tall fescue, white clover, and annual lespedeza.

PASTURE AND HAYLAND SUITABILITY GROUP 7C

The only soil in this group is Summit silty clay, 3 to 15 percent slopes, eroded. This is a deep soil on uplands. It is clayey throughout. It is slowly permeable and is somewhat poorly drained. It has a moderately high potential for growing forage plants, such as bermudagrass, tall fescue, white clover, and annual lespedeza.

PASTURE AND HAYLAND SUITABILITY GROUP 8A

This group consists of moderately deep and deep loamy soils that have a loamy or clayey subsoil. Some have a fragipan. These soils are very slowly permeable to moderately permeable and are somewhat poorly drained to well drained. Some are cherty. These soils are on uplands and stream terraces. They have a moderately high potential for growing forage plants, such as bermudagrass, tall fescue, white clover, and annual lespedeza.

[4] W. WILSON FERGUSON, conservation agronomist, Soil Conservation Service, helped to prepare this subsection.

PASTURE AND HAYLAND SUITABILITY GROUP 8B

This group consists of deep loamy soils that have a predominantly clayey subsoil. These soils are cherty throughout. They are on uplands and are difficult to manage for forage production with use of conventional equipment because of slope. These soils have a moderate potential for growing forage plants, such as bermudagrass, tall fescue, annual lespedeza, and white clover.

PASTURE AND HAYLAND SUITABILITY GROUP 8C

The only soil in this group is Enders gravelly loam, 3 to 12 percent slopes. This is a moderately deep to deep soil on uplands. It has a predominantly clayey subsoil. It is very slowly permeable and is well drained. This soil has a moderately low potential for growing forage plants, such as bermudagrass, tall fescue, and annual lespedeza.

PASTURE AND HAYLAND SUITABILITY GROUP 8D

This group consists of predominantly moderately deep, stony soils on uplands. These soils have a loamy surface layer and are clayey throughout most of the subsoil. They are very slowly permeable and are moderately well drained. These soils are difficult to manage for forage production with use of conventional equipment because of stones on the surface and slope. These soils have a moderately low potential for growing forage plants, such as bermudagrass, tall fescue, and annual lespedeza.

PASTURE AND HAYLAND SUITABILITY GROUP 8F

This group consists of deep loamy soils that have a loamy or clayey subsoil. Some have a fragipan. These soils are very slowly permeable and are poorly drained to somewhat poorly drained. They are on upland flats and stream terraces. These soils have a moderately high potential for growing forage plants, such as bermudagrass, tall fescue, annual lespedeza, and white clover.

PASTURE AND HAYLAND SUITABILITY GROUP 8G

This group consists of moderately deep soils that are loamy and cherty throughout. Some have a fragipan. These soils are very slowly permeable and moderately rapidly permeable and are moderately well drained and well drained. They are on uplands. These soils have moderate potential for growing forage plants, such as bermudagrass, tall fescue, weeping lovegrass, and annual lespedeza.

PASTURE AND HAYLAND SUITABILITY GROUP 8H

The only soil in this group is Clarksville cherty silt loam, 12 to 50 percent slopes. This is a deep soil on uplands. It is loamy and has a high content of chert throughout. This soil is droughty and is difficult to manage for forage production with use of conventional equipment because of slope. It has a low potential for growing forage plants, such as tall fescue, weeping lovegrass, crimson clover, and annual lespedeza.

PASTURE AND HAYLAND SUITABILITY GROUP 8K

The only soil in this group is Enders stony loam, 3 to 12 percent slopes. This is a moderately deep to deep soil on uplands. It has a predominantly clayey subsoil. It is very slowly permeable and is well drained. This soil is somewhat difficult to manage for forage production because of stones on the surface. It has moderately low potential for growing forage plants, such as bermudagrass, tall fescue, and annual lespedeza.

PASTURE AND HAYLAND SUITABILITY GROUP 14B

The only soil in this group is Mountainburg stony sandy loam, 12 to 40 percent slopes. This is a shallow soil on uplands. It is loamy and has a high content of stones and pebbles throughout. This soil is droughty and is difficult to manage for forage production with use of conventional equipment because of stones on the surface and slope. It has low potential for growing forage plants, such as weeping lovegrass, tall fescue, bermudagrass, annual lespedeza, and sericea lespedeza.

PASTURE AND HAYLAND SUITABILITY GROUP 14C

The only soil in this group is Mountainburg stony sandy loam, 3 to 12 percent slopes. This is a shallow soil on uplands. It is loamy and has a high content of stones and pebbles throughout. This soil is droughty, and is somewhat difficult to manage for forage production with use of conventional equipment because of stones on the surface. It has low potential for growing forage plants, such as weeping lovegrass, tall fescue, bermudagrass, annual lespedeza, and sericea lespedeza.

PASTURE AND HAYLAND SUITABILITY GROUP 17A

This group consists of shallow and very shallow loamy soils on uplands. Some of these soils have a clayey subsoil. These soils have a high content of stones and pebbles. They are droughty and are difficult to manage for forage production with use of conventional equipment because of stones on the surface and slope. These soils have low to very low potential for growing forage plants, such as tall fescue, weeping lovegrass, annual lespedeza, and sericea lespedeza.

Predicted Yields

Table 6 lists predicted yields of the principal crops grown in the county. The predictions are based on estimates made by farmers, soil scientists, agronomists, and others who have knowledge of yields in the county and on research data. The predicted yields are average yields per acre that can be expected by good commercial farmers at the level of management that tends to produce the highest economic returns.

Crops other than those shown in table 6 are grown in the county, but their acreage is small or reliable data on their yields are not available.

The predicted yields given in table 6 can be expected if the following management practices are used:

1. Rainfall is effectively used and conserved.
2. Surface drainage systems are installed.
3. Crop residue is managed to maintain tilth.
4. Minimum but timely tillage is used.
5. Insect, disease, and weed-control measures are consistently used.

TABLE 6.—*Predicted average yields per acre of principal crops under improved management*

[Absence of a figure indicates the crop is not suited to or is not commonly grown on the soil]

Soil	Corn	Soybeans	Oats	Wheat	Green beans	Grapes	Apples	Alfalfa hay	Tall fescue hay	Tall fescue pasture	Hybrid bermuda-grass pasture
	Bu	*Bu*	*Bu*	*Bu*	*Tons*	*Tons*	*Bu*	*Tons*	*Tons*	*AUM* [1]	*AUM* [1]
Britwater gravelly silt loam, 3 to 8 percent slopes	60		60	40	3.0	6.0	550	3.5	2.8	7.0	7.0
Britwater gravelly silt loam, 8 to 12 percent slopes										6.0	6.0
Cane loam, 3 to 8 percent slopes	60		55	30	3.0	5.0	450			7.0	7.0
Captina silt loam, 1 to 3 percent slopes	75	25	70	35	4.0	6.0	550	3.5	3.2	8.0	8.0
Carytown silt loam										6.0	
Cherokee silt loam										7.0	5.0
Clarksville cherty silt loam, 12 to 50 percent slopes										5.0	4.0
Elsah soils [2]								3.5	3.2	8.0	7.5
Enders gravelly loam, 3 to 12 percent slopes									2.0	5.0	5.0
Enders stony loam, 3 to 12 percent slopes										4.5	4.5
Enders stony loam, 12 to 30 percent slopes										4.5	
Fatima silt loam, occasionally flooded	80	30							3.8	9.0	9.0
Healing silt loam	85	35	70	50	5.0			5.5	4.0	10.0	10.0
Healing silt loam, occasionally flooded	85	35	65	40	5.0			5.5	4.0	9.5	10.0
Jay silt loam, 1 to 3 percent slopes	70	25	65	35	4.0	6.0	450	3.5	3.2	8.0	8.0
Johnsburg silt loam	55		60		3.0				3.0	7.0	7.0
Limestone outcrop											
Linker fine sandy loam, 3 to 8 percent slopes		20		25		5.0	450		2.8	6.5	6.0
Mayes silty clay loam		25		30					3.0	7.0	6.0
Mountainburg stony sandy loam, 3 to 12 percent slopes										4.0	3.0
Mountainburg stony sandy loam, 12 to 40 percent slopes										3.0	
Newtonia silt loam, 1 to 3 percent slopes	80	30	70	50	4.0	6.0	600	4.5	3.5	9.0	9.0
Nixa cherty silt loam, 3 to 8 percent slopes	45			20		5.0			2.5	5.5	5.5
Nixa cherty silt loam, 8 to 12 percent slopes									2.2	5.0	5.0
Noark cherty silt loam, 8 to 12 percent slopes									2.5	6.0	6.0
Noark cherty silt loam, 12 to 20 percent slopes										6.0	5.0
Noark cherty silt loam, 20 to 45 percent slopes										6.0	
Peridge silt loam, 1 to 3 percent slopes	80	30	70	50	4.0	6.0	600	4.2	3.2	8.5	8.5
Peridge silt loam, 3 to 8 percent slopes	75	25	60	45	3.0	6.(	550	4.0	3.0	8.0	8.0
Secesh gravelly silt loam, occasionally flooded	75	30	65	40				4.2	3.2	8.5	8.5
Sogn rocky silt loam, 12 to 40 percent slopes										2.5	
Sogn-Claresson complex, 8 to 20 percent slopes										3.0	
Summit silty clay, 3 to 15 percent slopes, eroded										6.0	5.5
Taloka silt loam, 0 to 1 percent slopes	55	30	55	40					3.0	6.5	6.5
Tonti cherty silt loam, 3 to 8 percent slopes	65	20	70	25		5.5	550	3.0	3.0	7.0	7.0
Ventris stony silt loam, 15 to 40 percent slopes										4.0	
Waben cherty silt loam, 3 to 8 percent slopes	50	20	50					3.0	3.0	7.0	7.0
Waben cherty silt loam, 8 to 12 percent slopes										6.0	6.0

[1] Animal-unit-months. The number of months that 1 acre will provide grazing for 1 animal unit (1,000 pounds live weight), or the number of months the pasture can be grazed multiplied by the number of animal units an acre will support. For example, 1 acre of Elsah soils in an improved pasture of tall fescue will provide grazing for two animals for 4 months, so it has a rating of 8 animal-unit-months.

[2] Yields apply only to the occasionally flooded part of this mapping unit.

6. Fertilizer is applied according to needs indicated by soil tests and crops.
7. Suited crop varieties are used at recommended seeding rates.

Wildlife [5]

Soils directly influence kinds and amounts of vegetation and amounts of water available, and in this way they indirectly influence the kinds of wildife that can live in an area. Soil properties that affect the growth of wildlife habitat are (1) thickness of soil useful to crops, (2) surface texture, (3) available water capacity, (4) wetness, (5) flood hazard, (6) slope, and (7) permeability.

In table 7 the soils of Benton County are rated for producing seven elements of wildlife habitat and for three groups, or kinds, of wildlife. The ratings indicate relative suitability for various elements.

A rating of *good* means the element of wildlife and kinds of habitat generally are easily created, improved, and maintained. Few or no limitations affect management in this category, and satisfactory results are expected when the soil is used for the prescribed purpose.

A rating of *fair* means the element of wildlife habitat and kinds of habitats can be created, improved, or maintained in most places. Moderate intensity of management and fairly frequent attention, however, may be required for satisfactory results.

A rating of *poor* means the element of wildlife habitat and limitations for the designated kinds of habitat are severe. Habitats can be created, improved, or maintained in most places, but management is difficult and requires intensive effort.

A rating of *very poor* means use of the soil for the elements of wildlife habitat are very severe and unsatisfactory results can be expected. It is either impossible or impractical to create, improve, or maintain habitats on soils in this category.

Each soil is rated in table 7 according to its suitability for producing various kinds of plants and other elements that make up wildlife habitats. The

[5] ROY A. GRIZZELL, biologist, Soil Conservation Service, helped to prepare this section.

TABLE 7.—*Suitability of soils for elements*

Soils	Elements of wildlife habitat			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees
Britwater gravelly silt loam, 3 to 8 percent slopes	Fair	Good	Good	Good
Britwater gravelly silt loam, 8 to 12 percent slopes	Fair	Good	Good	Good
Cane loam, 3 to 8 percent slopes	Fair	Good	Good	Fair
Captina silt loam, 1 to 3 percent slopes	Good	Good	Good	Good
Carytown silt loam	Poor	Fair	Fair	Fair
Cherokee silt loam	Poor	Fair	Fair	Fair
Clarksville cherty silt loam, 12 to 50 percent slopes	Very poor	Poor	Fair	Fair
Elsah soils	Poor	Fair	Fair	Fair
Enders gravelly loam, 3 to 12 percent slopes	Fair	Good	Good	Good
Enders stony loam, 3 to 12 percent slopes	Poor	Fair	Good	Good
Enders stony loam, 12 to 30 percent slopes	Poor	Fair	Good	Good
Fatima silt loam, occasionally flooded	Good	Good	Good	Good
Healing silt loam	Good	Good	Good	Good
Healing silt loam, occasionally flooded	Good	Good	Good	Good
Jay silt loam, 1 to 3 percent slopes	Good	Good	Good	Good
Johnsburg silt loam	Fair	Good	Good	Fair
Limestone outcrop	Not rated	Not rated	Not rated	Not rated
Linker fine sandy loam, 3 to 8 percent slopes	Fair	Good	Good	Fair
Mayes silty clay loam	Fair	Fair	Good	Good
Mountainburg stony sandy loam, 3 to 12 percent slopes	Poor	Poor	Fair	Poor
Mountainburg stony sandy loam, 12 to 40 percent slopes	Poor to very poor	Poor to very poor	Fair	Poor
Newtonia silt loam, 1 to 3 percent slopes	Good	Good	Good	Good
Nixa cherty silt loam, 3 to 8 percent slopes	Poor	Fair	Fair	Fair
Nixa cherty silt loam, 8 to 12 percent slopes	Poor	Fair	Fair	Fair
Noark cherty silt loam, 8 to 12 percent slopes	Fair	Good	Good	Fair
Noark cherty silt loam, 12 to 20 percent slopes	Poor	Fair	Good	Fair
Noark cherty silt loam, 20 to 45 percent slopes	Very poor	Fair	Good	Fair
Peridge silt loam, 1 to 3 percent slopes	Good	Good	Good	Good
Peridge silt loam, 3 to 8 percent slopes	Fair	Good	Good	Good
Secesh gravelly silt loam, occasionally flooded	Good	Good	Good	Good
Sogn rocky silt loam, 12 to 40 percent slopes	Very poor	Very poor	Poor	Very poor
Sogn-Clareson complex, 8 to 20 percent slopes	Poor	Poor	Poor to fair	Poor
Summit silty clay, 3 to 15 percent slopes, eroded	Fair	Fair	Fair	Good
Taloka silt loam, 0 to 1 percent slopes	Fair	Good	Good	Good
Tonti cherty silt loam, 3 to 8 percent slopes	Fair	Good	Good	Fair
Ventris stony silt loam, 15 to 40 percent slopes	Very poor	Poor	Good	Fair
Waben cherty silt loam, 3 to 8 percent slopes	Fair	Good	Good	Fair
Waben cherty silt loam, 8 to 12 percent slopes	Fair	Good	Good	Fair

ratings take into account mainly the characteristics of the soils and closely related natural factors of the environment. They do not take into account climate, present use of soils, or present distribution of wildlife and people. For this reason, selection of a site for development as a habitat for wildlife requires inspection at the site.

Grain and seed crops are annual grain-producing plants, such as corn, sorghum, millet, and soybeans.

Grasses and legumes are domestic grasses and legumes that are established by planting. They provide food and cover for wildlife. Grasses include bahiagrass, ryegrass, and panicgrass; legumes include annual lespedeza, shrub lespedeza, and other clovers.

Wild herbaceous plants are native or introduced perennial grasses, forbs, and weeds that provide food and cover for upland wildlife. Beggarweed, perennial lespedeza, wildbean, pokeweed, and cheatgrass are typical examples.

Hardwood woody plants are nonconiferous trees, shrubs, and woody vines that produce wildlife food in the form of fruits, nuts, buds, catkins, or browse. Such plants commonly grow in their natural environment, but they can be planted and developed through wildlife management programs. Typical species in this category are oak, beech, cherry, dogwood, maple, viburnum, grape, honeysuckle, greenbriar, and silverberry.

Coniferous plants are cone-bearing trees and shrubs that provide cover and frequently furnish food in the form of browse, seeds, or fruitlike cones. They commonly grow in their natural environment, but they can be planted and managed. Typical plants in this category are pines, cedars, and ornamental trees and shrubs.

Wetland plants are annual and perennial herbaceous plants that grow wild on wet or moist sites. They furnish food and cover mostly for wetland wildlife. Typical examples of plants are smartweed, wild millet, spikerush and other rushes, sedges, burreed, tearthumb, and aneilema. Submerged and floating aquatics are not included in this category.

Shallow-water developments are impoundments or excavations for controlling water, generally not more than 5 feet deep, to create habitats that are suitable for waterfowl. Some are designed to be drained,

of wildlife habitat and kinds of wildlife

Elements of wildlife habitat—Continued			Kinds of wildlife		
Coniferous plants	Wetland plants	Shallow-water areas	Openland	Woodland	Wetland
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Fair	Poor	Very poor	Good	Fair	Very poor.
Good	Poor	Poor	Good	Good	Poor.
Fair	Good	Good	Fair	Fair	Good.
Fair	Good	Good	Fair	Fair	Good.
Fair	Very poor	Very poor	Poor	Fair	Very poor
Fair	Very poor	Very poor	Fair	Fair	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Fair	Good	Very poor.
Good	Very poor	Very poor	Fair	Good	Very poor.
Good	Poor	Fair	Good	Good	Poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Poor	Poor	Good	Good	Poor.
Fair	Fair	Fair	Good	Fair	Fair.
Not rated	Not rated	Not rated	Not rated	Not rated	Not rated.
Fair	Poor	Very poor	Good	Good	Very poor.
Good	Fair	Good	Fair	Good	Fair.
Poor	Very poor	Very poor	Poor	Poor	Very poor.
Poor	Very poor	Very poor	Poor	Poor	Very poor.
Good	Poor	Very poor	Good	Good	Very poor.
Fair	Very poor	Very poor	Fair	Fair	Very poor.
Fair	Very poor	Very poor	Fair	Fair	Very poor.
Fair	Very poor	Very poor	Good	Fair	Very poor.
Fair	Very poor	Very poor	Fair	Fair	Very poor.
Fair	Very poor	Very poor	Fair	Fair	Very poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Poor	Very poor	Good	Good	Very poor.
Very poor	Very poor	Very poor	Very poor	Very poor	Very poor.
Poor	Very poor	Very poor	Poor	Poor	Very poor.
Good	Poor to very poor	Very poor	Fair	Good	Very poor.
Good	Fair	Fair	Good	Good	Fair.
Fair	Poor	Very poor	Good	Fair	Very poor.
Fair	Very poor	Very poor	Poor	Fair	Very poor.
Fair	Poor to very poor	Very poor	Good	Fair	Very poor.
Fair	Very poor	Very poor	Good	Fair	Very poor.

planted, and then flooded; others are permanent impoundments that grow submerged aquatics.

Table 7 also rates soils according to their suitability as habitat for the three kinds of wildlife in the county —open-land, woodland, and wetland wildlife. These ratings are related to ratings made for the elements of habitat. For example, soils rated very poor for shallow-water developments are rated very poor for wetland wildlife.

Open-land wildlife are birds and mammals that normally live in meadows, pastures, and open areas where grasses, herbs, and shrubby plants grow. Quail, dove, meadowlark, field sparrows, cottontail rabbit, and fox are typical open-land wildlife.

Woodland wildlife are birds and mammals that normally live in wooded areas of hardwood trees, coniferous trees, and shrubs. Woodcock, thrush, wild turkey, vireo, deer, squirrel and raccoons are typical woodland wildlife.

Wetland wildlife are birds and mammals that normally live in wet areas, marshes, and swamps. Ducks, geese, rails, shore birds, heron, mink, and muskrat are typical wetland wildlife.

Woodland [6]

Originally Benton County was mainly wooded, except for scattered prairies in the western part of the county. Now, trees cover about 39 percent of the county, including about 10,000 acres of public land in the Ozark National Forest, in Pea Ridge National Military Park, and along the shores of Beaver Reservoir.

Good to poor stands of commercial trees are produced in the county. Broadleaf forest types dominate throughout the county, but tracts of mixed broadleaf and needleleaf types are scattered on the uplands.

The value of the wood products is substantial, though it is far below its potential. Other values include grazing, wildlife habitat, recreation, natural beauty, and conservation of soil and water. This subsection has been provided to explain how soils affect tree growth and management in the county. In table 8 potential productivity for wood and forage crops and management problems of the soils in Benton County are given.

In the first column the soils are listed by their mapping unit symbols under the series name to which they belong. The next column gives the woodland ordination group. Each group is made up of soils that are suited to the same kind of trees, that need about the same kind of management to produce these trees, and that have about the same potential productivity.

Each woodland ordination group is identified by a three-part symbol. The first part of the symbol, a numeral, indicates the relative productivity of the soils: 1 means very high; 2 means high; 3 means moderately high; 4 means moderate; and 5 means low.

The second part of the symbol, a letter, indicates the important soil property that imposes a moderate or severe hazard or limitation in managing the soils for wood crops. The letter *x* shows that the main limitation is stoniness or rockiness; *w* shows that excessive water on or in the soil is the chief limitation; *t* shows that toxic substances in the soil are the chief limitations; *d* shows that the rooting depth is restricted; *c* shows that clay in the upper part of the soil is a limitation; *s* shows that the soils are sandy; *f* shows that the soils have large amounts of coarse fragments; *r* shows that the soils have steep slopes; and *o* means the soils have no significant restrictions or limitations for woodland use or management.

The third element in the symbol indicates the degree of management concerns and the general suitability of the soils for certain kinds of trees.

In the third column is a list of some of the commercially important trees that are adapted to the soil. These are the trees that woodland managers will generally favor in intermediate or improvement cuttings. Next is the potential productivity of the trees as indicated by site index. The site index is the average height of dominant trees, in feet, at age 30 for cottonwood; at age 35 for sycamore; at age 25 for planted pines; and at age 50 for all other species or types. Although some of the listed trees are known to make suitable growth on the soils, site index information is not available. This is indicated by dashes in place of the site index.

In the next column is the potential productivity of understory grasses, legumes, forbs, and low shrubs for a medium tree canopy class (36 to 55 percent canopy). Yield of forage species includes all understory species that are within reach of livestock and game animals. It is expressed in pounds of air-dry forage per acre. Where yield data are not available, the important forage-producing species are listed in approximate order of their productivity.

The management concerns evaluated in the next three columns are hazard of erosion, equipment limitations, and seedling mortality.

Hazard of erosion indicates the risk of soil losses in well-managed woodlands. The erosion hazard is *slight* if expected soil losses are small, *moderate* if some measures to control erosion are needed in logging and construction, and *severe* if intensive treatment or special equipment and methods are needed to prevent excessive soil losses.

Equipment limitation ratings reflect the soil conditions that restrict the use of equipment normally used in woodland management or harvesting. *Slight* ratings indicate equipment use is not limited to kind or time of year. A rating of *moderate* indicates a seasonal limitation or need for modification in methods or equipment. *Severe* limitations indicate the need for specialized equipment or operations.

Seedling mortality ratings indicate the degree of expected mortality of planted seedlings when plant competition is not a limiting factor. Normal rainfall, good planting stock, and proper planting are assumed. *Slight* indicates expected mortality is less than 25 percent; *moderate* indicates a loss of 25 to 50 percent; and *severe* indicates a loss of more than 50 percent of the seedlings.

In the last column is a list of trees suitable to plant for commercial wood production.

[6] MAX D. BOLAR, woodland conservationist, and IVAN R. PORTER, range conservationist, helped to prepare this subsection.

Range [7]

Soils vary in their capacity to produce grass and other plants for grazing. Soils that produce about the same kinds and amounts of forage if the range is in similar condition make up a range site.

Range sites are kinds of range that differ in their ability to produce vegetation. The soils of any one range site produce about the same kind of climax vegetation. Climax vegetation is the stabilized plant community; it reproduces itself and does not change as long as the environment remains unchanged. Throughout the prairie and the savannas, the climax vegetation consists of the plants that were growing there when the region was first settled. If cultivated crops are not grown, the most productive combination of forage plants on a range site is generally the climax vegetation.

Decreasers are plants in the climax vegetation that tend to decrease in relative amount under close grazing. They generally are the tallest and most productive perennial grasses and forbs and the most palatable to livestock.

Increasers are plants in the climax vegetation that increase in relative amount as the more desirable decreaser plants are reduced by close grazing. They are commonly shorter than decreasers and are generally less palatable to livestock.

Invaders are plants that cannot compete with plants in the climax plant community for moisture, nutrients, and light. Hence, invaders come in and grow along with increasers after the climax vegetation has been reduced by grazing. Many are annual weeds, and some are shrubs that have some grazing value, but others have little value for grazing.

Range condition is judged according to standards that apply to the particular range site. It expresses the present kind and amount of vegetation in relation to the climax plant community for that site.

Four *range condition classes* are used to indicate the degree of departure from the potential, or climax, vegetation brought about by grazing or other uses. The classes show the present condition of the native vegetation on a range site in relation to the native vegetation that could grow there. A range is in *excellent* condition if 76 to 100 percent of vegetation is of the same kind as that in the climax stand. It is in *good* condition if the percentage is 51 to 75; in *fair* condition if the percentage is 26 to 50; and in *poor* condition if the percentage is less than 25.

Potential forage production depends on the range site. Current forage production depends on the range condition and the moisture available to plants during their growing season.

A primary objective of good range management is to keep range in excellent or good condition. If this is done, water is conserved, yields are improved, and the soils are protected. The problem is recognizing important changes in the kind of cover on a range site. These changes take place gradually and can be misinterpreted or overlooked. Growth encouraged by heavy rainfall may lead to the conclusion that the range is in good condition, when actually the cover is weedy and the long-term trend is toward lower production. On the other hand, some rangeland that has been closely grazed for short periods, under the supervision of a careful manager, may have a degraded appearance that temporarily conceals its quality and ability to recover.

Descriptions of range sites

In the following pages, the range sites in Benton County are described and the climax plants and principal invaders on the sites are named. Also given is an estimate of the potential annual yield of air-dry herbage for each site in excellent condition. The soils in each site can be determined by referring to the "Guide to Mapping Units" at the back of this soil survey.

CHERT HILLS RANGE SITE

This site consists of moderately deep and deep, gently sloping to steep soils that are moderately well drained to somewhat excessively drained and are very slowly to moderately rapidly permeable. Available water capacity is medium to low. Content of plant nutrients is low. All of these soils have a high content of chert fragments. The surface and subsurface layers are cherty silt loam. The subsoil ranges from cherty silt loam to very cherty clay, and some of the soils have a fragipan of very cherty silt loam that restricts the growth of plant roots and the movement of water through the soil.

If this site is in excellent condition, the vegetation consists of open stands of oak and hickory that make up about 35 percent of the ground cover. The rest is grasses; legumes; and forbs, mainly big bluestem, indiangrass, lespedezas, tickclovers, Virginia tephrosia, New Jersey tea, goldenrods, and asters. As the condition of the site deteriorates, oak and hickory increase, along with broomsedge bluestem, ragweeds, sassafras, persimmon, sumac, coralberry, and hawthorn.

Total production of herbage on this site is about 4,500 pounds per acre in years when soil moisture is favorable and about 3,000 pounds per acre in unfavorable years. Forage production ranges from 1,500 to 3,200 pounds per acre.

CLAY BREAK, LIMESTONE, RANGE SITE

The only soil in this site is Ventris stony silt loam, 15 to 40 percent slopes. This moderately steep to steep soil is moderately well drained and is very slowly permeable. Available water capacity is medium. Content of plant nutrients is high. The rooting zone is about 26 to 40 inches thick over bedrock. The surface layer is cherty silt loam, and the subsoil is clay and silty clay. Many large stones are on the surface.

If this site is in excellent condition, the vegetation consists of open stands of oak, hickory, and redcedar that make up 30 to 45 percent of the ground cover. The rest is mainly big bluestem, little bluestem, indiangrass, switchgrass, lespedezas, catclaw sensitivebriar, sunflower, and other perennial forbs. As the condition of the site deteriorates, woody plants

[7] IVAN R. PORTER, range conservationist, Soil Conservation Service, helped to prepare this subsection.

TABLE 8.—*Woodland productivity*

[The symbol <

Soil series and map symbols	Woodland group	Potential productivity		
		Wood crops		Forage crops
		Important trees	Site index [1]	Important understory vegetation of forage species (medium canopy)
Britwater: BtC, BtD	3o7	Loblolly pine	80	Little bluestem, big bluestem, beaked panicum, low panicums, other grasses, legumes, and forbs.
		Shortleaf pine	70	
		Eastern redcedar	50	
		Red oak	70	
		Black walnut	----	
		Black cherry	----	
Cane: CeC	3o7	Loblolly pine	80	Little bluestem, big bluestem, beaked panicum, low panicums, other grasses, legumes, and forbs.
		Shortleaf pine	70	
		Eastern redcedar	50	
		Sweetgum	80	
		Red oak	70	
		Black cherry	----	
Captina: CnB	4o7	Shortleaf pine	60	Little bluestem, big bluestem, wildryes, low panicums, beaked panicums, sedges, other grasses, legumes, and forbs.
		Eastern redcedar	40	
		Red oak	65	
		Black walnut	----	
		Black locust	----	
		Black cherry	----	
Carytown: Co	5w6	Water oaks	50	Big bluestem, switchgrass, indiangrass, little bluestem, low panicums, meadow dropseed, native lespedezas, other grasses, legumes, and forbs.
		Sweetgum	60	
Cherokee: Cs	5w6	Water oaks	50	Big bluestem, switchgrass, indiangrass, little bluestem, low panicums, meadow dropseed, native lespedezas, other grasses, legumes, and forbs.
		Sweetgum	60	
Clarksville: CvF	4f9	Shortleaf pine	55	Little bluestem, big bluestem, indiangrass, native legumes, goldenrods and asters, New Jersey tea, deerberry, other grasses, legumes, and forbs.
		Red oak	60	
		Eastern redcedar	40	
		Loblolly pine	40	
		Black walnut	----	
		Black locust	----	
		White oak	----	
Elsah: Es	3f8	Cottonwood	90	Wildrye, switchgrass, broadspike uniola, other grasses, legumes, and forbs.
		Red oak	70	
		Shortleaf pine	70	
		Eastern redcedar	50	
Enders:				
EnD	4o1	Shortleaf pine	60	Little bluestem, big bluestem, indiangrass, Canada wildrye, catclaw sensitivebriar, Virginia tephrosia, other grasses, legumes, and forbs.
		Red oak	60	
		Loblolly pine	----	
		Eastern redcedar	----	
EoD, EoF	4x2	Shortleaf pine	60	Little bluestem, big bluestem, indiangrass, Canada wildrye, catclaw sensitivebriar, Virginia tephrosia, other grasses, legumes, and forbs.
		Red oak	60	
		Loblolly pine	----	
		Eastern redcedar	----	
Fatima: Ft	2o7	Cottonwood	90	Big bluestem, little bluestem, eastern gamagrass, wildryes, switchcane, prairie dock, compass plant, other grasses, legumes, and forbs.
		Red oak	80	
		Water oak	80	
		Shortleaf pine	80	
		Sweetgum	90	
		Sycamore	80	
		Black cherry	----	

See footnotes at end of table.

and management

means "less than"]

Potential productivity—Continued		Concerns of management			Trees to plant
Forage crops—Continued		Erosion hazard	Equipment limitations	Seedling mortality	
Yield					
Favorable years	Unfavorable years				
Lb per acre 2,500	*Lb per acre* 1,000	Slight	Slight	Slight	Loblolly pine, shortleaf pine, eastern redcedar, red oak, black walnut, black locust.
3,000	1,000	Slight	Slight	Slight	Loblolly pine, shortleaf pine, eastern redcedar, sweetgum, red oak.
3,000	1,500	Slight	Slight	Slight	Loblolly pine, shortleaf pine, eastern redcedar, red oak, black locust.
3,200	2,000	Slight	Severe	Moderate	Water oak, pin oak, sweetgum.
3,200	2,000	Slight	Severe	Moderate	Water oak, sweetgum.
2,800	1,500	Moderate to severe	Moderate to severe	Moderate to severe	Loblolly pine, shortleaf pine, red oak [2], black locust [2], black walnut [2], eastern redcedar.
2,000	500	Slight	Slight	Moderate	Cottonwood, sycamore, sweetgum, black walnut, red oak, shortleaf pine, loblolly pine, eastern redcedar.
2,800	1,200	Slight	Slight	Slight	Loblolly pine, shortleaf pine, eastern redcedar.
2,800	1,200	Slight to moderate	Moderate	Slight to moderate	Loblolly pine, shortleaf pine, eastern redcedar.
3,800	1,800	Slight	Slight	Slight	Cottonwood, sycamore, sweetgum, red oak, water oak, loblolly pine, shortleaf pine.

TABLE 8.—*Woodland productivity*

Soil series and map symbols	Woodland group	Potential productivity		
		Wood crops		Forage crops
		Important trees	Site index [1]	Important understory vegetation of forage species (medium canopy)
Healing: He, Hf	2o7	Cottonwood	90	Big bluestem, little bluestem, switchgrass, low panicums, sedges, other grasses, legumes, and forbs.
		Red oak	80	
		Water oak	80	
		Shortleaf pine	80	
		Sweetgum	90	
		Sycamore	80	
		Black cherry		
Jay: JaB	4o7	Shortleaf pine	60	Big bluestem, little bluestem, switchgrass, indiangrass, gayfeather, ashy sunflower, leadplant, other grasses, legumes, and forbs.
		Eastern redcedar	40	
		Red oak	65	
Johnsburg: Jo	4w8	Shortleaf pine	60	Big bluestem, little bluestem, switchgrass, beaked panicum, sedges, asters, goldenrods, other grasses, legumes, and forbs.
		Water oak		
Linker: LrC	4o1	Shortleaf pine	60	Big bluestem, little bluestem, indiangrass, wildryes, low panicums, other grasses, legumes, and forbs.
		Southern red oak	50	
		White oak	50	
		Eastern redcedar	40	
Mayes: Me	5w6	Water oak	50	Big bluestem, little bluestem, switchgrass, low panicums, meadow dropseed, native lespedezas, other grasses, legumes, and forbs.
		Green ash		
Mountainburg: MuD, MuE	5x3	Shortleaf pine	50	Big bluestem, little bluestem, indiangrass, low panicums, plumegrass, wildryes, black samson, asters, gayfeather, lespedezas, other grasses, legumes, and forbs.
		Eastern redcedar	30	
		Loblolly pine		
Newtonia: NeB	3o7	Shortleaf pine	70	Little bluestem, big bluestem, indiangrass, low panicums, switchgrass, wildryes, other grasses, legumes, and forbs.
		Red oak	70	
		Sweetgum	70	
		Eastern redcedar	50	
		Black walnut		
		Black cherry		
Nixa: NfC, NfD	4f8	Shortleaf pine	60	Little bluestem, big bluestem, indiangrass, low panicums, purpletop, other grasses, legumes, and forbs.
		Southern red oak	60	
		White oak	60	
		Eastern redcedar	40	
		Black locust		
Noark:				
NoD, NoE	4f8	Shortleaf pine	60	Little bluestem, big bluestem, indiangrass, low panicums, purpletop, other grasses, legumes, and forbs.
		Eastern redcedar	40	
		Southern red oak	60	
		White oak	60	
NoF	4r9	Shortleaf pine	60	Little bluestem, big bluestem, indiangrass, low panicums, purpletop, other grasses, legumes, and forbs.
		Eastern redcedar	40	
		Southern red oak	60	
		White oak	60	
Peridge: PeB, PeC	3o7	Shortleaf pine	70	Indiangrass, switchgrass, bluestems, wildrye, beaked panicum, low panicums, other grasses, legumes, and forbs.
		Southern red oak	70	
		Eastern redcedar	50	
		Black walnut		
		White oak		
		Black cherry		

See footnotes at end of table.

and management—Continued

Potential productivity—Continued		Concerns of management			Trees to plant
Forage crops—Continued		Erosion hazard	Equipment limitations	Seedling mortality	
Yield					
Favorable years	Unfavorable years				
Lb per acre	*Lb per acre*				
3,000	1,800	Slight	Slight	Slight	Cottonwood, sycamore, sweetgum, red oak, water oak, loblolly pine, shortleaf pine, black walnut, black locust.
3,000	1,500	Slight	Slight	Slight	Loblolly pine, shortleaf pine, eastern redcedar, red oak, black locust.
3,200	1,500	Slight	Moderate	Moderate	Loblolly pine, water oak, sweetgum.
3,000	1,200	Slight	Slight	Slight	Shortleaf pine, loblolly pine, eastern redcedar.
3,000	2,000	Slight	Severe	Moderate	Green ash, catalpa.
2,500	1,000	Slight to severe	Severe	Moderate	Shortleaf pine, eastern redcedar, loblolly pine.
3,500	1,500	Slight	Slight	Slight	Black walnut, black locust, red oak, sweetgum, eastern redcedar, loblolly pine, shortleaf pine.
3,200	1,500	Slight	Slight	Moderate	Shortleaf pine, loblolly pine, eastern redcedar, southern red oak.
3,200	1,500	Slight	Moderate	Moderate	Shortleaf pine, loblolly pine, eastern redcedar, southern red oak.
3,200	1,500	Moderate	Severe	Moderate	Shortleaf pine, loblolly pine, eastern redcedar, southern red oak.
3,000	1,500	Slight	Slight	Slight	Shortleaf pine, loblolly pine, black walnut, black locust, southern red oak, white ash, eastern redcedar.

TABLE 8.—*Woodland productivity*

Soil series and map symbols	Woodland group	Potential productivity		
		Wood crops		Forage crops
		Important trees	Site index [1]	Important understory vegetation of forage species (medium canopy)
Secesh: Se	3o7	Shortleaf pine Red oak White oak Sycamore Black walnut Black cherry	70 70 70 80 --- ---	Big bluestem, little bluestem, switchgrass, low panicums, sedges, other grasses, legumes, and forbs.
Sogn: SoF, SrE	5d9	Eastern redcedar	<35	Little bluestem, side-oats grama, Canada wildrye, tall dropseed, other grasses, legumes, and forbs.
Summit: SsD2	5c8	Red oak Eastern redcedar	--- 40	Little bluestem, big bluestem, indiangrass, Canada wildrye, low panicums, tall dropseed, other grasses, legumes, and forbs.
Taloka: ToA	5w6	None	---	Big bluestem, little bluestem, indiangrass, switchgrass, low panicums, sedges, other grasses, legumes, and forbs.
Tonti: TsC	4o7	Shortleaf pine Southern red oak Eastern redcedar	60 65 40	Little bluestem, big bluestem, indiangrass, low panicums, sedges, other grasses, legumes, and forbs.
Ventris: VsF	5x3	Eastern redcedar Southern red oak	35 55	Little bluestem, big bluestem, indiangrass, plumegrass, other grasses, legumes, and forbs.
Waben: WeC, WeD	3f8	Shortleaf pine Southern red oak Eastern redcedar Black walnut Black cherry White oak	70 70 40 --- --- ---	Little bluestem, big bluestem, indiangrass, switchgrass, low panicums, wildryes, other grasses, legumes, and forbs.

[1] Site class rating adapted from data gathered in soil site studies by the Soil Conservation Service and the Forest Service.
[2] On cool slopes that are in coves, on benches, along drains, or in deep pockets.

increase, along with broomsedge bluestem, poverty oatgrass, ironweed, and numerous annual weeds and grasses.

Total production of herbage on this site is about 4,000 pounds per acre in years when soil moisture is favorable and about 2,700 pounds per acre in unfavorable years. Forage production ranges from 500 to 2,000 pounds per acre.

CLAY BREAK, SHALE, RANGE SITE

This site consists of moderately deep and deep, gently sloping to steep soils that are well drained and somewhat poorly drained and very slowly and slowly permeable. Available water capacity is high, but runoff is medium to rapid. Content of plant nutrients is low in most of these soils. The surface layer is gravelly loam, stony loam, or silty clay. The subsoil is mainly clay and silty clay.

If this site is in excellent condition, the vegetation consists of open stands of oak, hickory, and winged elm that make up about 35 to 45 percent of the ground cover. The rest is grasses, legumes, and forbs. Little bluestem, big bluestem, indiangrass, and Canada wildrye are the main decreaser grasses; Virginia tephrosia, native lespedezas, and catclaw sensitivebriar are the main legumes. As the condition of the site deteriorates, redcedar and hardwood trees, broomsedge bluestem, ragweeds, white snakeroot, and annual three-awn grasses invade and increase.

Total production of herbage on this site is about 5,000 pounds per acre in years when soil moisture is favorable and about 2,500 pounds per acre in unfavorable years. Forage production ranges from 1,000 to 2,800 pounds per acre.

CLAYPAN PRAIRIE RANGE SITE

This site consists of deep, level soils that are somewhat poorly drained and poorly drained and are very slowly permeable. Available water capacity is medium to high. Content of plant nutrients is low to high. In most of these soils the surface and subsurface layers are silt loam, but in some the surface layer is silty clay loam. Their subsoil is commonly silty clay and clay.

and management—Continued

Potential productivity—Continued		Concerns of management			Trees to plant
Forage crops—Continued		Erosion hazard	Equipment limitations	Seedling mortality	
Yield					
Favorable years	Unfavorable years				
3,000	1,200	Slight	Slight	Slight	Shortleaf pine, loblolly pine, southern red oak, sycamore, black walnut.
2,000	500	Severe	Severe	Severe	None.
2,500	1,000	Moderate	Moderate	Severe	Osage-orange (bois d'arc), eastern redcedar, green ash.
4,000	2,000	Slight	Severe	Moderate	Water oak, sweetgum, green ash.
3,000	1,500	Slight	Slight	Slight	Shortleaf pine, eastern redcedar, southern red oak, black locust.
2,000	500	Moderate	Severe	Severe	Eastern redcedar.
3,200	1,500	Slight	Slight	Moderate	Shortleaf pine, loblolly pine, eastern redcedar, black walnut, black locust, southern red oak.

If this site is in excellent condition, the vegetation consists mainly of big bluestem, little bluestem, switchgrass, indiangrass, eastern gamagrass, gayfeathers, and perennial legumes. The rest is increaser plants such as dropseeds, longspike tridens, purpletop, low panicums, sedges, ashy sunflower, heath aster, indigo, and other forbs along with scattered woody plants, such as sumac and elm on low mounds. As the condition of the site deteriorates, broomsedge bluestem, ragweeds, blackberry and other woody plants, and annual grasses and forbs invade and increase.

Total production of herbage on this site is about 5,000 pounds per acre in years when soil moisture is favorable and about 3,500 pounds in unfavorable years. Forage production ranges from 2,000 to 4,000 pounds per acre.

LIMESTONE LEDGE RANGE SITE

This site consists of very shallow to moderately deep soils that are rocky or stony. These soils are moderately sloping to steep, well drained and somewhat excessively drained, and slowly to moderately permeable. Available water capacity is low, and runoff is rapid. Content of plant nutrients is moderate to high. The surface layer is silt loam. The subsoil is commonly clay that has a large amount of limestone and chert fragments throughout.

If this site is in excellent condition, most of the vegetation is big bluestem, little bluestem, side-oats grama, Canada wildrye, compassplant, black samson, catclaw sensitivebriar, and perennial lespedezas. About 15 percent is such woody plants as redcedar, fragrant sumac, smoketree, and coralberry. As the condition of the site deteriorates, such woody plants as redcedar and oak increase, along with purple prairie clover, blackeyed susan, poverty oatgrass, annual grasses, and weeds.

Total production of herbage on this site is about 3,000 pounds per acre in years when moisture is favorable and about 1,200 pounds per acre in unfavorable years. Forage production ranges from 500 to 2,000 pounds per acre.

LOAMY PRAIRIE RANGE SITE

The only soil in this site is Jay silt loam, 1 to 3 percent slopes. This nearly level soil is moderately well drained and slowly permeable. Available water capacity is medium. Content of plant nutrients is moderate. The surface layer is silt loam, and the upper part of the subsoil is silty clay loam. Below this is a firm, brittle fragipan of silty clay loam and silty loam overlying siltstone bedrock. Average thickness of the soil above the fragipan is about 2 feet. This layer restricts root growth and movement of water into the soil.

If this site is in excellent condition, the vegetation is mainly tall grasses. Big bluestem, little bluestem, indiangrass, and switchgrass are the main decreaser grasses. Growing with these grasses are perennial legumes and forbs such as bobsroot scurfpea, brownhair tephrosia, ashy sunflower, gayfeather, and leadplant. Increaser plants such as purpletop, meadow dropseed, wild indigo, heath aster, low panicums, and goldenrod make up the rest of the plant community. As the condition of the site deteriorates, the decreaser plants are replaced by dropseeds, three-awns, broomsedge bluestem, ragweeds, ironweed, coralberry, persimmon, hawthorn, sassafras, and sumac.

Total production of herbage on this site is about 7,000 pounds per acre in years when the soil moisture is favorable and about 4,200 pounds per acre in unfavorable years. Forage production ranges from 1,500 to 3,000 pounds per acre.

LOAMY UPLAND RANGE SITE

The only soil in this site is Linker fine sandy loam, 3 to 8 percent slopes. This gently sloping soil is well drained and moderately permeable. Available water capacity is medium. Content of plant nutrients is low. The rooting zone is 20 to 40 inches thick over sandstone bedrock. The surface layer is fine sandy loam, and the subsoil is loam and gravelly sandy clay loam.

If this site is in excellent condition, the vegetation consists of such trees as white oak, red oak, post oak, hickory, and shortleaf pine that make up 40 to 50 percent of the ground cover. The rest is mainly tall grasses, legumes, and forbs. The main decreaser plants are little bluestem, big bluestem, indiangrass, beaked panicum, native lespedezas, and perennial sunflowers. As the condition of the site deteriorates, the decreaser plants are replaced by broomsedge bluestem, annual three-awn grasses, ragweeds, white snakeroot, ironweed, and tree seedlings; or the canopy may be filled with hardwoods, shortleaf pine, and redcedar, with only a few palatable understory plants.

Total production of herbage on this site is about 5,500 pounds per acre in years when soil moisture is favorable and about 3,000 pounds per acre in unfavorable years. Forage production ranges from 1,200 to 3,000 pounds per acre.

SANDSTONE RIDGE RANGE SITE

This site consists of shallow, gently sloping to steep soils that are well drained and moderately rapidly permeable. Available water capacity is low. Content of plant nutrients is low. The rooting zone is 12 to 20 inches thick over sandstone bedrock. The surface and subsurface layers are gravelly sandy loam, and the subsoil is gravelly loam. These soils are stony throughout.

If this site is in excellent condition, the vegetation consists of open stands of scrubby post oak, blackjack oak, and hickory that make up about 25 to 35 percent of the ground cover. The rest is grasses, legumes, and forbs. Little bluestem makes up most of the understory; indiangrass, big bluestem, Canada wildrye, and switchgrass are other decreasers. The main forbs and legumes are perennial sunflowers, native lespedezas, Virginia tephrosia, and tickclovers. Two important shrubs are New Jersey tea and fragrant sumac.

As the condition of the site deteriorates, the decreaser grasses are replaced by oak seedlings and sprouts and such plants as hidden dropseed, three-awn grasses, broomsedge bluestem, poverty oatgrass, ironweed, ragweeds, sassafras, and persimmon; or the canopy may be filled with hardwoods, shortleaf pine, and redcedar, with only a few palatable understory plants.

Total production of herbage on this site is about 4,800 pounds per acre in years when soil moisture is favorable and about 2,000 pounds per acre in unfavorable years. Forage production ranges from 1,000 to 2,500 pounds per acre.

Engineering Uses of the Soils [8]

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 commissioners, town and city managers, land developers, engineers, contractors, and farmers.

Among properties of soils highly important in engineering are permeability, shear strength, compressibility, 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 predicted performance of structures on the same or similar kinds of soil in other locations.

[8] ROBERT P. CANTRELL, agricultural engineer, Soil Conservation Service, assisted in preparation of this section.

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 9, 10, and 11, which show, respectively, several estimated soil properties significant to engineering; interpretations for various engineering uses; and results of engineering laboratory tests on soil samples.

This information, along with the soil map and other parts of this publication, can be used to make interpretations in addition to those given in tables 9 and 10, and 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 the 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 special meaning to soil scientists that is not known to all engineers. The Glossary defines many of these terms commonly 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 (*14*), used by the SCS engineers, Department of Defense, and others, and the AASHO system (*1*), 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. Soils are grouped in 15 classes. There are eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils in the cross-hatched area of the classification chart are designated by dual symbols for example, CL-ML, SM-SC.

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 clay soils that have low strength when wet and that are the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A-1, A-2, and A-7 groups are divided as follows: A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, and A-7-6. As additional refinement, the engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 for the best material to 20 or more for the poorest. The AASHO classification for tested soils, with group index numbers in parentheses, is shown in table 11; the estimated classification, without group index numbers, is given in table 9 for all soils mapped in the survey area.

Soil properties significant to engineering

Several estimated soil properties significant in engineering are given in table 9. These estimates are made for typical soil profiles, by layers sufficiently different to have different significance for soil engineering. The estimates are based on field observations made in the course of mapping, on test data for these and similar soils, and on experience with the same kinds of soil in other counties. Following are explanations of some of the columns in table 9.

Depth to bedrock is distance from the surface of the soil to the upper surface of the rock layer.

Depth to seasonal high water table is distance from the surface of the soil to the highest level that ground water reaches in the soil in most years. The depths given in table 9 are the depths to a seasonal perched water table that is separated from the permanent water table by an impervious layer or a dry zone.

Soil texture is described in table 9 in the standard terms used by the Department of Agriculture. These terms take into account relative percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the soil contains gravel or other particles coarser than sand, an appropriate modifier is added, as for example, "gravelly silt loam." "Sand," "silt," "clay," and some of the other terms used in USDA textural classification are defined in the Glossary of this soil survey.

Liquid limit and plasticity index indicate the effect of water on the strength and consistence of soil material. As the moisture content of a clayey soil is increased from a dry state, the material changes from a semisolid to a plastic state. If the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material changes from the semisolid to a plastic state; and the liquid limit, from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is plastic. Liquid limit and plasticity index are estimated in table 9, but in table 11 the data on liquid limit and plasticity index are based on tests of soil samples.

Permeability is that quality of a soil that enables it to transmit water or air. It is estimated on the basis of those soil characteristics observed in the field, particularly structure and texture. The estimates in table 9 do not take into account lateral seepage or such transient soil features as plowpans and surface crusts. These estimates should not be confused with the coefficient of permeability, or k value, used by engineers.

Available water capacity is the ability of soils to hold water for use by most plants. It is commonly

TABLE 9.—*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 that appear in the first column of this table.

Soil series and map symbols	Depth to—		Depth from surface	USDA texture	Classification		Coarse fraction greater than 3 inches
	Bedrock	Seasonal high water table			Unified	AASHO	
	In	*Ft*	*In*				*Pct*
Britwater: BtC, BtD	>72	>6	0–6	Gravelly silt loam	ML, CL–ML, CL	A–4	
			6–22	Gravelly silty clay loam	CL	A–6	
			22–35	Gravelly silty clay loam	GC, CL	A–2 or A–6	
			35–60	Gravelly silty clay loam	GC	A–2 or A–6	
			60–74	Gravelly silty clay	GC	A–2, A–6, or A–7	
Cane: CeC	>60	1½–2	0–5	Loam	ML, CL–ML, or CL	A–4	
			5–22	Loam	ML	A–4	
			22–40	Clay loam	CL	A–6	
			40–68	Clay loam	CL	A–6	
Captina: CnB	>42	1½–2	0–7	Silt loam	ML	A–4	
			7–21	Silty clay loam	CL–ML or CL	A–4 or A–6	
			21–30	Silty clay loam	CL–ML or CL	A–4 or A–6	
			30–48	Cherty silty clay loam	GC, GM–GC, CL–ML or CL	A–4 or A–6	0–20
			48–58	Chert bedrock that has silty clay loam in crevices.			
Careytown: Co	>72	0–1	0–18	Silt loam	ML, CL–ML, or CL	A–4	
			18–27	Clay	CH	A–7	
			27–84	Clay	CH	A–7	
Cherokee: Cs	>72	0–1	0–14	Silt loam	ML or CL–ML	A–4	
			14–84	Clay and silty clay	MH or CH	A–7	
Clareson Mapped only in a complex with Sogn soils.	20–30	>2½	0–9	Silt loam	GM–GC, GM, GC, ML, CL, or CL–ML	A–4 or A–6	20–40
			9–26	Clay	GC, CL, or CH	A–7	15–35
Clarksville: CvF	>72	>6	0–24	Cherty silt loam	GM	A–1 or A–2	5–20
			24–40	Cherty silt loam	GC	A–2, A–4, A–6	10–25
			40–72	Weathered chert beds that have silt loam in crevices.	GP–GC or GC	A–2	50–75
Elsah: Es [3]	>60	>5	0–60	Cherty silt loam	GP–GM or GM	A–1 or A–2	0–10
Enders:							
EnD	>40	>3½	0–7	Gravelly loam	GM–GC, SM–SC, GM, SM, ML, or CL–ML	A–2 or A–4	0–10
			7–11	Silty clay loam	CL	A–6	0–5
			11–48	Clay	MH or CH	A–7	
EoD, EoF	>40	>3½	0–7	Loam	GM–GC, SM–SC, GM, SM, ML, or CL–ML	A–2 or A–4	25–45
			7–11	Silty clay loam	CL	A–6	0–10
			11–48	Clay	MH or CH	A–7	
Fatima: Ft [3]	>60	1–2	0–32	Silt loam	CL–ML or ML	A–4	
			32–68	Silt loam	CL–ML or CL	A–4 or A–6	

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
The symbol < means less than; the symbol > means more than]

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability [1]	Available water capacity	Reaction	Shrink-swell potential	Corrosivity to—	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
						Inches per hour	*Inches per inch of soil*	*pH*			
75–90	70–85	65–85	65–80	<30	[2] NP–10	0.6–2.0	0.15–0.20	5.1–6.0	Low	Low	Moderate.
60–80	55–75	50–75	50–70	25–40	15–25	0.6–2.0	0.09–0.16	5.1–6.0	Moderate	Moderate	Moderate.
35–60	40–55	35–55	35–55	25–40	15–25	0.6–2.0	0.08–0.11	5.1–6.0	Moderate	Moderate	Moderate.
35–60	25–50	20–50	20–50	25–40	15–25	0.6–2.0	0.04–0.11	5.1–6.0	Moderate	Moderate	Moderate.
35–60	20–50	15–45	15–45	35–55	25–40	0.6–2.0	0.03–0.09	5.1–6.0	Moderate	Moderate	Moderate.
90–100	85–95	80–95	65–80	<30	NP–10	0.6–2.0	0.15–0.18	5.1–6.0	Low	Moderate	Moderate.
90–100	85–95	80–95	65–80	20–40	2–10	0.6–2.0	0.15–0.18	4.5–5.5	Low	Moderate	High.
90–100	85–95	80–95	75–90	30–40	15–25	0.06–0.2	0.07–0.10	4.5–5.5	Low	High	High.
90–100	85–95	80–95	75–90	30–40	20–30	0.2–0.6	0.15–0.18	4.5–5.5	Low	High	High.
100	95–100	90–100	80–95	<20	NP–3	0.6–2.0	0.16–0.24	5.1–6.0	Low	Moderate	Moderate.
95–100	95–100	90–100	85–100	20–40	5–20	0.6–2.0	0.18–0.22	4.5–5.5	Low	High	High.
80–100	70–100	70–100	65–100	20–40	5–20	0.06–0.2	0.08–0.10	4.5–5.5	Low	High	High.
50–90	45–90	45–90	40–90	20–40	5–20	0.06–0.2	0.06–0.10	4.5–5.5	Low	High	High.
100	100	95–100	90–100	20–30	2–10	0.6–2.0	0.16–0.24	5.6–7.3	Low	High	Low.
100	100	95–100	90–100	55–70	30–45	<0.06	0.09–0.15	5.6–9.0	High	High	Low.
90–100	80–95	85–95	80–95	55–70	30–45	<0.06	0.06–0.09	6.6–9.0	High	High	Low.
95–100	95–100	95–100	90–100	20–40	4–10	0.2–2.0	0.16–0.24	4.5–5.5	Low	High	High.
95–100	95–100	95–100	90–100	55–65	25–35	<0.06	0.12–0.18	4.5–5.5	Moderate	High	High.
50–75	40–60	36–60	36–55	25–40	6–15	0.6–2.0	0.04–0.12	6.1–7.8	Low	Low	Low.
55–80	45–65	40–65	40–65	41–65	20–40	0.06–0.2	0.03–0.09	6.1–7.8	Moderate to high.	High	Low.
35–55	30–40	25–35	20–35		NP	2.0–6.0	0.05–0.10	4.5–6.0	Low	Low	Moderate.
35–60	30–45	25–40	20–40	25–40	8–20	2.0–6.0	0.05–0.10	4.5–5.5	Low	Low	High.
25–50	10–35	5–30	5–30	25–40	8–20	2.0–6.0	0.02–0.08	4.5–5.5	Low	Low	High.
25–60	15–45	10–40	10–35	<35	NP–10	2.0–6.0	0.03–0.10	5.6–6.5	Low	Low	Low.
50–85	40–70	35–65	30–60	25–35	4–10	0.6–2.0	0.07–0.15	5.1–6.0	Low	Low	Moderate.
80–95	70–85	65–80	60–80	30–40	11–15	0.6–2.0	0.10–0.18	4.5–5.5	Low	Moderate	High.
95–100	90–100	85–100	85–100	65–80	35–45	<0.06	0.12–0.18	4.5–5.5	High to moderate.	High	High.
50–85	40–70	35–65	30–60	25–35	4–10	0.6–2.0	0.07–0.15	5.1–6.0	Low	Low	Moderate.
80–95	70–85	65–80	60–80	30–40	11–15	0.6–2.0	0.10–0.18	4.5–5.5	Low	Moderate	High.
95–100	90–100	85–100	85–100	65–80	35–45	<0.06	0.12–0.18	4.5–5.5	High to moderate.	High	High.
95–100	95–100	90–100	90–100	<35	NP–10	0.6–2.0	0.16–0.24	5.6–6.5	Low	Moderate	Moderate.
90–100	90–100	85–100	85–100	25–40	5–20	0.6–2.0	0.16–0.24	5.6–6.5	Low	Moderate	Moderate.

TABLE 9.—*Estimated soil properties*

Soil series and map symbols	Depth to—		Depth from surface	USDA texture	Classification		Coarse fraction greater than 3 inches
	Bedrock	Seasonal high water table			Unified	AASHO	
	In	*Ft*	*In*				*Pct*
Healing: He, Hf [2]	>60	>5	0–15	Silt loam	ML or CL–ML	A–4	
			15–50	Silt loam	CL–ML or CL	A–4 or A–6	
			50–68	Gravelly silt loam	GC, CL, or SC	A–2, A–4, or A–6	
Jay: JaB	>54	1½–2½	0–11	Silt loam	ML or CL–ML	A–4	
			11–22	Silty clay loam	CL–ML or CL	A–4 or A–6	
			22–54	Silty clay loam and silt loam.	CL–ML or CL	A–4 or A–6	
			54–62	Gravelly silt loam	GM–GC, GC, SC, SM–SC, CL, or CL–ML	A–4 or A–6	
Johnsburg: Jo	>72	1–2	0–8	Silt loam	ML or CL–ML	A–4	
			8–22	Silty clay loam	CL–ML or CL	A–4 or A–6	
			22–56	Silty clay loam	CL–ML or CL	A–4 or A–6	
			56–72	Gravelly silty clay loam	GC, GM–GC, CL–ML, or CL, SC, SM–SC	A–2, A–4, or A–6	
Limestone outcrop: Lm. Too variable to estimate.							
Linker: LrC	20–40	>3½	0–6	Fine sandy loam	SM, ML, SM–SC, or CL–ML	A–2 or A–4	
			6–19	Loam	CL–ML or CL	A–4 or A–6	
			19–26	Gravelly sandy clay loam	GC, SC, SM–SC, or GM–GC	A–2, A–4, or A–6	10–40
Mayes: Me	>72	½–1	0–11	Silty clay loam	CL or CH	A–6 or A–7	
			11–72	Silty clay and clay	CH	A–7	
Mountainburg: MuD, MuE	12–20	>2	0–6	Gravelly sandy loam	SM	A–2	20–40
			6–19	Gravelly loam	SM, SC, SM–SC, ML, CL, or CL–ML	A–2 or A–4	20–40
Newtonia: NeB	>72	>6	0–17	Silt loam	ML, CL–ML, or CL	A–4 or A–6	
			17–61	Silty clay loam	CL	A–4, A–6, or A–7	
			61–72	Silty clay	CL or CH	A–6 or A–7	
Nixa: NfC, NfD	40–60	>5	0–17	Cherty silt loam	GM, GC, or GM–GC	A–1, A–2, or A–4	0–15
			17–30	Cherty silt loam	GM, GC, or GM–GC	A–1, A–2, or A–4	0–15
			30–50	Weathered chert beds that has clay in crevices.	GC or GP–GC	A–2	10–40
Noark: NoD, NoE, NoF	>60	>5	0–10	Cherty silt loam	GM	A–1, A–2, or A–4	
			10–17	Cherty silty clay loam	GC–GM or GC	A–2, A–4, or A–6	
			17–30	Cherty clay	GC	A–2 or A–7	5–10
			30–72	Very cherty clay	GP–GC or GC	A–2	5–10
Peridge: PeB, PeC	>60	>5	0–9	Silt loam	ML or CL–ML	A–4	
			9–42	Silty clay loam	CL	A–6	
			42–54	Gravelly silty clay loam	GC, CL, SC, or SM–SC	A–6	

See footnotes at end of table.

significant to engineering—Continued

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability [1]	Available water capacity	Reaction	Shrink-swell potential	Corrosivity to—	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
						Inches per hour	*Inches per inch of soil*	*pH*			
90–100	90–100	90–100	85–100	<30	NP–7	0.6–2.0	0.16–0.24	5.6–6.5	Low	Low	Moderate.
90–100	90–100	90–100	85–100	20–35	5–15	0.6–2.0	0.16–0.24	5.6–6.5	Low	Low	Moderate.
50–95	40–90	35–85	30–80	25–40	8–20	0.6–2.0	0.08–0.22	5.6–6.5	Low	Low	Moderate.
95–100	95–100	90–100	85–95	<30	NP–7	0.6–2.0	0.16–0.24	5.6–6.5	Low	Moderate	Moderate.
95–100	95–100	90–100	85–95	25–35	5–15	0.2–0.6	0.18–0.22	4.5–5.5	Low	Moderate	High.
95–100	90–100	90–100	80–95	25–35	5–15	0.06–0.2	0.09–0.12	4.5–5.5	Low	Moderate	High.
60–90	45–90	45–90	40–85	25–35	5–15	0.2–0.6	0.8–0.22	4.5–5.5	Low	Moderate	High.
95–100	95–100	90–100	90–100	<30	NP–7	0.6–2.0	0.16–0.24	5.1–6.0	Low	Moderate	Moderate.
95–100	95–100	90–100	90–100	20–35	5–15	0.06–0.2	0.18–0.22	4.5–5.5	Low	Moderate	High.
90–100	90–100	85–100	85–100	25–40	5–18	<0.06	0.09–0.11	4.5–5.5	Low	Moderate	High.
60–95	45–80	40–80	30–80	25–35	5–15	0.06–0.2	0.09–0.11	4.5–5.5	Low	Moderate	High.
90–100	80–95	60–80	30–70	<30	NP–7	0.6–2.0	0.10–0.14	5.1–6.0	Low	Low	Moderate.
90–100	85–100	80–100	60–95	20–40	5–15	0.6–2.0	0.14–0.20	4.5–5.5	Low	Low	High.
60–80	50–75	40–65	30–50	20–40	5–15	0.6–2.0	0.06–0.14	4.5–5.5	Low	Low	High.
.....	100	95–100	90–100	35–55	15–30	0.06–0.2	0.18–0.22	6.1–7.8	Moderate	High	Low.
100	95–100	95–100	90–100	51–65	30–40	<0.06	0.12–0.18	6.1–7.8	High	High	Low.
75–85	65–80	50–60	15–35	.....	NP	2.0–6.0	0.05–0.08	5.1–6.0	Low	Low	Moderate.
75–85	65–80	55–85	30–60	<30	NP–10	2.0–6.0	0.05–0.08	4.5–5.5	Low	Low	High.
.....	.....	100	85–100	<35	NP–12	0.6–2.0	0.16–0.24	5.6–7.3	Low	Low	Low.
95–100	95–100	95–100	85–100	30–45	8–20	0.6–2.0	0.18–0.22	5.6–6.5	Low	Moderate	Moderate.
90–100	80–100	80–100	75–100	40–60	20–35	0.6–2.0	0.14–0.18	5.6–6.5	Moderate	High	Moderate.
40–70	30–60	25–55	20–50	<30	NP–8	0.6–2.0	0.06–0.16	4.5–6.0	Low	Moderate	Moderate.
40–70	30–60	25–55	20–50	<30	NP–8	<0.06	0.03–0.08	4.5–5.5	Low	Moderate	High.
15–45	5–35	5–30	5–25	30–40	12–20	0.06–0.2	0.02–0.06	4.5–5.5	Low	Moderate	High.
20–50	20–50	20–50	15–45	.....	NP	0.6–2.0	0.10–0.14	4.5–6.0	Low	Low	High.
20–50	20–50	20–50	15–45	20–35	5–15	0.6–2.0	0.10–0.14	4.0–5.5	Low	Low	High.
20–50	20–50	20–50	15–45	45–60	20–35	0.6–2.0	0.04–0.12	4.0–5.5	Low	Moderate	High.
10–40	10–40	10–40	5–35	45–60	20–35	0.6–2.0	0.02–0.09	4.0–5.5	Low	Moderate	High.
95–100	90–100	85–100	80–95	<20	NP–5	0.6–2.0	0.16–0.24	5.1–6.5	Low	Low	Moderate.
95–100	90–100	85–100	80–95	30–40	11–20	0.6–2.0	0.18–0.22	4.5–5.5	Low	Moderate	High.
60–80	50–80	45–75	40–70	30–40	11–20	0.6–2.0	0.09–0.22	4.5–5.5	Low	Moderate	High.

TABLE 9.—*Estimated soil properties*

Soil series and map symbols	Depth to—		Depth from surface	USDA texture	Classification		Coarse fraction greater than 3 inches
	Bedrock	Seasonal high water table			Unified	AASHO	
	In	*Ft*	*In*				*Pct*
Peridge.—Continued			54–74	Gravelly silty clay and silty clay.	GC, CL, SC, or SM–SC	A–6 or A–7	
Secesh: Se [1]	>60	>5	0–10	Gravelly silt loam	GM, GM–GC, ML, CL–ML, SC, or SM–SC	A–4	
			10–24	Gravelly silt loam	GM–GC, GC, CL–ML, CL, SC, or SM–SC	A–4 or A–6	
			24–74	Gravelly silt loam	GC, GP–GC, or SM–SC	A–2, A–4, or A–6	
*Sogn: SoF, SrE For Clareson part of SrE, see Clareson series.	5–16	>1½	0–8	Cobbly silt loam	CL, CL–ML	A–4 or A–6	25–55
Summit: SsD?	>60	2–3	0–26	Silty clay	CL or CH	A–7	
			26–72	Clay	CL or CH	A–7	
Taloka: ToA	>72	0–1	0–22	Silt loam	ML or CL–ML	A–4	
			22–36	Clay	CL or CH	A–7	
			36–72	Silty clay loam	CL or CH	A–6 or A–7	
Tonti: TsC	40–60	>5	0–6	Cherty silt loam	ML	A–4	0–5
			6–19	Cherty silty clay loam	GC, GM–SC, SC, SM–SC, CL–ML, or CL	A–4 or A–6	0–5
			19–29	Cherty silty clay loam	GC, CL, or SC	A–2, A–4, or A–6	0–5
			29–42	Cherty silty clay loam	GC	A–2, A–4, or A–6	5–10
Ventris: VsF	26–40	>3½	0–4	Cherty silt loam	GC, GM, CL, ML, SM, or SC	A–2, A–4, A–6, or A–7	0–10
			4–14	Clay	CL or CH	A–7	
			14–36	Silty clay	CL or CH	A–7	
Waben: WeC, WeD	>60	>5	0–66	Cherty silt loam and very cherty silt loam.	GP–GM, GP–GC, GM, GM–GC, GC, SM, SC, SM–SC, or SP–SM	A–1 or A–2	0–5

[1] The range of permeability should not be confused with the coefficient of permeability, or *k*-value, used by engineers.
[2] NP = nonplastic.

defined as the difference between the amount of water in the soil at field capacity and the amount at the wilting point of most crop plants.

Reaction is the degree of acidity or alkalinity of a soil, expressed in pH values. The pH value and terms used to describe soil reaction are explained in the Glossary.

Shrink-swell potential is the relative change in volume to be expected of soil material with changes in moisture content, that is, the extent to which the soil shrinks as it dries out or swells when it gets wet. Extent of shrinking and swelling is influenced by the amount and kind of clay in the soil. Shrinking and swelling of soils causes much damage to building foundations, roads, and other structures. A *high* shrink-swell potential indicates a hazard to maintenance of structures built in, on, or with material having this rating.

Corrosivity, as used in table 9, pertains to potential soil-induced chemical action that dissolves or weakens

significant to engineering—Continued

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability [1]	Available water capacity	Reaction	Shrink-swell potential	Corrosivity to—	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
						Inches per hour	*Inches per inch of soil*	*pH*			
60–80	50–80	45–75	40–70	35–45	15–25	0.6–2.0	0.06–0.18	4.5–5.5	Moderate	High	High.
60–85	55–75	50–70	45–65	<30	NP–7	0.6–2.0	0.11–0.20	5.6–6.5	Low	Low	Low.
60–85	55–75	50–70	45–65	20–35	5–15	0.6–2.0	0.11–0.20	5.1–6.0	Low	Low	Moderate.
20–70	10–60	5–55	5–50	20–35	8–15	0.6–2.0	0.04–0.18	5.1–6.0	Low	Low	Moderate.
60–75	55–70	55–65	55–65	25–40	5–15	0.6–2.0	0.04–0.16	6.6–8.4	Low	Low	Low.
85–100	75–100	70–100	70–100	41–55	20–30	0.06–0.2	0.10–0.18	5.6–7.3	High	High	Low.
80–100	70–100	65–100	65–100	45–65	25–35	0.06–0.2	0.10–0.18	6.1–7.8	High	High	Low.
95–100	95–100	95–100	90–100	<35	NP–10	0.2–0.6	0.16–0.24	5.1–6.0	Low	High	Moderate.
95–100	95–100	95–100	90–100	45–70	30–40	<0.06	0.12–0.18	5.1–6.0	High	High	Moderate.
95–100	95–100	95–100	90–100	35–55	25–35	0.06–0.2	0.18–0.22	5.1–6.0	Moderate	High	Moderate.
70–80	65–75	60–70	60–70	.....	NP	0.6–2.0	0.12–0.20	4.5–5.5	Low	Moderate	High.
60–85	50–80	45–75	45–75	20–40	5–15	0.6–2.0	0.12–0.20	4.5–5.5	Low	High	High.
50–70	40–65	35–60	30–60	20–40	8–20	0.06–0.2	0.03–0.08	4.5–5.5	Low	High	High.
35–55	25–45	20–40	20–45	20–40	8–20	0.06–0.2	0.03–0.06	4.5–5.5	Low	High	High.
45–80	40–80	35–75	30–70	30–49	8–25	0.6–2.0	0.08–0.22	5.6–7.3	Low	Moderate	Low.
85–100	75–100	70–95	65–95	45–65	20–40	<0.06	0.10–0.18	5.6–7.3	High	High	Low.
85–100	75–100	70–95	65–95	41–65	20–40	<0.06	0.12–0.18	6.1–8.4	High	High	Low.
30–60	15–50	10–45	5–35	<30	NP–10	2.0–6.0	0.03–0.12	5.1–6.5	Low	Low	Moderate.

[1] These soils are subject to flooding.

uncoated steel or concrete. Rate of corrosion of uncoated steel is related to soil properties such as drainage, texture, total acidity, and electrical conductivity of the soil material. Corrosivity to concrete is influenced mainly by the content of sodium or magnesium sulfate, but also by soil texture and acidity. Installations of uncoated steel that intersect soil boundaries or soil horizons are more susceptible to corrosion than installations entirely in one kind of soil or in one soil horizon. A corrosivity rating of *low* means that there is a low probability of soil-induced corrosion damage. A rating of *high* means that there is a high probability of damage, so that protective measures for steel and more resistant concrete should be used to avoid or minimize damage.

Engineering interpretations of the soils

The estimated interpretations in table 10 are based on the engineering properties of soils shown in table 9, on test data for soils in this survey area and others

TABLE 10.—*Engineering*

[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 that appear

Soil series and map symbols	Suitability as a source of—		Soil features affecting—
	Topsoil	Road fill [1]	Pond reservoir areas
Britwater: BtC, BtD	Poor: somewhat plastic above a depth of 6 inches; coarse fragments.	Fair to poor: moderate shrink-swell potential; moderate bearing capacity.	Moderate permeability
Cane: CeC	Fair: coarse fragments; material below a depth of 22 inches somewhat difficult to reclaim.	Fair: moderate bearing capacity	Features generally favorable
Captina: CnB	Fair: somewhat plastic above a depth of 7 inches; material below a depth of 21 inches somewhat difficult to reclaim.	Fair: moderate bearing capacity	Features generally favorable; moderately deep or deep to bedrock.
Careytown: Co	Poor: poorly drained	Poor: poorly drained; high shrink-swell potential; low bearing capacity.	Features generally favorable
Cherokee: Cs	Fair: plastic within a depth of 14 inches.	Poor: low bearing capacity	Features generally favorable
Clareson Mapped only in a complex with Sogn soils.	Poor: coarse fragments; underlying material difficult or impractical to reclaim; slopes of more than 15 percent in many places.	Fair to poor: moderate to high shrink-swell potential; moderate to low bearing capacity; material less than 30 inches thick; excavated areas difficult or impractical to reclaim.	Bedrock at a depth of 20 to 30 inches.
Clarksville: CvF	Poor: coarse fragments; slopes of more than 15 percent in most places.	Good to fair where slopes are less than 25 percent: high to moderate bearing capacity. Poor where slopes are more than 25 percent: excavated areas difficult to reclaim.	Moderately rapid permeability.
Elsah: Eg	Poor: coarse fragments	Good to fair: high to moderate bearing capacity.	Moderately rapid permeability.
Enders:			
EnD	Poor: coarse fragments; underlying material difficult to reclaim.	Poor: high shrink-swell potential; low bearing capacity; excavated areas difficult to reclaim.	Features generally favorable; very slow permeability.
EoD, EoF	Poor: surface stones; slopes of more than 15 percent in many places; underlying material difficult to reclaim.	Poor: high to moderate shrink-swell potential; low bearing capacity; excavated areas difficult to reclaim; slopes of more than 25 percent in some places.	Surface stones; moderately deep to bedrock; slopes limit storage capacity.
Fatima: Ft	Good	Fair: moderate bearing capacity	Moderate permeability
Healing: He, Hf	Good	Fair: moderate bearing capacity	Moderate permeability

interpretations

such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for in the first column of this table]

Soil features affecting—Continued			
Embankments, dikes, and levees	Drainage of crops and pasture	Irrigation	Terraces and diversions
Medium to low strength; low to medium compressibility; good to fair compaction characteristics.	Well drained; gently sloping to moderately sloping.	Moderate intake rate; moderate permeability; medium available water capacity; medium to rapid runoff.	Features generally favorable. Slope in BcD; erodible.
Medium to low strength; medium compressibility; fair to good compaction characteristics; subject to piping unless well mixed.	Moderately well drained; gently sloping.	Slow intake rate; slow permeability; medium available water capacity; medium runoff.	Features generally favorable.
Medium to low strength; medium compressibility; fair to good compaction characteristics; subject to piping.	Moderately well drained; nearly level.	Moderate intake rate; slow permeability; medium available water capacity; medium runoff.	Features generally favorable.
Medium to low strength; high compressibility; fair to poor compaction characteristics; high shrink-swell potential.	Very slow permeability; poorly drained.	Slow intake rate; very slow permeability; medium available water capacity.	Level; practice not applicable.
Medium to low strength; high compressibility; fair to poor compaction characteristics; moderate shrink-swell potential.	Very slow permeability; somewhat poorly drained.	Slow intake rate; very slow permeability; high available water capacity.	Level; practice not applicable.
Medium to low strength; medium to high compressibility; fair to poor compaction characteristics; moderate to high shrink-swell potential; thin layer of borrow material.	Well drained; moderately sloping to moderately steep.	Generally nonarable; practice not applicable.	Slope; generally nonarable; practice not applicable.
High to medium strength; low to medium compressibility; fair to good compaction characteristics; medium to low permeability; subject to piping.	Somewhat excessively drained; moderately steep to steep.	Generally nonarable; practice not applicable.	Slope; generally nonarable; practice not applicable.
High to medium strength; low compressibility; fair to good compaction characteristics; medium to low permeability; subject to piping.	Somewhat excessively drained.	Rapid intake rate; moderately rapid permeability; low available water capacity; subject to flooding.	Level to nearly level; on flood plains; practice not applicable.
Low strength; high compressibility; fair to poor compaction characteristics; low to medium permeability.	Well drained; gently sloping to moderately sloping.	Slow intake rate; very slow permeability; high available water capacity; rapid runoff.	Erodible; very slow permeability; subsoil material in embankments likely to crack when dry; terraces subject to fail; slope.
Low strength; high compressibility; fair to poor compaction characteristics; low to medium permeability; surface stones.	Well drained; gently sloping to steep.	Generally nonarable; practice not applicable.	Generally nonarable; surface stones; slope; practice not applicable.
Medium to low strength; medium compressibility; fair to good compaction characteristics; medium to low permeability; subject to piping.	Moderately well drained	Moderate intake rate; moderate permeability; high available water capacity; subject to occasional flooding.	Level; practice not applicable.
Medium to low strength; medium compressibility; fair to good compaction characteristics; medium to low permeability; subject to piping.	Well drained	Moderate intake rate; moderate permeability; high available water capacity; Hf subject to occasional flooding.	Level to nearly level; practice not applicable.

TABLE 10.—*Engineering*

Soil series and map symbols	Suitability as a source of—		Soil features affecting—
	Topsoil	Road fill [1]	Pond reservoir areas
Jay: JaB	Fair: somewhat plastic material above a depth of 11 inches; material below a depth of 22 inches somewhat difficult to reclaim.	Fair: moderate bearing capacity	Features generally favorable
Johnsburg: Jo	Fair: somewhat plastic material above a depth of 8 inches; material below a depth of 22 inches somewhat difficult to reclaim.	Fair: moderate bearing capacity	Features generally favorable
Limestone outcrop: Lm	Unsuited: bedrock at or near the surface.	Unsuited: bedrock at or near the surface.	Bedrock at or near the surface.
Linker: LrC	Fair to poor: coarse fragments; thin layer over moderately plastic material; excavated areas difficult or impractical to reclaim.	Fair to poor: moderate bearing capacity; material between 20 and 40 inches thick; excavated areas difficult or impractical to reclaim.	Moderate permeability; bedrock at a depth of 20 to 40 inches.
Mayes: Me	Fair to poor: somewhat plastic and difficult to work; plastic material below a depth of 11 inches.	Poor: high shrink-swell potential; low bearing capacity.	Features generally favorable
Mountainburg: MuD, MuE	Poor: stony; thin layer; bedrock at a depth of 12 to 20 inches; excavated areas impractical to reclaim.	Poor: thin layer; stony; bedrock at a depth of 12 to 20 inches; excavated areas impractical to reclaim.	Moderately rapid permeability; bedrock at a depth of 12 to 20 inches.
Newtonia: NeB	Good	Fair to poor: moderate bearing capacity; moderate shrink-swell potential below a depth of 61 inches.	Moderate permeability
Nixa: NlC, NlD	Poor: coarse fragments; excavated areas difficult to reclaim.	Fair: moderate to high bearing capacity; excavated areas difficult or impractical to reclaim.	Moderately deep to bedrock
Noark: NoD	Poor: coarse fragments	Fair: moderate bearing capacity; excavated areas difficult to reclaim.	Moderate permeability
NoE, NoF	Poor: coarse fragments; slopes of more than 15 percent in most places.	Fair where slopes are less than 25 percent: moderate bearing capacity; excavated areas difficult to reclaim. Poor where slopes are more than 25 percent.	Moderate permeability; slopes limit storage capacity.
Peridge: PeB, PeC	Fair: somewhat plastic material above a depth of 9 inches.	Fair: moderate bearing capacity	Moderate permeability
Secesh: Se	Poor: coarse fragments	Good to fair: high to moderate bearing capacity; excavated areas difficult to reclaim.	Moderate permeability
*Sogn: SoF, SrE. For Clareson part of SrE, see Clareson series.	Poor: cobbly and stony; thin layer; bedrock at a depth between 5 and 16 inches; excavated areas impractical to reclaim; slopes of more than 15 percent in most places.	Poor: thin layer; bedrock at a depth between 5 and 16 inches; excavated areas impractical to reclaim.	Bedrock at a depth between 5 and 16 inches.

interpretations—Continued

Soil features affecting—Continued			
Embankments, dikes, and levees	Drainage of crops and pasture	Irrigation	Terraces and diversions
Medium to low strength; medium compressibility; fair to good compaction characteristics; medium to low permeability; subject to piping.	Moderately well drained; nearly level.	Slow intake rate; slow permeability; medium available water capacity; medium runoff.	Features generally favorable.
Medium to low strength; medium compressibility; fair to good compaction characteristics; medium to low permeability; subject to piping.	Very slow permeability; somewhat poorly drained.	Slow intake rate; very slow permeability; medium available water capacity.	Level; practice not applicable.
Bedrock at or near the surface	Excessively drained; bedrock at or near the surface.	Bedrock at or near the surface; nonarable; practice not applicable.	Bedrock at or near the surface; nonarable; practice not applicable.
Medium strength; medium compressibility; fair compaction characteristics; thin layer of borrow material.	Well drained; gently sloping	Moderate intake rate; moderate permeability; medium available water capacity; medium runoff.	Features generally favorable; erodible; subject to piping; bedrock at a depth of 20 to 40 inches.
Medium to low strength; high compressibility; fair to poor compaction characteristics; high shrink-swell potential.	Very slow permeability; somewhat poorly drained.	Slow intake rate; very slow permeability; high available water capacity.	Level; practice not applicable.
Thin layer of borrow material; stony; medium permeability; subject to piping.	Well drained; gently sloping to steep.	Rapid intake rate; moderately rapid permeability; low available water capacity; rapid runoff; generally nonarable.	Coarse fragments; bedrock at a depth of 12 to 20 inches; slope; generally nonarable.
Medium to low strength; medium to high compressibility; fair to poor compaction characteristics; moderate shrink-swell potential in material below a depth of 61 inches.	Well drained; nearly level	Moderate intake rate; moderate permeability; high available water capacity.	Features generally favorable.
Medium to high strength; low to medium compressibility; fair to good compaction characteristics; low to medium permeability; subject to piping.	Moderately well drained; gently sloping to moderately sloping.	Slow intake rate; very slow permeability; low available water capacity; medium to rapid runoff.	Erodible; very slow permeability; slope.
Medium to high strength; low to medium compressibility; good to fair compaction characteristics; low to medium permeability.	Well drained; moderately sloping.	Moderate intake rate; moderate permeability; medium available water capacity; medium to rapid runoff.	Slope; practice not applicable.
Medium to high strength; low to medium compressibility; good to fair compaction characteristics; low to medium permeability.	Well drained; moderately steep to steep.	Generally nonarable; slope; practice not applicable.	Slope; generally nonarable; practice not applicable.
Medium to low strength and compressibility; fair to good compaction characteristics.	Well drained; nearly level to gently sloping.	Moderate intake rate; moderate permeability; high available water capacity; medium runoff.	Features generally favorable.
Medium to low strength and compressibility; fair to good compaction characteristics.	Well drained; on flood plains	Moderate intake rate; moderate permeability; medium available water capacity; subject to occasional flooding.	Level to nearly level; practice not applicable.
Bedrock at a depth between 5 and 16 inches.	Somewhat excessively drained; moderately sloping to steep.	Generally nonarable soil; bedrock at a depth between 5 and 16 inches; practice not applicable.	Slope; bedrock at a depth between 5 and 16 inches; generally nonarable; practice not applicable.

TABLE 10.—*Engineering*

Soil series and map symbols	Suitability as a source of—		Soil features affecting—
	Topsoil	Road fill [1]	Pond reservoir areas
Summit: SsD2	Poor: plastic material; difficult to work.	Poor: low bearing capacity; high shrink-swell potential.	Features generally favorable.
Taloka: ToA	Good	Poor: low to moderate bearing capacity; high to moderate shrink-swell potential; subject to piping unless well mixed.	Features generally favorable.
Tonti: TsC	Poor: coarse fragments	Fair: moderate bearing capacity; bedrock at a depth between 40 and 60 inches.	Bedrock at a depth between 40 and 60 inches.
Ventris: VsF	Poor: stones and coarse fragments in thin surface layer; material below plastic, clayey; excavated areas difficult to reclaim.	Poor: stony surface; bedrock at a depth between 26 and 40 inches; low bearing capacity; high shrink-swell potential; excavated areas difficult or impractical to reclaim.	Bedrock at a depth between 26 and 40 inches.
Waben: WeC, WeD	Poor: coarse fragments	Good	Moderately rapid permeability.

[1] Engineers and others should not apply specific values to the ratings of bearing capacity in this table.

nearby or adjoining, and on the experience of engineers and soil scientists with the soils of Benton County. In table 10, ratings are used to summarize suitability of the soils for all listed purposes other than for drainage of cropland and pasture, irrigation, pond reservoir areas, embankments, and terraces and diversions. For these particular uses, table 10 lists those soil features not to be overlooked in planning, installation, and maintenance. Specific values should not be assigned to the ratings of bearing capacity given in table 10.

Soil suitability is rated by the terms *good*, *fair*, and *poor*, which have, respectively, meanings approximately parallel to the terms slight, moderate, and severe. The latter terms are defined in the section "Town and Country Planning."

Following are explanations of some of the columns in table 10.

Sand and gravel are used in great quantities in many kinds of construction. Because sand and gravel of suitable quality for use as aggregate are of very limited quantity in Benton County, the soils are not rated for suitability as possible sources.

Topsoil is used for topdressing an area where vegetation is to be established and maintained. Suitability is affected mainly by ease of working and spreading the soil material, as for preparing a seedbed; natural fertility of the material, or the response of plants when fertilizer is applied; and absence of substances toxic to plants. Texture of the soil material and its content of stone fragments are characteristics that affect suitability, but also considered in the ratings is damage that will result at the area from which topsoil is taken.

Road fill is soil material used in embankments for roads. The suitability ratings reflect (1) the predicted performance of soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage and (2) the relative ease of excavating the material at borrow areas.

Pond reservoir areas hold water behind a dam or embankment. Soils suitable for pond reservoir areas have low seepage, which is related to their permeability and depth to fractured or permeable bedrock or other permeable material.

Embankments, dikes, and levees require soil material resistant to seepage and piping and of favorable stability, shrink-swell potential, shear strength, and compactibility. Presence of stones or organic material in a soil are among factors that are unfavorable.

Drainage of crops and pasture is affected by such soil properties as permeability, texture, and structure; depth to claypan, rock, or other layers that influence rate of water movement; depth to the water table; slope stability in ditchbanks; susceptibility to stream overflow; salinity or alkalinity; and availability of outlets for drainage.

Irrigation of a soil is affected by such features as slope; susceptibility to stream overflow, water erosion or soil blowing; soil texture; content of stones; accu-

interpretations—Continued

Soil features affecting—Continued			
Embankments, dikes, and levees	Drainage of crops and pasture	Irrigation	Terraces and diversions
Medium to low strength; medium to high compressibility; fair to poor compaction characteristics; low to medium permeability; high shrink-swell potential.	Slow permeability; somewhat poorly drained.	Slow intake rate; slow permeability; high available water capacity; generally nonarable; practice not applicable.	Slope; material shrinks and cracks when dry, terraces likely to fail; generally nonarable; practice not applicable.
Medium to low strength; medium to high compressibility; fair to poor compaction characteristics; low to medium permeability; moderate to high shrink-swell potential.	Very slow permeability; somewhat poorly drained.	Slow intake rate; very slow permeability; high available water capacity.	Level; practice not applicable.
Medium to low strength and compressibility; fair to good compaction characteristics; bedrock at a depth between 40 and 60 inches.	Moderately well drained; gently sloping.	Slow intake rate; slow permeability; medium available water capacity; medium runoff.	Features generally favorable.
Medium to low strength; medium to high compressibility; fair to poor compaction characteristics; high shrink-swell potential; bedrock at a depth between 26 and 40 inches.	Moderately well drained; moderately steep to steep.	Generally nonarable; practice not applicable.	Slope; generally nonarable; practice not applicable.
Medium to high strength; low to medium compressibility; fair to good compaction characteristics; low to medium permeability; subject to piping.	Well drained; gently sloping to moderately sloping.	Moderately rapid intake rate and permeability; medium to low available water capacity; medium runoff.	Features generally favorable in WeC; subject to piping, terraces difficult to maintain. Slope in WeD.

mulations of salts and alkali; depth of root zone; rate of water intake at the surface; permeability of soil layers below the surface layer and in fragipans or other layers that restrict movement of water; amount of water held available to plants; and need for drainage, or depth to water table or bedrock.

Terraces and diversions are embankments, or ridges, constructed across the slope to intercept runoff so that it soaks into the soil or flows slowly to a prepared outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock or other unfavorable material; presence of stones; permeability; and resistance to water erosion, soil slipping, and soil blowing. A soil suitable for these structures provides outlets for runoff and is not difficult to vegetate.

Soil test data

Table 11 contains engineering test data for some of the major soil series in Benton County. These tests were made to help evaluate the soils for engineering purposes. The engineering classifications given are based on data obtained by mechanical analyses and by tests to determine liquid limit and plastic limit. The mechanical analyses were made by combined sieve and hydrometer methods.

Compaction (or moisture-density) data are important in earthwork. If a soil material is compacted at 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, density decreases with increase in moisture content. The highest dry density obtained in the compactive test is termed *maximum dry density*. As a rule, maximum strength of earthwork is obtained if the soil is compacted to the maximum dry density.

Tests to determine liquid limit and plastic limit measure the effect of water on the consistence of soil material, as has been explained for table 9.

Town and Country Planning

Table 12 gives the degree and kind of limitation of the soils of Benton County for selected uses. The degree of limitation reflects features that affect a particular use of the given soil, to a depth of about 6 feet or to bedrock.

The detailed soil map and the information in table 12 are guides for evaluating areas for the specific uses. They do not eliminate the need for detailed onsite investigations before a final determination is made.

Additional information that may be useful in town and country planning is given in the sections "Engineering Uses of the Soils" and "Recreation."

Soil limitations are indicated by the ratings slight, moderate, and severe. *Slight* means soil properties are generally favorable for the rated use, or limitations are minor and easily overcome. *Moderate* means some

TABLE 11.—*Engineering*

[Tests made by the Arkansas State Highway

Soil name and location	Parent material	SCS number 5-67-Ark-4	Depth	Moisture density [1]	
				Maximum dry density	Optimum moisture
			In	*Lb per cu ft*	*Pct*
Nixa cherty silt loam: NE¼SW¼SE¼ sec. 23, T. 21 N., R. 31 W. (Modal)	Cherty limestone residuum.	3-2	3–17	102	17
		3-3	17–30	104	18
Peridge silt loam: SE¼SW¼SW¼ sec. 12, T. 18 N., R. 30 W. (Modal)	Stream terrace material weathered from limestone and siltstone on uplands.	9-1	0–9	106	15
		9-2	9–26	108	18
		9-3	26–42	110	17
Secesh gravelly silt loam: SW¼SW¼SE¼ sec. 19, T. 19 N., R. 31 W. (Modal)	Alluvium weathered from cherty limestone on uplands.	8-3	24–44	109	16
Taloka silt loam: SW¼NE¼SW¼ sec. 24, T. 21, N., R. 34 W. (Modal)	Loess over clayey old alluvium.	3-1	0–12	103	17
		3-4	22–36	85	29
		3-5	36–72	102	23
Ventris stony silt loam: NW¼SE¼SE¼ sec. 13, T. 20 N., R. 28 W. (Modal)	Limestone residuum.	6-1	0–7	94	24
		6-2	7–14	95	25
		6-3	14–31	107	19

[1] Based on AASHO Designation T 99-57, Method A (*1*).

[2] Mechanical analyses according to the AASHO Designation T 88-57 (*1*). Results by this procedure may differ somewhat from the result obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by a hydrometer method, and the various grain-size fractions are calculated on the basis of all material up to and including that 3 inches in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method, and the material coarser than 2 millimeters in diameter is excluded from the calculation of grain-size fractions. The mechanical analysis data used in this table are not suitable for use in naming textural classes of soil.

soil properties are unfavorable, but the limitations can be overcome or modified by special planning and design. *Severe* means soil properties are so unfavorable and so difficult to correct or overcome that major soil reclamation, special designs, or intensive maintenance are needed.

Dwellings, as rated in table 12, are not more than three stories high and are supported by foundation footings placed in undisturbed soil. The features that affect the rating of a soil for dwellings are those that relate to capacity to support load and resist settlement under load and those that relate to ease of excavation. Soil properties that affect capacity to support load are wetness, susceptibility to flooding, density, plasticity, texture, and shrink-swell potential. Those that affect excavation are wetness, slope, depth to bedrock, and content of stones and rock.

Shallow excavations require digging or trenching to a depth of less than 6 feet; for example, excavations for pipelines, sewerlines, phone and power transmission lines, basements, open ditches, and cemeteries. Desirable soil properties are good workability, moderate resistance to sloughing, gentle slopes, absence of rock outcrop or big stones, and freedom from flooding or a high water table.

Local roads and streets, as rated in table 12, have an all-weather surface expected to carry automobile traffic all year. They have a subgrade of underlying soil material; a base of gravel, crushed rock, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly of asphalt or concrete. These roads are graded to shed water and have ordinary provisions for drainage. They are built mainly from soil at hand, and most cuts and fills are less than 6 feet deep.

Soil properties that affect design and construction of roads and streets are load supporting capacity and stability of the subgrade and the workability and quantity of cut and fill material available. The AASHO and Unified classifications of the soil material, and also the shrink-swell potential, indicate traffic-supporting capacity. Wetness and flooding affect stability of the material. Slope, depth to hard rock, content of stones and rocks, and wetness affect ease of excavation and amount of cut and fill needed to reach an even grade.

Ratings for light industry are for undisturbed soils that are used to support building foundations. Emphasis is on foundations, ease of excavation for underground utilities, and corrosion potential of uncoated steel pipe. The undisturbed soil is rated for spread footing foundations for buildings less than three stories high or foundation loads not in excess of that weight. Properties affecting load-supporting capacity

test data

Department, Division of Materials and Tests]

Mechanical analyses [1]							Liquid limit [2]	Plasticity index [4]	Classification	
Percentage less than 3 inches passing sieve—										
1½ in	¾ in	⅜ in	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)			AASHO [3]	Unified [5]
							Pct			
[7] 90	78	68	56	53	49	47	----------	[8] NP	A–4(3)	GM
89	72	59	48	45	42	41	24	3	A–4(1)	GM
----------	----------	----------	----------	100	98	82	----------	NP	A–4(8)	ML
----------	----------	----------	----------	100	99	92	36	16	A–6(11)	CL
----------	----------	----------	100	99	98	90	34	16	A–6(11)	CL
[9] 89	87	65	53	46	41	37	28	10	A–4(1)	GC
----------	----------	----------	100	99	98	96	25	2	A–4(1)	ML
----------	----------	----------	100	99	97	93	67	33	A–7–5(37)	MH
----------	----------	----------	100	98	95	91	49	29	A–7–6(21)	CL
99	86	64	49	44	41	37	49	20	A–7–6(3)	GM
98	95	89	84	81	80	77	65	37	A–7–6(27)	CH
----------	----------	----------	100	96	90	88	44	22	A–7–6(15)	CL

[1] Based on AASHO Designation T 89-60 (*1*).
[2] Based on AASHO Designation T 90-56 and AASHO Designation T 91-54 (*1*).
[3] Based on AASHO Designation M 145-66I (*2*).
[4] Based on ASTM Designation D2487-66T (*3*).
[7] 1 percent of material is more than 3 inches in diameter.
[8] NP = Nonplastic.
[9] 2 percent of material is more than 3 inches in diameter.

and settlement under load are wetness, flooding, texture, plasticity, density, and shrink-swell behavior. Properties affecting excavation are wetness, flooding, slope, and depth to bedrock. Properties affecting corrosion of buried uncoated steel pipe are wetness, texture, total acidity, and electrical resistivity.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into natural soil. The soil material between depths of 18 inches and 6 feet is evaluated. The soil properties considered are those that affect both absorption of effluent and construction and operation of the system. Properties that affect absorption are permeability, depth to water table or rock, and susceptibility to flooding. Slope is a soil property that affects difficulty of layout and construction and also the risk of soil erosion, lateral seepage, and downslope flow of effluent. Large rocks or boulders increase construction costs.

Sewage lagoons are shallow ponds constructed to hold sewage within a depth of 2 to 5 feet long enough for bacteria to decompose the solids. A lagoon has a nearly level floor, and sides, or embankments, of compacted soil material. The assumption is made that the embankment is compacted to medium density and the pond is protected from flooding. Properties are considered that affect the pond floor and the embankment. Those that affect the pond floor are permeability, organic matter, and slope, and if the floor needs to be leveled, depth to bedrock becomes important. The soil properties that affect the embankment are the engineering properties of the embankment material as interpreted from the Unified soil classification and the amounts of stones, if any, that influence the ease of excavation and compaction of the embankment material.

Sanitary landfill is a method of disposing of refuse in dug trenches. The waste is spread in thin layers, compacted, and covered with soil throughout the disposal period. Landfill areas are subject to heavy vehicular traffic. Some soil properties that affect suitability for landfill are ease of excavation, hazard of pollution of ground water, and trafficability. The best soils have moderately slow permeability, withstand heavy traffic, and are friable and easy to excavate. Unless otherwise stated the ratings in table 12 apply only to a depth of about 6 feet; therefore, limitation ratings of *slight* or *moderate* may not be valid if trenches are to be much deeper than that. For some soils, reliable predictions can be made to a depth of 10 to 15 feet, but regardless of that, every site should be investigated before it is selected. For information about the use of soils for area-type sanitary landfills, contact the local Soil Conservation Service office.

TABLE 12.—*The degree and kinds of soil limitations*

[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 that appear

Soil series and map symbols	Dwellings without basements [1]	Shallow excavations	Local roads and streets [1]
Britwater: BtC, BtD	Moderate: moderate shrink-swell potential; moderate bearing capacity; slopes of more than 8 percent in BtD.	Moderate: gravelly; slopes of more than 8 percent in some places.	Moderate: moderate shrink-swell potential; moderate bearing capacity; slopes of more than 8 percent in BtD.
Cane: CeC	Moderate: moderate bearing capacity; perched seasonal high water table.	Moderate: moderately well drained; perched seasonal high water table; somewhat difficult to excavate with hand tools.	Moderate: moderate bearing capacity.
Captina: CnB	Moderate: moderate bearing capacity; perched seasonal high water table.	Moderate: perched seasonal high water table; bedrock at a variable depth below 42 inches; somewhat difficult to excavate with hand tools.	Moderate: moderate bearing capacity.
Careytown: Co	Severe: poorly drained; perched seasonal high water table; low bearing capacity; high shrink-swell potential.	Severe: poorly drained; perched seasonal high water table; plastic; clayey.	Severe: poorly drained; low bearing capacity; high shrink-swell potential.
Cherokee: Cs	Severe: low bearing capacity; perched seasonal high water table.	Severe: somewhat poorly drained; perched seasonal high water table; plastic; clayey.	Severe: low bearing capacity
Clareson Mapped only in a complex with Sogn soils.	Severe: low bearing capacity; moderate to high shrink-swell potential; slopes of more than 15 percent in some places; stony.	Severe: plastic; clayey; bedrock at a depth of 20 to 30 inches; slopes of more than 15 percent in some places; stony.	Severe: low bearing capacity; moderate to high shrink-swell potential; slopes of more than 15 percent in some places; stony.
Clarksville: CvF	Severe where slopes are more than 15 percent. Moderate where slopes are less than 15 percent.	Severe: cherty; slopes of more than 15 percent in most places.	Severe where slopes are more than 15 percent. Moderate where slopes are less than 15 percent.
Elsah: Es	Severe: subject to occasional flooding to frequent flooding.	Severe: cherty; subject to occasional flooding to frequent flooding.	Moderate where occasionally flooded; severe where frequently flooded.
Enders:			
EnD	Severe: low bearing capacity; high shrink-swell potential.	Severe: plastic, clayey material.	Severe: low bearing capacity; high shrink-swell potential.
EoD, EoF	Severe: low bearing capacity; high shrink-swell potential; stony; slopes of more than 15 percent in most places in EoF.	Severe: plastic, clayey material; stony; slopes of more than 15 percent in most places in EoF.	Severe: low bearing capacity; high shrink-swell potential; stony; slopes of more than 15 percent in most places in EoF.
Fatima: Ft	Severe: subject to occasional flooding; perched seasonal high water table.	Severe: subject to occasional flooding; perched seasonal high water table.	Moderate: subject to occasional flooding; moderate bearing capacity.
Healing:			
He	Severe: subject to rare flooding.	Slight	Moderate: moderate bearing capacity.
Hf	Severe: subject to occasional flooding.	Severe: subject to occasional flooding.	Moderate: subject to occasional flooding; moderate bearing capacity.
Jay: JaB	Moderate: moderate bearing capacity; perched seasonal high water table.	Moderate: moderately well drained; perched seasonal high water table; somewhat difficult to excavate with hand tools.	Moderate: moderate bearing capacity.

for stated uses in town and country planning

such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for in the first column of this table]

Light industry [1]	Septic tank absorption fields	Sewage lagoons [1]	Sanitary landfills (trench type)[2]
Moderate for BtC: moderate shrink-swell potential; moderate bearing capacity. Severe for BtD: slope.	Moderate: moderate permeability; slopes of more than 8 percent in BtD.	Moderate where slopes are less than 7 percent; moderate permeability. Severe where slopes are more than 7 percent.	Moderate: somewhat plastic.
Moderate: moderate bearing capacity; perched seasonal high water table; slopes of more than 4 percent in most places.	Severe: slow permeability; perched seasonal high water table.	Moderate where slopes are less than 7 percent. Severe where slopes are more than 7 percent.	Moderate: moderately well drained; somewhat plastic.
Moderate: moderate bearing capacity; perched seasonal high water table; slope.	Severe: slow permeability; perched seasonal high water table; bedrock at a variable depth below 42 inches.	Moderate: bedrock at a variable depth below 42 inches.	Severe: bedrock at a variable depth below 42 inches.
Severe: poorly drained; perched seasonal high water table; low bearing capacity; high shrink-swell potential.	Severe: very slow permeability; poorly drained; perched seasonal high water table.	Slight	Severe: poorly drained; perched seasonal high water table; plastic; clayey.
Severe: low bearing capacity; perched seasonal high water table.	Severe: very slow permeability; perched seasonal high water table.	Slight	Severe: perched seasonal high water table; plastic; clayey.
Severe: low bearing capacity; moderate to high shrink-swell potential; slope; stony.	Severe: slow permeability; bedrock at a depth of 20 to 30 inches; slopes of more than 15 percent in some places; stony.	Severe: slope; bedrock at a depth of 20 to 30 inches; stony.	Severe: plastic; clayey; bedrock at a depth of 20 to 30 inches; stony.
Severe: slope	Severe where slopes are more than 15 percent. Moderate where slopes are less than 15 percent.	Severe: slope; moderately rapid permeability.	Severe: cherty; moderately rapid permeability; slopes of more than 25 percent in many places.
Severe: subject to occasional flooding to frequent flooding.	Severe: subject to occasional flooding to frequent flooding.	Severe: subject to occasional flooding to frequent flooding; moderately rapid permeability.	Severe: cherty; subject to occasional flooding to frequent flooding; moderately rapid permeability.
Severe: low bearing capacity; high shrink-swell potential; slopes of more than 8 percent in some places.	Severe: very slow permeability.	Moderate: bedrock at depths between 40 and 60 inches; slope; severe where slopes are more than 7 percent.	Severe: plastic, clayey material; bedrock at depths between 40 and 60 inches.
Severe: low bearing capacity; high shrink-swell potential; stony; slopes of more than 8 percent in most places.	Severe: very slow permeability; stony; slopes of more than 15 percent in most places in EoF.	Severe: stony; slopes of more than 7 percent in most places.	Severe: plastic, clayey material; bedrock at depths between 40 and 60 inches; stony; slopes of more than 25 percent in some places.
Severe: subject to occasional flooding; perched seasonal high water table.	Severe: subject to occasional flooding; perched seasonal high water table.	Severe: subject to occasional flooding.	Severe: subject to occasional flooding; perched seasonal high water table.
Severe: subject to rare flooding.	Moderate: subject to rare flooding.	Moderate: moderate permeability.	Slight.
Severe: subject to occasional flooding.	Severe: subject to occasional flooding.	Severe: subject to occasional flooding.	Severe: subject to occasional flooding.
Moderate: moderate bearing capacity; perched seasonal high water table.	Severe: slow permeability; perched seasonal high water table.	Slight: moderate where slopes are more than 2 percent.	Moderate: material somewhat plastic.

TABLE 12.—*The degree and kinds of soil limitations*

Soil series and map symbols	Dwellings without basements [1]	Shallow excavations	Local roads and streets [1]
Johnsburg: Jo	Severe: perched seasonal high water table.	Severe: somewhat poorly drained; perched seasonal high water table; somewhat difficult to dig with hand tools.	Moderate: somewhat poorly drained; moderate bearing capacity.
Limestone outcrop: Lm	Severe: bedrock at or near surface.	Severe: bedrock at or near surface.	Severe: bedrock at or near surface.
Linker: LrC	Moderate: bedrock at a depth between 20 and 40 inches.	Severe: bedrock at a depth between 20 and 40 inches.	Moderate: bedrock at a depth between 20 and 40 inches.
Mayes: Me	Severe: perched seasonal high water table; low bearing capacity; high shrink-swell potential.	Severe: perched seasonal high water table; plastic, clayey material.	Severe: low bearing capacity; high shrink-swell potential.
Mountainburg: MuD, MuE	Severe: bedrock at a depth between 12 and 20 inches; stony; slopes of more than 15 percent in most places in MuE.	Severe: bedrock at a depth between 12 and 20 inches; stony; slopes of more than 15 percent in most places in MuE.	Severe: bedrock at a depth between 12 and 20 inches; stony; slopes of more than 15 percent in most places in MuE.
Newtonia: NeB	Moderate: moderate bearing capacity.	Slight	Moderate: moderate bearing capacity.
Nixa: NfC, NfD	Slight in NfC. Moderate in NfD; slope.	Severe: cherty material; difficult to dig with hand tools; bedrock at a depth between 40 and 60 inches.	Moderate: moderate bearing capacity.
Noark: NoD, NoE, NoF	Moderate where slopes are less than 15 percent; moderate bearing capacity. Severe where slopes are more than 15 percent.	Severe: cherty and clayey material; slopes of more than 15 percent in many places.	Moderate: moderate bearing capacity. Severe where slopes are more than 15 percent.
Peridge: PeB, PeC	Slight	Moderate: material somewhat plastic.	Moderate: moderate bearing capacity.
Secesh: Se	Severe: subject to occasional flooding.	Severe: subject to occasional flooding.	Moderate: subject to occasional flooding; moderate bearing capacity.
*Sogn: SoF, SrE For Clareson part of SrE, see Clareson series.	Severe: bedrock at a depth between 5 and 16 inches; slopes of more than 15 percent in most places.	Severe: bedrock at a depth between 5 and 16 inches; slopes of more than 15 percent in most places.	Severe: bedrock at a depth between 5 and 16 inches; slopes of more than 15 percent in most places.
Summit: SsD2	Severe: low bearing capacity; high shrink-swell potential.	Severe: plastic, clayey material.	Severe: low bearing capacity; high shrink-swell potential.
Taloka: ToA	Severe: low bearing capacity; high to moderate shrink-swell potential; perched seasonal high water table.	Severe: plastic, clayey material; perched seasonal high water table.	Severe: low bearing capacity; high to moderate shrink-swell potential.
Tonti: TsC	Slight	Severe: cherty material; difficult to dig with hand tools.	Moderate: moderate bearing capacity.
Ventris: VsF	Severe: low bearing capacity; high shrink-swell potential; slope.	Severe: plastic, clayey material; bedrock at a depth between 26 and 40 inches.	Severe: low bearing capacity; high shrink-swell potential; slope.
Waben: WeC, WeD	Generally slight. Moderate where slopes are more than 8 percent.	Severe: very cherty material	Slight: moderate where slopes are more than 8 percent.

[1] Engineers and others should not apply specific values to the estimates of bearing capacity.
[2] For more information about lagoon embankments, see the column "Embankments, dikes, and levees," table 10, page 62.

for stated uses in town and country planning—Continued

Light industry [1]	Septic tank absorption fields	Sewage lagoons [2]	Sanitary landfills (trench type)[2]
Severe: perched seasonal high water table.	Severe: very slow permeability; perched seasonal high water table.	Slight	Severe: perched seasonal high water table.
Severe: bedrock at or near surface.	Severe: bedrock at or near surface.	Severe: bedrock at or near surface.	Severe: bedrock at or near surface.
Severe: bedrock at a depth between 20 and 40 inches.	Severe: bedrock at a depth between 20 and 40 inches.	Severe: bedrock at a depth between 20 and 40 inches; slopes of more than 7 percent in some places.	Severe: bedrock at a depth between 20 and 40 inches.
Severe: perched seasonal high water table; low bearing capacity; high shrink-swell potential.	Severe: very slow permeability; perched seasonal high water table.	Slight	Severe: perched seasonal high water table; plastic, clayey material.
Severe: bedrock at a depth between 12 and 20 inches; surface stones; slopes of more than 8 percent in most places.	Severe: bedrock at a depth between 12 and 20 inches; stony; slopes of more than 15 percent in most places in MuE.	Severe: bedrock at a depth between 12 and 20 inches; stony; slopes of more than 7 percent in most places.	Severe: bedrock at a depth between 12 and 20 inches; stony; slopes of more than 25 percent in some places in MuE.
Moderate: moderate bearing capacity.	Moderate: moderate permeability.	Moderate: moderate permeability; slopes of more than 2 percent in some places.	Moderate: material somewhat plastic.
Slight: moderate where slopes are 4 to 8 percent; severe where slopes are more than 8 percent.	Severe: very slow permeability.	Severe: cherty material; slopes of more than 7 percent in most places.	Severe: bedrock at a depth between 40 and 60 inches.
Severe: slope	Moderate: slope; severe where slopes are more than 15 percent.	Severe: slope	Severe: cherty and clayey material; slopes of more than 25 percent in some places.
Slight: moderate where slopes are more than 4 percent.	Moderate: moderate permeability.	Moderate: moderate permeability; slope; severe where slopes are more than 7 percent.	Moderate: material somewhat plastic.
Severe: subject to occasional flooding.	Severe: subject to occasional flooding.	Severe: subject to occasional flooding.	Severe: subject to occasional flooding.
Severe: bedrock at a depth between 5 and 16 inches; slope.	Severe: bedrock at a depth between 5 and 16 inches; slopes of more than 15 percent in most places.	Severe: bedrock at a depth between 5 and 16 inches; slope.	Severe: bedrock at a depth between 5 and 16 inches; slopes of more than 25 percent in some places.
Severe: low bearing capacity; high shrink-swell potential; slopes of more than 8 percent in most places.	Severe: slow permeability	Moderate: slope; severe where slopes are more than 7 percent.	Severe: plastic, clayey material; bedrock at a depth below 60 inches.
Severe: low bearing capacity; high to moderate shrink-swell potential; perched seasonal high water table.	Severe: very slow permeability; perched seasonal high water table.	Slight	Severe: plastic, clayey material; perched seasonal high water table.
Moderate: bedrock at a depth between 40 and 60 inches; slopes of more than 4 percent in some places.	Severe: slow permeability; bedrock at a depth between 40 and 60 inches.	Moderate: slope; bedrock at a depth between 40 and 60 inches; cherty material; severe where slopes are more than 7 percent.	Severe: bedrock at a depth between 40 and 60 inches.
Severe: low bearing capacity; high shrink-swell potential; slope.	Severe: very slow permeability; bedrock at a depth between 26 and 40 inches; slope.	Severe: bedrock at a depth between 26 and 40 inches; slope.	Severe: plastic, clayey material; bedrock at a depth between 26 and 40 inches; slopes of more than 25 percent in most places.
Slight where slopes are 3 to 4 percent. Moderate where slopes are 4 to 8 percent. Severe where slopes are more than 8 percent.	Slight: moderate where slopes are more than 8 percent; permeability.	Severe: moderately rapid permeability; very cherty material; slopes of more than 7 percent in most places.	Severe: moderately rapid permeability; very cherty material.

[1] Onsite studies of the underlying strata, water table, and hazards of aquifer pollution and drainage into ground water should be made for land fill deeper than 6 feet.

The detailed soil map and information in table 12 are guides for evaluating areas for specific uses. They do not eliminate the need for detailed onsite investigations before a final determination is made.

Additional information that may be useful in town and country planning is given in the sections "Engineering Uses of the Soils" and "Recreation."

Recreation

Knowledge of soils is necessary in planning, developing, and maintaining areas for recreation. In table 13 the soils of Benton County are rated according to limitations that affect their suitability for camp areas, playgrounds, picnic areas, and paths and trails.

In table 13 the soils are rated as having slight, moderate, or severe limitations for the specified uses. For all of these ratings, it is assumed that a good cover of vegetation can be established and maintained. A limitation of *slight* means that soil properties are generally favorable and limitations are so minor that they easily can be overcome. A *moderate* limitation can be overcome or modified by planning, by design, or by special maintenance. A *severe* limitation means that costly soil reclamation, special design, intense maintenance, or a combination of these, is required.

Camp areas are used intensively for tents and small camp trailers and the accompanying activities of outdoor living. Little preparation of the site is required, other than shaping and leveling for tent and parking areas. Camp areas are subject to heavy foot traffic and limited vehicular traffic. The best soils have mild slopes, good drainage, a surface free of rocks and coarse fragments, freedom from flooding during periods of heavy use, and a surface that is firm after rains but not dusty when dry.

Playgrounds are used intensively for baseball, football, badminton, and similar organized games. Soils suitable for this use need to withstand intensive foot traffic. The best soils have a nearly level surface free of coarse fragments and rock outcrops, good drainage, freedom from flooding during periods of heavy use, and a surface that is firm after rains but not dusty when dry. If grading and leveling are required, depth to rock is important.

Picnic areas are attractive natural or landscaped tracts used primarily for preparing meals and eating outdoors. These areas are subject to heavy foot traffic. Most of the vehicular traffic, however, is confined to access roads. The best soils are firm when wet but not dusty when dry; are free of flooding during the season of use; do not have slopes or stoniness that greatly increase cost of leveling sites or of building access roads.

Paths and trails are used for local and cross-country travel by foot or horseback. Design and layout should require little or no cutting and filling. The best soils are at least moderately well drained, are firm when wet but not dusty when dry, are flooded not more than once during the season of use, have slopes of less than 15 percent, and have few or no rocks or stones on the surface.

Formation and Classification of the Soils

In this section the factors that affect soil formation in Benton County and the processes of horizon differentiation are discussed. Then, the system of soil classification is explained, and the soil series are placed in some of the higher categories of that system. Following that, physical and chemical analyses are given for representative profiles of selected soil series. The soil series in the county, including a profile representative of each series, are described in the section "Descriptions of the Soils."

Factors of Soil Formation

Soil is formed by weathering and other processes that act upon the soil. The characteristics of the soil at any given point depend upon climate, living organisms, parent material, relief, and time. Each factor acts on the soil and modifies the effect of the other four. When climate, living organisms, or any other of the five factors is varied to a significant extent, a different soil is likely to form (*11*).

Climate and living organisms are the active forces in soil formation. Relief modifies the effects of climate and living organisms, mainly by its influence on temperature and runoff. Climate, vegetation, parent material, and relief interact over a period of time. Thus, the effect of time is also reflected in the soil characteristics.

The interaction of the five factors of soil formation is more complex for some soils than for others. The five factors and how they interact to form some of the soils in the county are discussed in the following paragraphs.

Climate

The climate of Benton County is characterized by relatively mild winters, warm summers, and fairly abundant rainfall. The generally warm temperatures and high precipitation probably are similar to the climate under which the soils in the county formed. The average daily maximum temperature in July is about 90° F., and in January is about 47°. The total annual rainfall is about 45 inches and is well distributed throughout the year. For additional information about the climate, refer to the section "General Nature of the County."

The warm, moist climate promotes rapid soil formation, and the warm temperature encourages rapid chemical reactions. The large amount of water that moves through the soil removes dissolved or suspended material. Because remains of plants decompose rapidly, the organic acids thus formed hasten the removal of carbonates and the formation of clay minerals. Because the soil is frozen only to a shallow depth and for relatively short periods, soil formation continues almost all year. The climate throughout the county is relatively uniform, though its effect is modified locally by runoff and slope aspect. Climate alone does not account for differences in the soils of the county.

Living organisms

The higher plants and animals, as well as insects, bacteria, and fungi, are important in the formation of soils. Among the changes they cause are gains in organic matter and nitrogen in the soil, gains or losses in plant nutrients, and changes in structure and porosity.

Before Benton County was settled, the native vegetation had more influence on soil formation than animal activity. Forests consisting of hardwood trees or mixed hardwoods and shortleaf pine covered most of the county. There were scattered tall grass prairies surrounded by larger areas of forest (*7*). In the eastern part of the county, near the present location of Beaver Reservoir, moderately deep and shallow upland soils overlying limestone supported savannas. The vegetation on these savannas was eastern redcedar or mixed redcedar and hardwoods and an understory of tall grasses similar to those on the prairies. Clareson, Sogn, and Ventris soils are dominant in these areas.

The native vegetation in most of the dissected hilly areas of the county was forests of upland oaks and hickory, locally in mixed stands with shortleaf pine. Only the uppermost few inches of the soils in these areas have a significant accumulation of organic matter and are dark colored. Clarksville, Enders, Mountainburg, Nixa, and Noark soils formed on these uplands. They differ chiefly in parent material, relief, age, and degree of weathering.

Areas on broad, level to gently rolling uplands had two types of plant cover: forest and prairie. Forests of upland oaks and hickory were dominant. Significant amounts of organic matter accumulated only in the upper few inches of the soils. The surface layer of plowed areas is brown. The Captina, Cherokee, Johnsburg, Peridge, and Tonti soils formed in these areas. They differ chiefly in relief and parent material.

The prairie areas in Benton County supported a luxuriant growth of tall bunchgrasses, legumes, and forbs and a few scattered small clumps of trees. The soils, mainly the Jay and Taloka soils, have a thick, dark-colored surface layer of organic-matter accumulation, a common property of soils that formed under prairie vegetation. The Captina and Cherokee soils formed in similar parent material, under a similar climate, on comparable topographic positions, and over a similar period as with Jay and Taloka soils, but they formed under forest rather than prairie vegetation. They have a thinner surface layer of organic-matter accumulation.

In the alluvial areas, the native vegetation was mainly hardwood trees, such as sycamore, hackberry, elm, black walnut, ash, oak, and hickory. Elsah, Fatima, Healing, and Secesh soils formed in these areas. Their differences appear to be chiefly due to the effects of parent material and age.

Variations in native vegetation in the county are related partly to variations in the available water capacity and in the surface and internal drainage of soils. Slope aspect and soil fertility cause minor variations. Wildfire may have been a factor in maintaining or extending prairie vegetation.

Only the major differences in the original vegetation are reflected to any extent by the characteristics of the soils.

Man is important to the future rate and direction of soil formation. He clears the forest, cultivates the soils, and introduces new kinds of plants. He adds fertilizer, organic residue, lime, and chemicals for insect, disease, and weed control. Building dams for flood control, improving drainage, grading the soil surface, cultivating erodible areas, and using or controlling fire affect the future development of soils. Some results of these changes will not be evident for many centuries. Nevertheless, the complex of living organisms affecting soil formation in this county has been drastically changed by man. Thus, in Benton County man has become the most important organism affecting soil formation.

Parent material

Most of Benton County is on the Springfield Plateau (*6*). The Boone Formation of the Mississippian Period covers most of the surface of the plateau, except where it is capped by sandstone and shale of the same period (*4*). The Boone Formation consists of alternating beds of limestone and chert of cherty limestone that were deposited in marine waters. The amount of chert varies both vertically and laterally within the formation.

The limestone weathers more rapidly than the chert. Clarksville, Nixa, and Noark soils, which contain large quantities of chert, formed in dissected areas. Captina, Jay, Peridge, and Tonti soils in the broad upland areas of the Springfield Plateau contain relatively little chert. These soils formed in residuum from cherty limestone of the Boone Formation or in material weathered from siltstone of the Batesville Formation, which caps the Boone Formation in several places (*5, 10*). Possibly, they formed in thin deposits of loess over residuum of the cherty limestone and siltstone.

Scattered outliers of the Boston Mountains rise above the Springfield Plateau. These low, isolated mountains are formed by the Fayetteville Shale capped by a sandstone more resistant to weathering, possibly the Wedington Sandstone Member. The Enders soils formed in material weathered mainly from the shale, and the Linker and Mountainburg soils formed in material weathered from the sandstone.

The basal member of the Boone Formation, the St. Joe Limestone, forms a prominent bluff in places. This forms the mapping unit of Limestone outcrop. Exposed in deeply entrenched areas, mainly in the vicinity of Beaver Lake, are the Chattanooga Shale of the Devonian Period and the Powell Limestone and Cotter Dolomite of the Ordovician Period. In these areas Ventris and Summit soils formed in material weathered from shale or dolomitic limestone. Sogn and Clareson soils formed in residuum derived primarily from dolomitic limestone.

Elsah, Fatima, Healing, and Secesh soils are on the flood plains of the county. They formed in loamy sediment washed from local uplands. These soils differ

TABLE 13.—*Degree and kind of limitations for recreational uses*

[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 such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for referring to other series that appear in the first column of this table]

Soil series and map symbols	Camp areas	Playgrounds	Picnic areas	Paths and trails
Britwater:				
BtC	Slight	Moderate where slope is less than 6 percent. Severe where slope is more than 6 percent; coarse fragments.	Slight	Slight.
BtD	Moderate: slope	Severe: slope	Moderate: slope	Slight.
Cane: CeC	Moderate: moderately well drained; slow permeability.	Moderate where slope is less than 6 percent. Severe where slope is more than 6 percent: moderately well drained; slow permeability.	Slight	Slight.
Captina: CnB	Moderate: moderately well drained; slow permeability.	Moderate: moderately well drained; slow permeability; slope of more than 2 percent in places.	Slight	Slight.
Carytown: Co	Severe: poorly drained; very slow permeability.	Severe: poorly drained; very slow permeability.	Severe: poorly drained	Severe: poorly drained.
Cherokee: Cs	Severe: somewhat poorly drained; perched seasonal high water table; very slow permeability.	Severe: somewhat poorly drained; perched seasonal high water table; very slow permeability.	Severe: somewhat poorly drained; perched seasonal high water table.	Severe: somewhat poorly drained; perched seasonal high water table.
Clareson Mapped only in a complex with Sogn soils.	Severe: coarse fragments on surface; slopes of more than 15 percent in places.	Severe: coarse fragments on surface; slope.	Severe: coarse fragments on surface; slopes of more than 15 percent in places.	Severe: coarse fragments on surface.
Clarksville: CvF	Severe: coarse fragments on surface; slopes of more than 15 percent in most places.	Severe: slopes; coarse fragments on surface.	Severe: coarse fragments on surface; slopes of more than 15 percent in most places.	Severe: coarse fragments on surface; slopes of more than 25 percent in places.
Elsah:				
Es	Severe: subject to flooding.	Severe: subject to flooding; coarse fragments on surface.	Moderate: subject to flooding; coarse fragments on surface.	Moderate: subject to flooding; coarse fragments on surface.
Enders:				
EnD	Severe: very slow permeability.	Severe: very slow permeability; clayey surface when graded; slopes of more than 6 percent in places.	Moderate: coarse fragments on surface.	Moderate: coarse fragments on surface.
EoD, EoF	Severe: stones on surface; very slow permeability; slopes of more than 15 percent in places.	Severe: very slow permeability; stones on surface; clayey surface when graded; slopes of more than 6 percent in places.	Severe: stones on surface; slopes of more than 15 percent in places.	Severe: stones on surface; slopes of more than 25 percent in places.
Fatima: Ft	Moderate: moderately well drained; subject to occasional flooding.	Moderate: moderately well drained; subject to occasional flooding.	Moderate: subject to occasional flooding.	Slight.
Healing:				
He	Slight	Slight	Slight	Slight.
Hf	Moderate: subject to occasional flooding.	Moderate: subject to occasional flooding.	Moderate: subject to occasional flooding.	Slight.

TABLE 13.—*Degree and kind of limitations for recreational uses*—Continued

Soil series and map symbols	Camp areas	Playgrounds	Picnic areas	Paths and trails
Jay: JaB	Moderate: moderately well drained; slow permeability.	Moderate: moderately well drained; slow permeability; slopes of more than 2 percent in places.	Slight	Slight.
Johnsburg: Jo	Severe: somewhat poorly drained; perched seasonal high water table; very slow permeability.	Severe: somewhat poorly drained; perched seasonal high water table; very slow permeability.	Severe: somewhat poorly drained; perched seasonal high water table.	Severe: somewhat poorly drained; perched seasonal high water table.
Limestone outcrop: Lm	Severe: rocky and stony; slopes of more than 15 percent in many places; near vertical bluffs in places.	Severe: rocky and stony; slope.	Severe: rocky and stony; slopes of more than 15 percent in many places; near vertical bluffs in places.	Severe: rocky and stony; slopes of more than 25 percent in places; near-vertical bluffs in places.
Linker: LrC	Slight	Moderate where slopes are less than 6 percent: moderately deep to bedrock. Severe where slopes are more than 6 percent.	Slight	Slight.
Mayes: Me	Severe: somewhat poorly drained; perched seasonal high water table; very slow permeability.	Severe: somewhat poorly drained; perched seasonal high water table; very slow permeability.	Moderate: somewhat poorly drained; perched seasonal high water table; surface somewhat sticky when wet; poor trafficability.	Moderate: somewhat poorly drained; perched seasonal high water table; surface somewhat sticky when wet; poor trafficability.
Mountainburg: MuD, MuE	Severe: stones on surface; slopes of more than 15 percent in places.	Severe: stones on surface; shallow to bedrock; slopes of more than 6 percent in most places.	Severe: stones on surface; slopes of more than 15 percent in places.	Severe: stones on surface; slopes of more than 25 percent in places.
Newtonia: NeB	Slight	Slight	Slight	Slight.
Nixa:				
NfC	Severe: coarse fragments on surface; very slow permeability.	Severe: coarse fragments on surface; very slow permeability; slopes of more than 6 percent in places.	Moderate to severe: coarse fragments on surface.	Moderate to severe: coarse fragments on surface.
NfD	Severe: coarse fragments on surface; very slow permeability.	Severe: coarse fragments on surface; very slow permeability.	Moderate to severe: coarse fragments on surface.	Moderate to severe: coarse fragments on surface.
Noark:				
NoD, NoE	Moderate: coarse fragments on surface; slope. Severe where slopes are more than 15 percent.	Severe: coarse fragments on surface; slope	Moderate: coarse fragments on surface; slope. Severe where slopes are more than 15 percent.	Moderate: coarse fragments on surface; slopes of more than 15 percent in places.
NoF	Severe: slope	Severe: coarse fragments on surface; slope.	Severe: slope	Moderate: coarse fragments on surface; slope. Severe where slopes are more than 25 percent.
Peridge: PeB, PeC	Slight	Slight where slopes are less than 2 percent. Moderate where slopes are 2 to 6 percent. Severe where slopes are more than 6 percent.	Slight	Slight.
Secesh: Se	Moderate: subject to occasional flooding.	Moderate: subject to occasional flooding; coarse fragments on surface.	Moderate: subject to occasional flooding.	Slight.

TABLE 13.—*Degree and kind of limitations for recreational uses*—Continued

Soil series and map symbols	Camp areas	Playgrounds	Picnic areas	Paths and trails
*Sogn: SoF, SrE. For Clareson part of SrE, see Clareson series.	Severe: rocky and stony; slopes of more than 15 percent in places.	Severe: rocky and stony; shallow to bedrock; slope.	Severe: rocky and stony; slopes of more than 15 percent in places.	Severe: rocky and stony; slopes of more than 25 percent in places.
Summit: SsD2	Severe: clayey surface; poor trafficability.	Severe: clayey surface; poor trafficability; slopes of more than 6 percent in places.	Severe: clayey surface; poor trafficability.	Severe: clayey surface; poor trafficability.
Taloka: ToA	Severe: somewhat poorly drained; perched seasonal high water table; very slow permeability.	Severe: somewhat poorly drained; perched seasonal high water table; very slow permeability.	Severe: somewhat poorly drained; perched seasonal high water table.	Severe: somewhat poorly drained; perched seasonal high water table.
Tonti: TsC	Moderate: slow permeability.	Moderate: slow permeability, coarse fragments on surface. Severe where slopes are more than 6 percent.	Slight	Slight.
Ventris: VsF	Severe: stony surface; very slow permeability; slope.	Severe: stony surface; very slow permeability; slope.	Severe: stony surface; slope.	Severe: stony surface; slopes of more than 25 percent in places.
Waben: WeC, WeD	Moderate: coarse fragments on surface; slopes of more than 8 percent in places.	Severe: coarse fragments on surface; slopes of more than 6 percent in places.	Moderate: coarse fragments on surface; slopes of more than 8 percent in places.	Moderate: coarse fragments on surface.

primarily in the amount of chert or gravel in the parent material and the degree of development. Britwater, Captina, Peridge, and Waben soils formed in old alluvium or colluvium on stream terraces or valley foot slopes.

Relief

Relief is differences in elevation that have been produced in Benton County chiefly by the entrenchment of streams and drainage channels into the land surface and in a few places by faulting. The highest elevation above sea level recorded in the county is 1,808 feet, atop Whiney Mountain, south of Garfield. The lowest elevation, about 940 feet above sea level, is in the southwest corner of the county at Lake Francis.

Some of the greatest differences in the soils of Benton County are caused by differences in relief through its effect on drainage, runoff, erosion, and percolation of water through the soil. Relief ranges from near-vertical bluffs to broad flats.

In places the steeper slopes, narrow ridges, and hilltops have lost so much soil material through geologic erosion that the soils on them, such as Sogn and Mountainburg soils, are shallow. In other areas of strong relief over cherty limestone, Clarksville, Nixa, and Noark soils formed. These soils contain large quantities of chert residue left after weathering of the cherty limestone. This chert mantle retards geologic erosion. In contrast, soils on broad upland flats, such as Captina, Newtonia, Peridge, and Taloka soils, have lost little material erosion. These soils contain few coarse fragments in the upper part of the profile and are deep over bedrock.

Some foot slopes have deep accumulations of material that washed or sloughed down from adjacent higher slopes. Cane and Waben soils formed in these areas. Britwater and other soils are on nearly level to moderately sloping stream terraces. They formed in deep, loamy material washed from the uplands and deposited on stream flood plains before the streams were further entrenched.

The present flood plains along streams in the county are level to nearly level. Most are subject to occasional flooding or frequent flooding. Flood plains on the upstream parts of the drainageways commonly contain more coarse fragments than areas further downstream, because as runoff water loses velocity, coarse fragments are deposited first. Thus, coarse fragments are carried shorter distances than soil particles.

Broad level flats or slightly depressional areas have slow to very slow surface drainage. Soils in these areas are poorly drained or somewhat poorly drained and are slowly permeable or very slowly permeable. They have a seasonally perched water table. They are gray or have gray mottles because of the reduction of iron. Johnsburg, Cherokee, Carytown, Mayes, and Taloka soils are on the flats and in the depressions.

Time

The length of time required for soil formation depends largely upon other factors of soil formation. Generally, less time is required if the climate is warm and humid and the vegetation is luxuriant. If other factors are equal, less time is also required if the parent material is loamy than if it is clayey.

In terms of geologic time, most of the soils of Benton County are old, regardless of whether they are on broad uplands, hillsides, or stream terraces. Relatively young soils formed either in alluvium along streams or in residual material weathered from bedrock where geologic erosion has nearly kept pace with weathering.

Most of the soils on the uplands are old. They formed in material weathered from rocks chiefly of Mississippian age. In such soils most of the cations have been leached out, reaction of the B horizon is strongly acid or very strongly acid, considerable weathering and translocation of clay have taken place, and the B horizon is clearly expressed. Iron, as well as clay, has been translocated from the A horizon to the B horizon and then oxidized, causing the B horizon to have stronger red, brown, and yellow colors than the A horizon. Captina, Tonti, Enders, and Noark soils clearly show the impact of time, acting with other soil-forming factors, on parent material.

Elsah soils on stream flood plains in narrow valleys are relatively young soils. These soils formed an organic-enriched A horizon, but they lack a B horizon. In most places Elsah soils are still undergoing scouring and further deposition. The shallow Sogn soils are young soils that formed over limestone where geologic erosion has nearly kept pace with weathering.

Processes of Soil Formation

The marks that the soil-forming factors leave on the soil are recorded in the soil profile, which is a succession of layers, or horizons, from the surface to the parent rock. The horizons differ in one or more properties, such as color, texture, structure, consistence, and porosity.

Most soil profiles consist of three major horizons, called A, B, and C. Very young soils do not have a B horizon.

The A horizon can be the horizon of maximum accumulation of organic matter, called the A1 horizon or the surface layer, or it can be the horizon of maximum leaching of dissolved or suspended materials, called the A2 horizon or the subsurface layer.

The B horizon lies immediately beneath the A horizon and is sometimes called the subsoil (*15*). It is a horizon of maximum accumulation of suspended materials, such as clay and iron. Commonly, the B horizon has blocky structure and is firmer than the horizons just above and below it.

Beneath the B horizon is the C horizon, which has been little affected by the soil-forming processes, though it can be materially modified by weathering. In some young soils, the C horizon underlies the A horizon and has been slightly modified by living organisms, as well as by weathering.

Several processes have been active in the formation of soil horizons in Benton County. Among these processes are (1) the accumulation of organic matter, (2) the leaching of bases, (3) the oxidation or reduction and transfer of iron, and (4) formation and translocation of silicate clay materials. In most of the soils of the county, more than one of these processes has been active in soil formation.

Physical weathering of rocks through heating and cooling and wetting and drying slowly breaks them into small pieces that form the parent material for the residual soils in the county. This is most evident in Linker, Mountainburg, and Sogn soils.

Accumulation of organic matter in the upper part of the profile to form an A1 horizon has been an important process of soil formation. The A1 horizon is evident in profiles that have a light-colored subsurface layer from which organic matter, clay, and iron oxides have been removed. These processes are readily evident in Taloka soils.

Leaching of bases has occurred to some degree in nearly all the soils of Benton County. Bases are leached downward in soils before silicate clay minerals begin to move. Most of the soils in the county are moderately leached, an important factor in horizon development. Some, such as Summit, Mayes, and Sogn soils, are only slightly leached, whereas others, such as Tonti, Captina, and Clarksville soils, are strongly leached.

Oxidation of iron is evident in the moderately well drained and well drained soils in the county. Oxidation of iron is indicated by the red and brown colors in the B horizons of such soils as Britwater, Captina, Peridge, and Newtonia soils.

Reduction and transfer of iron has occurred to a significant degree in the poorly drained and somewhat poorly drained soils. In the naturally wet soils this process is called gleying. Gray colors in the horizons below the surface layer indicate the reduction and loss of iron. Some horizons contain red, brown, or yellow mottles and concretions derived from segregated iron or manganese. Gleying is most pronounced in Cherokee and Taloka soils.

Translocation of silicate clay minerals has contributed to horizon development in most of the soils in the county. In cultivated areas most of the eluviated A2 horizon has been destroyed, but where it occurs the clay content is less than in the lower horizons, where the clay has accumulated, and the A2 horizon is lighter in color. Generally, clay films accumulate in pores and on surfaces of peds in the B horizon. The soils were probably leached of carbonates and soluble salts to a great extent before translocation of silicate clay occurred, even though the content of bases is still relatively high in some of the soils on flood plains, such as Fatima and Healing soils, and a few soils on uplands that have been enriched with bases from weathering limestone, such as Summit, Clareson, and Sogn soils.

Leaching of bases and translocation of silicate clay are among the most important processes of horizon differentiation in the soils of Benton County.

Classification of Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about 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

TABLE 14.—*Classification of soil series*

Series	Family	Subgroup	Order
Britwater	Fine-loamy, mixed, mesic	Typic Paleudalfs	Alfisols.
Cane	Fine-loamy, siliceous, thermic	Typic Fragiudults	Ultisols.
Captina	Fine-silty, mixed, mesic	Typic Fragiudults	Ultisols.
Carytown [1]	Fine, mixed, thermic	Albic Natraqualfs (Typic)	Alfisols.
Cherokee	Fine, mixed, thermic	Typic Albaqualfs	Alfisols.
Clareson [1]	Clayey-skeletal, mixed, thermic	Typic Argiudolls	Mollisols.
Clarksville	Loamy-skeletal, siliceous, mesic	Typic Paleudults	Ultisols.
Elsah	Loamy-skeletal, mixed, nonacid, mesic	Typic Udifluvents	Entisols.
Enders	Clayey, mixed, thermic	Typic Hapludults	Ultisols.
Fatima [1]	Fine-silty, mixed, mesic	Fluvaquentic Hapludolls	Mollisols.
Healing	Fine-silty, mixed, mesic	Typic Argiudolls	Mollisols.
Jay	Fine-silty, mixed, thermic	Mollic Fragiudalfs	Alfisols.
Johnsburg	Fine-silty, mixed, mesic	Aquic Fragiudults	Ultisols.
Linker	Fine-loamy, siliceous, thermic	Typic Hapludults	Ultisols.
Mayes	Fine, montmorillonitic, thermic	Vertic Argiaquolls	Mollisols.
Mountainburg	Loamy-skeletal, siliceous, thermic	Lithic Hapludults	Ultisols.
Newtonia	Fine-silty, mixed, thermic	Typic Paleudolls	Mollisols.
Nixa	Loamy-skeletal, siliceous, mesic	Glossic Fragiudults	Ultisols.
Noark	Clayey-skeletal, mixed, mesic	Typic Paleudults	Ultisols.
Peridge	Fine-silty, mixed, mesic	Typic Paleudalfs	Alfisols.
Secesh	Fine-loamy, siliceous, mesic	Ultic Hapludalfs	Alfisols.
Sogn [1]	Loamy, mixed, mesic	Lithic Haplustolls	Mollisols.
Summit	Fine, montmorillonitic, thermic	Vertic Argiudolls	Mollisols.
Taloka	Fine, mixed, thermic	Mollic Albaqualfs	Alfisols.
Tonti	Fine-loamy, mixed, mesic	Typic Fragiudults	Ultisols.
Ventris	Fine, mixed, mesic	Albaquic Hapludalfs	Alfisols.
Waben	Loamy-skeletal, siliceous, mesic	Ultic Hapludalfs	Alfisols.

[1] These soils are taxadjuncts to the series for which they are named. They are outside the defined range of the series as follows: *Carytown*: There is evidence of destruction of the upper part of the argillic horizon in the form of interfingering of albic material. *Clareson*: In more than one-half of the pedons, reaction is ½ to 1 unit higher than is specified for the series. *Fatima*: More than one-half of the pedons have a barely discernible argillic horizon. *Sogn*: These soils contain more than 35 percent coarse fragments.

through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

The narrow categories of classification, such as those used in detailed soil surveys, allow us to organize and apply knowledge about soils in managing farms, fields, and woodlands; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison in large areas such as countries and continents.

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965.[9] 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 the 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 14, the soil series of Benton County are placed in some categories of the current system. Classes of the current system are briefly defined in the following paragraphs.

[9] UNITED STATES DEPARTMENT OF AGRICULTURE, soil taxonomy of the national cooperative soil survey. Unpublished.

ORDER: Ten soil orders are recognized. The properties used to differentiate among soil orders are those that tend to give broad climatic groupings of soils. The two exceptions to this are the Entisols and Histosols, which occur in many different climates. Each order is named with a word of three or four syllables ending in *sol* (Ent-i-sol).

SUBORDER: Each order is divided into suborders, primarily on the basis of those soil characterisitics 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 differences in 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: Each suborder is divided 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 or 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 of water, and *ent*, from Entisols).

SUBGROUP: Each great group is divided 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 integrade 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 Paleudalfs (a typical Paleudalf).

FAMILY: Each subgroup is divided into families, 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 14). An example is the fine-loamy, mixed, mesic family of the Typic Paleudalfs.

Physical and Chemical Analyses

Physical and chemical data from laboratory analyses can be useful to the soil scientist in classifying soils. These data help in estimating available water capacity, acidity, cation-exchange capacity, mineralogical composition, organic-matter content, and other soil characteristics that affect management needs. The data are also helpful in developing concepts of soil formation. More recently, laboratory data have proved helpful in rating soils for nonfarm uses; that is, for residential, industrial, recreational, or transportational use.

Several factors are involved in selecting soils for laboratory analyses. Soils that are extensive and most important in the survey area are considered first. A review of available laboratory data is made to determine the need for additional information on these particular soils. Generally, priority is given to soils for which little or no laboratory data are available.

In Benton County, soils representing 13 series were selected for laboratory analysis. Profiles of these soils are described in the section "Descriptions of the Soils." The analyses were made by the University of Arkansas in Fayetteville. Table 15 gives the results.

The percentages of silt and clay were determined by the hydrometer method (*8*). The sand of various classes were separated by sieving (*13*).

The extractable bases were removed from the soil by using a 1 normal ammonium acetate solution that had a pH of 7.0. Calcium, potassium, and sodium were determined by a flame photometer, and magnesium was measured by atomic absorption.

The extractable acidity was determined by the barium chloride-triethanolamine method (*13*).

The total of extractable calcium, potassium, magnesium, sodium, and extractable acidity is an approximation of the cation-exchange capacity of the soil. Except for soils that contain soluble salts, base saturation is determined by dividing this total into the sum of calcium, potassium, magnesium, and sodium, and multiplying by 100.

Soil reaction, expressed as a pH value, was determined by using a glass electrode pH meter and a 1:1 soil-water mixture.

Organic matter was determined by a modified Walkley-Black method (*9*). The organic matter is digested in a potassium dichromate-sulfuric acid solution, and the quantity of chromic acid reduced is measured colorimetrically.

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TABLE 15.—*Physical and chemical*

[Analyses made by the University of Arkansas, Fayetteville, Arkansas. Dashes indicate

Soil and report number	Depth from surface	Horizon	Percentage of material less than 2.0 mm in size that is—			
			Very coarse through medium sand (2.0–0.25 mm)	Fine sand (0.25–0.10 mm)	Very fine sand (0.10–0.05 mm)	Total sand (2.0–0.05 mm)
	In					
Britwater gravelly silt loam:	0–6	Ap	2	3	6	11
S71-Ark-4-1.	6–22	B21t	2	3	5	10
	22–35	B22t	4	4	5	13
	35–60	B23t	12	5	4	21
	60–74	B24t	18	9	6	33
Captina silt loam:	0–½	Ap1	3	3	3	9
S66-Ark-4-4.	½–7	Ap2	2	4	3	9
	7–21	B21t	1	2	2	5
	21–30	Bx1	1	2	2	5
	30–48	Bx2	2	3	4	9
	48–58	R&B	20	12	6	38
Cherokee silt loam:	1–5	A12	1	1	4	6
S66-Ark-4-1.	5–11	A21g	1	1	5	7
	11–14	A22g	1	1	2	4
	14–44	B21t	----	1	2	3
	44–54	B22t	----	1	2	3
	54–66	B23t	----	1	1	2
	66–84	B3	2	1	4	7
Elsah cherty silt loam:	0–7	A1	6	5	7	18
S67-Ark-4-1.	7–32	C(1)'	13	8	4	25
	32–60	C(2)	23	6	3	32
Healing silt loam:	0–15	A1	4	9	8	21
S66-Ark-4-3.	15–27	B21t	5	10	6	21
	27–50	B22t	5	8	8	21
	50–68	B23t	7	14	8	29
Linker fine sandy loam:	0–6	Ap	4	34	12	50
S69-Ark-4-2.	6–9	B1	4	27	11	42
	9–19	B2t	6	26	10	42
	19–26	B3	9	34	13	56
Mayes silty clay loam:	0–11	Ap	----	1	2	3
S65-Ark-4-2.	11–19	B21t	----	----	1	1
	19–28	B22t	----	1	2	3
	28–58	B23tg	----	1	2	3
	58–72	B24tg	----	----	2	2
Mountainburg stony sandy loam:	0–3	A1	12	23	8	43
S70-Ark-4-1.	3–6	A2	13	23	7	43
	6–19	B2t	12	24	7	43
Newtonia silt loam:	0–6	Ap	----	2	5	7
S65-Ark-4-1.	6–10	A1	----	5	6	11
	10–17	B1	----	----	1	1
	17–26	B21t	----	----	15	15
	26–61	B22t	----	1	2	3
	61–72	B23t	----	1	2	3
Secesh gravelly silt loam:	0–10	A1	2	2	2	6
S67-Ark-4-8.	10–24	B21t	4	1	2	7
	24–44	B22t	16	4	2	22
	44–55	B23t	11	4	3	18
	55–74	B24t	16	4	3	23
Taloka silt loam:	0–12	A1	2	1	3	6
S69-Ark-4-3.	12–19	A21g	5	1	4	10
	19–22	A22g	6	1	3	10
	22–36	B21tg	1	1	1	3
	36–72	B22tg	3	1	3	7

analyses of selected soils

that no analysis was made or that the data resulting from the analysis were insignificant]

Percentage of material less than 2.0 mm in size that is—Continued		Extractable bases				Extractable acidity	Base saturation (sum)	Reaction (1:1 soil-water)	Organic matter
Silt (0.05–0.002 mm)	Clay (<0.002 mm)	Calcium	Magnesium	Sodium	Potassium				
		Meq per 100 g	*Meq per 100 g*	*Meq per 100 g*	*Meq per 100 g*	*Meq per 100 g*	*Pct*	*pH*	*Pct*
74	15	2.9	0.8	0.2	0.2	5.1	45	5.7	1.1
59	31	4.7	1.7	.2	.2	6.1	53	5.6	.6
61	26	2.8	1.2	.2	.2	6.1	42	5.1	.4
41	38	3.7	1.9	.2	.2	7.4	45	5.4	.3
24	43	3.5	2.1	.2	.2	8.8	41	5.3	.3
83	8	2.2	.5	.1	.3	4.2	42	5.6	3.8
80	11	1.1	.4	.1	.1	2.6	40	5.6	1.1
62	33	.6	1.2	.1	.2	13.4	14	5.0	.4
70	25	.3	1.0	.1	.2	13.5	11	4.9	.3
59	32	.3	.9	.2	.2	16.5	9	4.8	.3
51	11	.3	.7	.2	.1	13.5	9	4.5	.2
81	13	1.8	.4	.1	.1	7.6	24	4.7	2.2
73	20	1.0	.2	.2	.1	6.9	18	5.0	.8
87	9	.4	.1	.2	----------	3.8	16	5.5	.3
41	56	.8	.5	2.1	----------	26.4	11	5.0	.8
53	44	1.8	.6	2.1	.2	15.5	23	5.1	.5
51	47	3.3	.8	2.7	.2	16.9	29	5.1	.5
41	52	4.5	1.2	3.4	.3	16.4	36	5.3	.5
74	8	7.9	.9	.1	.4	13.2	41	5.8	3.2
64	11	7.6	.3	.1	.1	9.0	47	6.2	1.8
55	13	6.8	.3	.1	.1	4.0	66	6.4	1.5
65	14	3.7	.4	.1	.2	3.7	54	5.8	1.8
56	23	3.4	.4	.1	.1	3.4	54	6.0	.9
56	23	3.6	.4	.1	.1	4.1	51	5.9	.6
45	26	3.9	.5	.1	.1	3.4	57	6.0	.4
46	4	1.5	.3	.2	.1	4.4	32	5.5	1.5
49	9	1.3	.3	.1	.2	4.0	32	5.5	.7
34	24	1.8	1.0	.2	.2	10.4	24	5.2	.5
24	20	1.8	.8	.2	.2	10.0	23	5.1	.4
62	35	23.5	1.2	.2	.3	5.1	(2)	6.5	3.4
50	49	29.5	1.2	.4	.5	7.5	----------	6.2	2.2
47	50	27.0	1.1	.4	.5	8.2	----------	6.1	1.8
42	55	35.5	1.4	.4	.5	6.2	----------	6.9	.7
46	52	32.0	1.1	.4	.5	4.3	----------	7.2	.4
51	6	2.8	.7	.1	.2	7.7	33	5.6	2.8
49	8	.7	.2	.1	.1	6.4	15	5.0	1.8
46	11	.5	.2	.2	.1	6.1	14	5.0	1.1
75	18	4.3	1.4	.1	.2	2.6	70	6.9	1.7
69	20	3.8	1.3	.1	.2	2.9	65	6.8	1.7
73	26	3.4	1.3	.1	.2	3.0	62	6.8	1.2
57	28	3.3	1.4	.1	.2	4.0	56	6.8	1.0
63	34	4.3	1.7	.1	.3	5.0	56	6.3	.9
56	41	3.0	1.8	.1	.3	6.5	44	5.6	.3
77	17	2.9	1.3	.2	.7	7.7	40	5.9	2.1
72	21	3.5	.8	.2	.2	6.8	41	5.7	1.5
53	25	2.6	.9	.3	.2	7.2	36	5.4	.7
58	24	2.1	1.1	.2	.2	5.5	40	5.4	.4
58	19	1.8	.9	.2	.2	5.2	37	5.5	.4
82	12	1.5	.2	.2	.1	10.6	16	5.3	2.3
77	13	.4	.1	.2	.1	8.1	9	5.4	1.1
76	14	.4	.2	.5	.1	6.6	15	6.0	.5
35	62	3.4	2.2	4.0	.4	30.0	25	5.7	1.3
61	32	3.4	1.9	2.8	.2	10.7	44	5.8	.5

TABLE 15.—*Physical and chemical*

Soil and report number	Depth from surface	Horizon	Percentage of material less than 2.0 mm in size that is—			
			Very coarse through medium sand (2.0–0.25 mm)	Fine sand (0.25–0.10 mm)	Very fine sand (0.10–0.05 mm)	Total sand (2.0–0.05 mm)
	In					
Tonti cherty silt loam:	0–6	Ap	6	5	4	15
S69-Ark-4-1.	6–19	B2t	4	4	5	13
	19–29	Bx1	3	3	4	10
	29–42	Bx2	6	3	5	14
Waben cherty silt loam:	0–5	A1	13	3	3	19
S68-Ark-4-4.	5–15	A2	10	3	3	16
	15–40	B2t	11	2	3	16
	40–66	B3	25	4	4	33

[1] Thick horizon, subdivided for sampling and analysis.

Glossary

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.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

Claypan. A compact, slowly permeable soil horizon that contains more clay than the horizon above and below it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climax vegetation. The stabilized plant community on a particular site; it reproduces itself and does not change so long as the environment does not change.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Drainage class (natural). Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and 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.

Deferred grazing. The practice of delaying grazing until range plants have reached a definite stage of growth, in order to increase the vigor of the forage and to allow the desirable plants to produce seed. Contrasts with continuous grazing and rotation grazing.

Diversion, or diversion terrace. A ridge of earth, generally a terrace, that is built to divert runoff from its natural

analyses of selected soils—Continued

Percentage of material less than 2.0 mm in size that is—Continued		Extractable bases				Extractable acidity	Base saturation (sum)	Reaction (1:1 soil-water)	Organic matter
Silt (0.05–0.002 mm)	Clay (<0.002 mm)	Calcium	Magnesium	Sodium	Potassium				
		Meq per 100 g	*Meq per 100 g*	*Meq per 100 g*	*Meq per 100 g*	*Meq per 100 g*	*Pct*	*pH*	*Pct*
72	13	2.0	.6	.2	.1	6.4	31	5.1	1.1
62	25	1.6	1.1	.2	.2	10.9	22	4.8	.5
62	28	.6	1.1	.2	.2	13.4	14	4.7	.4
59	27	.6	.8	.2	.2	12.3	13	4.7	.3
73	8	4.5	1.2	.2	.4	7.3	46	6.1	3.3
74	10	.8	.5	.2	.2	3.8	31	5.4	1.0
65	19	2.3	1.2	.2	.3	4.2	49	5.4	.5
53	14	1.9	1.1	.2	.4	3.0	55	6.0	.3

[1] Calcium values indicate the presence of modest amounts of soluble salts, probably gypsum, in all horizons.

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.

Fallow. Cropland left idle in order to restore productivity, mainly through accumulation of water, nutrients, or both. Summer fallow is a common stage before cereal grain in regions of limited rainfall. The soil is tilled for at least one growing season to control weeds, to aid decomposition of plant residues, and to encourage the storage of moisture for the succeeding grain crop.

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.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has been allowed to drain away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Flood plain. Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

Fragipan. A loamy, brittle, subsurface horizon that is very low in organic-matter content and clay but is rich in silt or very fine sand. The layer is seemingly cemented. When dry, it is hard or very hard and has a high bulk density in comparison with the horizon or horizons above it. When moist, the fragipan tends to rupture suddenly if pressure is applied, rather than to deform slowly. The layer is generally mottled, is slowly or very slowly permeable to water, and has few or many bleached fracture planes that form polygons. Fragipans are a few inches to several feet thick; they generally occur below the B horizon, 15 to 40 inches below the surface.

Gleization. The reduction, translocation, and segregation of soil compounds, notably of iron, usually in the lower horizons, as a result of waterlogging with poor aeration and drainage; expressed in the soil by mottled colors dominated by gray. The soil-forming processes leading to the development of a gley soil.

Gleyed soil. A soil in which waterlogging and lack of oxygen have caused the material in one or more horizons to be neutral gray in color. The term "gleyed" is applied to soil horizons with yellow and gray mottling caused by intermittent waterlogging.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rains. The distinction between gully and rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by normal tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage. V-shaped gullies result if the material is more difficult to erode with depth; whereas U-shaped gullies result if the lower material is more easily eroded than that above it.

Gypsum. Calcium sulphate.

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.

Humus. The well-decomposed, more or less stable part of the organic matter in mineral soils.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to relatively level plots surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops, or in orchards, to confine the flow of water to one direction.

Furrow.—Water is applied in small ditches made by cultivation implements used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Irrigation water, released at high points, flows onto the field without controlled distribution.

Loess. Fine-grained material, dominantly of silt-sized particles, that has been deposited by wind.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and their thickness and arrangement in the soil profile.

Mottling, soil. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: abundance—*few*, *common*, and *many*; size—*fine*, *medium*, and *coarse*; and contrast—*faint*, *distinct*, and *prominent*. The size measurements are these: *fine*, less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium*, ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse*, more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

Parent material. Disintegrated and partly weathered rock from which soil has formed.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Permeability. The quality 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*.

pH value. A numerical means for designating acidity and alkalinity in soils. A pH value of 7.0 indicates precise neutrality; a higher value, alkalinity; and a lower value, acidity.

Plowpan. A compacted layer formed in the soil immediately below the plowed layer.

Poorly graded. A soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles in poorly graded soil material, density can be increased only slightly by compaction.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock. Only the upper part of this, modified by organisms and other soil-building forces, is regarded by soil scientists as soil. Most American engineers speak of the whole regolith, even to great depths, as "soil."

Relief. The elevations or inequalities of a land surface, considered collectively.

Rill. A steep-sided channel resulting from accelerated erosion. A rill normally is a few inches in depth and width and is not large enough to be an obstacle to farm machinery.

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.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. If two sequa are present in a single soil profile, it is said to have a bisequum.

Silica. Silica is a combination of silicon and oxygen. The mineral form is called quartz.

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.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on relatively steep slopes and in swelling clays, where there is marked change in moisture content.

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.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: *Very coarse sand* (2.0 to 1.0 millimeter); *coarse sand* (1.0 to 0.5 millimeter); *medium sand* (0.5 to 0.25 millimeter); *fine sand* (0.25 to 0.10 millimeter); *very fine sand* (0.10 to 0.05 millimeter); *silt* (0.05 to 0.002 millimeters); and *clay* (less than 0.002 millimeter). The separates recognized by the International Society of Soil Science are as follows: I (2.0 to 0.2 millimeter); II (0.2 to 0.02 millimeter); III (0.02 to 0.002 millimeter); IV (less than 0.002 millimeter).

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.

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 grained* (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.

Surface layer. A term used in nontechnical soil descriptions for the layers at the surface or immediately below an organic layer. Generally, the A, A1, or Ap horizon.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

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.

Topsoil. A presumed fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

Well-graded soil. A soil or soil material consisting of particles that are well distributed over a wide range in size or diameter. Such a soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which plants (specifically sunflower) wilt so much that they do not recover when placed in a dark, humid atmosphere.

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. The suitability of the soils for use as cropland and pasture is discussed in the soil descriptions. For information about the capability grouping, refer to page 39. The pasture and hayland groups are described on pages 41 and 42. For information about the suitability of the soils as woodland or for wildlife habitat, read the introduction to that section and refer to the table in each section. Other information is given in the tables as follows:

Acreage and extent, table 5, page 9.
Predicted yields, table 6, page 43.
Engineering, tables 9, 10, and 11, pages 56 through 69.

Town and country planning, table 12, page 70.
Recreational development, table 13, page 76.

Map symbol	Mapping unit	Page	Capability unit	Pasture and hayland group	Woodland group	Range site	
			Symbol	Symbol	Symbol	Name	Page
BtC	Britwater gravelly silt loam, 3 to 8 percent slopes	10	IIIe-1	8A	3o7	----------	--
BtD	Britwater gravelly silt loam, 8 to 12 percent slopes	11	IVe-1	8A	3o7	----------	--
CeC	Cane loam, 3 to 8 percent slopes	11	IIIe-2	8A	3o7	----------	--
CnB	Captina silt loam, 1 to 3 percent slopes	12	IIe-1	8A	4o7	----------	--
Co	Carytown silt loam	13	IIIw-1	8F	5w6	Claypan Prairie	52
Cs	Cherokee silt loam	15	IIIw-1	8F	5w6	Claypan Prairie	52
CvF	Clarksville cherty silt loam, 12 to 50 percent slopes	18	VIIs-1	8H	4f9	Chert Hills	47
Eg	Elsah soils	18	------	2A	3f8	----------	--
	Occasionally flooded part	--	IIIw-2	--	---	----------	--
	Frequently flooded part	--	Vw-1	--	---	----------	--
EnD	Enders gravelly loam, 3 to 12 percent slopes	20	IVe-2	8C	4o1	Clay Break, Shale	52
EoD	Enders stony loam, 3 to 12 percent slopes	20	VIs-1	8K	4x2	Clay Break, Shale	52
EoF	Enders stony loam, 12 to 30 percent slopes	20	VIIs-2	8D	4x2	Clay Break, Shale	52
Ft	Fatima silt loam, occasionally flooded	21	IIw-1	2A	2o7	----------	--
He	Healing silt loam	21	I-1	2A	2o7	----------	--
Hf	Healing silt loam, occasionally flooded	22	IIw-1	2A	2o7	----------	--
JaB	Jay silt loam, 1 to 3 percent slopes	23	IIe-1	8A	4o7	Loamy Prairie	54
Jo	Johnsburg silt loam	24	IIIw-3	8F	4w8	----------	--
Lm	Limestone outcrop	24	VIIIs-1	--	---	----------	--
LrC	Linker fine sandy loam, 3 to 8 percent slopes	25	IIIe-2	8A	4o1	Loamy Upland	54
Me	Mayes silty clay loam	25	IIw-2	8F	5w6	Claypan Prairie	52
MuD	Mountainburg stony sandy loam, 3 to 12 percent slopes	26	VIs-2	14C	5x3	Sandstone Ridge	54
MuE	Mountainburg stony sandy loam, 12 to 40 percent slopes	26	VIIs-3	14B	5x3	Sandstone Ridge	54
NeB	Newtonia silt loam, 1 to 3 percent slopes	27	IIe-2	8A	3o7	----------	--
NfC	Nixa cherty silt loam, 3 to 8 percent slopes	27	IIIs-1	8G	4f8	Chert Hills	47
NfD	Nixa cherty silt loam, 8 to 12 percent slopes	28	IVs-1	8G	4f8	Chert Hills	47
NoD	Noark cherty silt loam, 8 to 12 percent slopes	29	IVe-3	8A	4f8	Chert Hills	47
NoE	Noark cherty silt loam, 12 to 20 percent slopes	29	VIe-1	8B	4f8	Chert Hills	47

Map symbol	Mapping unit	Page	Capability unit	Pasture and hayland group	Woodland group	Range site	
			Symbol	Symbol	Symbol	Name	Page
NoF	Noark cherty silt loam, 20 to 45 percent slopes	29	VIIe-1	8B	4r9	Chert Hills	47
PeB	Peridge silt loam, 1 to 3 percent slopes	30	IIe-2	8A	3o7	----------	--
PeC	Peridge silt loam, 3 to 8 percent slopes	31	IIIe-1	8A	3o7	----------	--
Se	Secesh gravelly silt loam, occasionally flooded	32	IIw-1	2A	3o7	----------	--
SoF	Sogn rocky silt loam, 12 to 40 percent slopes	34	VIIs-4	17A	5d9	Limestone Ledge	53
SrE	Sogn-Clareson complex, 8 to 20 percent slopes	34	VIIs-4	17A	5d9	Limestone Ledge	53
SsD2	Summit silty clay, 3 to 15 percent slopes, eroded	34	VIe-2	7C	5c8	Clay Break, Shale	52
ToA	Taloka silt loam, 0 to 1 percent slopes	35	IIs-1	8A	5w6	Claypan Prairie	52
TsC	Tonti cherty silt loam, 3 to 8 percent slopes	36	IIIe-2	8A	4o7	----------	--
VsF	Ventris stony silt loam, 15 to 40 percent slopes	37	VIIs-5	8D	5x3	Clay Break, Limestone	47
WeC	Waben cherty silt loam, 3 to 8 percent slopes	38	IIIs-1	8G	3f8	----------	--
WeD	Waben cherty silt loam, 8 to 12 percent slopes	38	IVs-1	8G	3f8	----------	--

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