



United States
Department of
Agriculture

Natural
Resources
Conservation
Service

In cooperation with
Missouri Department of
Natural Resources and
Missouri Agricultural
Experiment Station

Soil Survey of Adair County, Missouri



How To Use This Soil Survey

General Soil Map

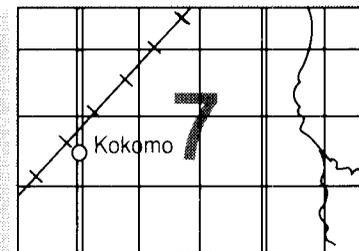
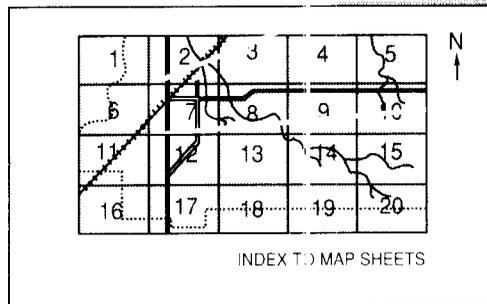
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

Detailed Soil Maps

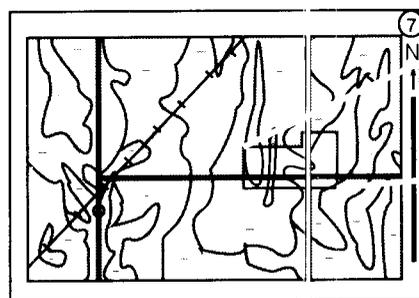
The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.

To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.

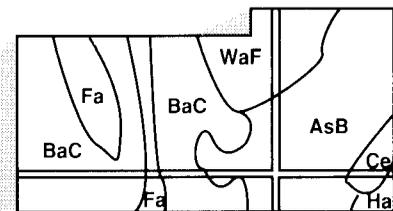


MAP SHEET

Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.



MAP SHEET



AREA OF INTEREST

NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (formerly 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 1986-1991. Soil names and descriptions were approved in 1992. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1991. This survey was made cooperatively by the Natural Resources Conservation Service, the Missouri Department of Natural Resources, and the Missouri Agricultural Experiment Station. The Missouri Department of Natural Resources provided soil scientists to assist with the fieldwork. Through the Adair County Soil and Water Conservation District, the Adair County Commission, private businesses, and individuals donated funds for a soil scientist to assist with the fieldwork and for other support of the soil survey. This survey is part of the technical assistance furnished to the Adair County Soil and Water Conservation District.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

All programs and services of the Natural Resources Conservation Service are offered on a nondiscriminatory basis, without regard to race, color, national origin, religion, sex, age, marital status, or handicap.

Cover: Typical landscape of the Gara-Armstrong association.

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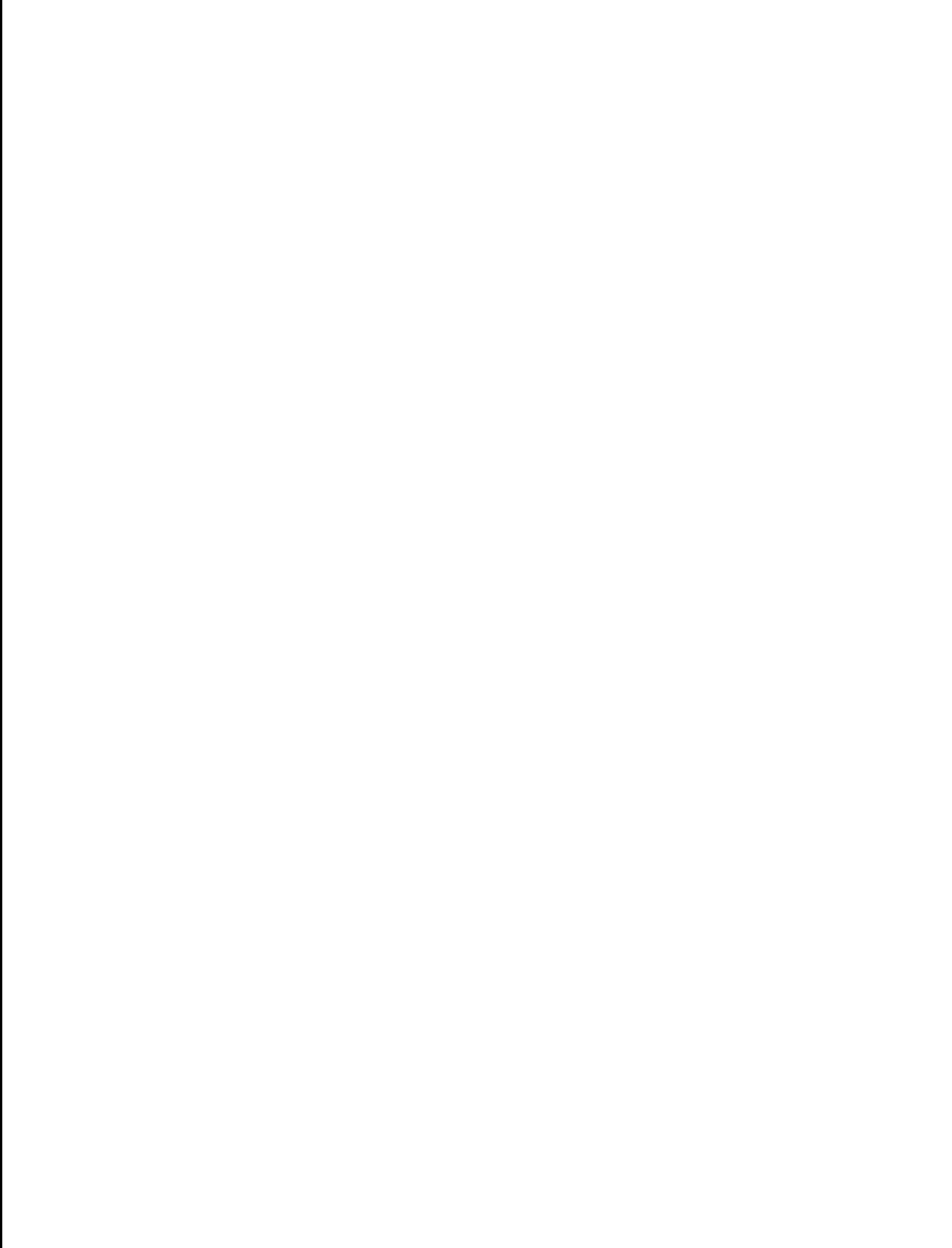
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Foreword

This soil survey contains information that can be used in land-planning programs in Adair County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow over bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Natural Resources Conservation Service or the Missouri Cooperative Extension Service.

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Soil Survey of Adair County, Missouri

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Fieldwork by Henry J. Ferguson and Clayton Lee, Natural Resources Conservation Service; Jerry L. Smith, Thomas Morgan, Michael L. Chalfant, and Rodney R. Taylor, Missouri Department of Natural Resources; and James C. Remley, Adair County Soil and Water Conservation District

United States Department of Agriculture, Natural Resources Conservation Service,
in cooperation with
Missouri Department of Natural Resources and Missouri Agricultural Experiment Station

ADAIR COUNTY is in the rolling hills of northeastern Missouri (fig. 1). It has an area of 364,448 acres, or 569.45 square miles. In 1990, the county had a population of 24,577 and Kirksville, the county seat, had a population of 17,139 (15). Kirksville is near the center of the county.

The county benefits from a diversified economy. Farming is the main enterprise. Several small industries, a state university, and a medical college provide numerous jobs. The main areas of crop production are along the streams and in the nearly level to gently rolling areas in the uplands. Rolling and hilly areas are seeded to pasture and hay. Extensive stands of timber are in the steepest areas of the county.

General Nature of the County

This section gives general information concerning the county. It describes climate; history and development; farming; and physiography, relief, and drainage.

Climate

The consistent pattern of climate in Adair County is one of cold winters and long, hot summers. Heavy rains occur mainly in spring and early summer, when moist air from the Gulf of Mexico interacts with drier continental air. Snow falls nearly every winter and often lasts a few weeks. The annual precipitation is normally

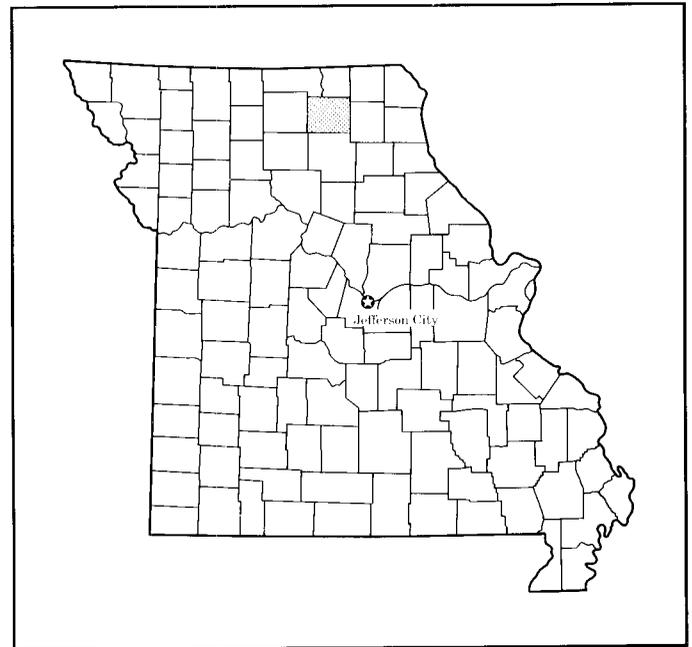


Figure 1.—Location of Adair County in Missouri.

adequate for corn, soybeans, and all grain crops.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Kirksville in the period 1961 to 1990. Table 2 shows probable dates of

the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter, the average temperature is 27 degrees F and the average daily minimum temperature is 18 degrees. The lowest temperature on record, which occurred at Kirksville on December 28, 1924, and January 10, 1982, is -23 degrees. In summer, the average temperature is 74 degrees and the average daily maximum temperature is 85 degrees. The highest recorded temperature, which occurred on July 15, 1936, is 113 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (40 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 35.25 inches. Of this, 23.53 inches, or about 67 percent, usually falls in April through September. The growing season for most crops falls within this period. The heaviest 1-day rainfall was 8.07 inches at Kirksville on July 22, 1951. Thunderstorms occur on about 53 days each year, and most occur in May. Tornadoes and severe thunderstorms occur occasionally but are local in extent and of short duration. They cause damage in scattered small areas. Hailstorms occur at times during the warmer part of the year. They occur in an irregular pattern and in only small areas.

The average seasonal snowfall is 23.2 inches. The greatest snow depth at any one time during the period of record was 27 inches. On the average, 8 days of the year have at least 1 inch of snow on the ground. The heaviest 1-day snowfall on record was 18 inches.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 83 percent. The sun shines 66 percent of the time possible in summer and 49 percent in winter. The prevailing wind is from the south-southeast. Average windspeed is highest, 12 miles per hour, in March.

History and Development

Jerry L. Smith, soil scientist, Missouri Department of Natural Resources, helped prepare this section.

The earliest known inhabitants of Adair County were prehistoric Indians, who hunted and camped along the major streams. Evidence of their inhabitancy includes earthen burial mounds that were usually constructed from the upper part of Gorin soils. Indian tribes were encountered by early explorers and trappers traveling

up the Chariton River in pirogues, or boats hewn from cottonwood trees (4).

The first white settlers in Adair County established a settlement along the Chariton River in 1828 (6). At the time of settlement, the sloping Winnegan soils supported large tracts of hardwoods. Tall prairie grasses were extensive in the county. They influenced the formation of Armstrong, Purdin, Adco, and other soils that are characterized by high natural fertility. The native grasses were highly productive and well adapted to the climate and soils of the county. Various resources were available to the pioneers. Early accounts indicate that black bear, elk, white-tailed deer, bison, turkey, prairie chickens, quail, and beaver inhabited the forests and prairies of the county (6).

The lowland areas that were timbered were settled first. The first farmers learned that clearing woodland for cropping was less difficult than turning the tough prairie sod of the uplands with crude wooden plows. When the steel plow was developed in the mid-1800's, the areas of prairie were cropped and became more densely settled (23).

The farmers in the county have supplemented their farm income in various ways. Timber was harvested and sold for ties as railroads were developed in the late 19th century. Coal mines in the western half of the county provided not only jobs but also a market for construction timbers. Walnut trees were harvested during World War I for the manufacture of gunstocks. By the end of the war, no significant areas of virgin timber remained (10).

A coal resource influenced the development of Adair County. The first settlers made private use of the coal. The earliest known coal mine in the county was operated in 1854 near Nineveh, which is now known as Connelville (3). By 1858, coal was considered an important resource. In 1878, the first trainloads of coal from the mines in the county arrived in Quincy, Illinois. About 53 mines were established in the county between 1894 and 1966. The Billy Creek Coal Mine was probably the last shaft mine to be operated in Missouri (23).

Most of the early settlement was in areas of Gifford and Chariton soils on the higher stream terraces or in areas of Gorin soils on the tops of upland ridges adjacent to wooded areas of Winnegan soils. The early settlers had easy access to lumber, water, and shelter. The nearby prairies were used as open range for livestock. The native grasses were well adapted to the landscape and climate in areas of Armstrong, Purdin, Bevier, and Zook soils. Over 50 varieties of native grasses grew in the county. Timothy and orchardgrass were introduced as cool-season grasses for early spring, late fall, and winter feeding.

Once the sod could be plowed, the settlers planted tobacco, hemp, corn, wheat, rye, and oats. Tobacco was the principal cash crop. The sale of cattle and hogs was the chief source of revenue.

The types of crops and livestock enterprises have changed over the years. Corn was the dominant crop for many years. Soybeans were introduced after 1920 bringing the greatest change in the agricultural production of the county. A decline in soil fertility was noted by 1911. As a result, more legumes were grown and more organic matter was incorporated into the soils (14). By the mid-1960's, soybeans had surpassed corn as the dominant crop. While beef and pork production has remained rather stable through the years, dairy and sheep production has decreased significantly (7).

Technological advances of the 20th century allowed farmers to replace manual labor with machinery. These advances have resulted in a steady decrease in the number of farms and a corresponding increase in their size (7). As the profitability of crops has decreased, some farmers have increased their number of livestock as a means of increasing their income. Another important development has been a trend toward reduced tillage and no-till farming. These practices not only lower machinery costs but also help to control erosion and preserve the vital soil resources of the county.

Farming

Adair County is a rural area. Farming is the main enterprise. It is diversified. The main crops are corn, soybeans, winter wheat, legumes, and grasses. Livestock enterprises account for the largest portion of the annual farm income. The chief kinds of livestock are beef cattle and hogs.

In 1828, at the time of the first settlement, much of the county was covered with hardwoods. The forested areas were steadily cleared and converted to agricultural uses. Only about 18 percent of the acreage in the county currently is wooded (20).

In 1987, the number of farms in the county was 879. The average size of the farms was about 325 acres. Of the total acreage in farms, about 35 percent was harvested cropland (21).

The acreage and yields of crops have fluctuated significantly during the past 100 years. In 1899, corn was harvested on 65,452 acres, yielding 27.6 bushels per acre. In 1983, it was harvested on 12,100 acres, yielding about 33.9 bushels per acre (7). In 1990, it was harvested on 10,800 acres, yielding about 98.4 bushels per acre.

Soybeans are grown on the largest acreage of any crop in the county. In 1950, they were harvested on

11,100 acres, yielding an average of 20.8 bushels per acre. In 1986, they were harvested on 53,800 acres, yielding an average 32.9 bushels per acre. In 1990, they were harvested on 31,300 acres, yielding about 26.5 bushels per acre.

The number of livestock has fluctuated in the county. In 1850, the county had about 1,010 cattle and 11,762 hogs. In 1990, it had about 11,300 hogs and 41,400 cattle. The highest numbers recorded were 39,700 hogs in 1970 and 61,600 cattle in 1975.

Physiography, Relief, and Drainage

Jerry L. Smith, soil scientist, Missouri Department of Natural Resources, helped prepare this section.

The landscape in Adair County consists mainly of gently sloping to strongly sloping uplands. The surface was created by postglacial erosion. At least two glaciers advanced across the county. They transported glacial till that buried previous landforms. When the glacial ice retreated, it left a wide plain gradually sloping to the south. The original surface of this plain was modified by geologic erosion and deposition. In some areas drainage patterns are entrenched through the glacial till overburden to the underlying bedrock formations. The more nearly level areas that have not been dissected have accumulated thick layers of loess. The present topography is the product of these earlier processes. The only remnants of the once extensive plain are on the summits of current drainage divides.

The elevation within the county ranges from 735 feet on the flood plain along the Chariton River to 1,060 feet on the highest ridges in the northwestern part of the county.

Adair County is drained by two major rivers—the Chariton and Salt Rivers. The Chariton River drains the western half of the county. It runs in a north-south direction as it flows toward the Missouri River. The Salt River drains the eastern half of the county. It runs in a northwest-southeast direction as it flows toward the Mississippi River. The two rivers are fed by numerous smaller streams.

The topography of the county ranges from nearly level areas to very steep uplands. The nearly level areas generally are on the flood plains along streams and on the main ridgetop divide, which extends in a north-south direction near the center of the county.

The topography of the eastern side of the county gradually slopes toward the southeast. The nearly level Putnam and very gently sloping Adco soils are on the more stable upland summits. These soils formed in loess. Below the broad summits are concave areas of Leonard soils, which formed in a thin layer of loess and in the underlying loamy sediments and paleosol. These

soils incline toward the drainageways, which extend into tributaries of the Salt River. Winnegan soils are on the lower side slopes. They are eroded down through the paleosol and into the underlying glacial till.

West of the Grand Divide, the physiography exhibits transitional characteristics. The central part of the county is typified by a rolling topography and somewhat narrow ridges. Adco and Bevier soils are on the ridgetops, and Armstrong soils are on the side slopes. Adco and Bevier soils formed in loess and in the underlying loamy sediments or paleosol, and Armstrong soils formed in a paleosol weathered from the underlying glacial till.

The western part of the county is the most dissected area in the county. The dominant landforms are narrow ridges with moderately steep to very steep side slopes. The primary divides have a thin mantle of loess overlying loamy sediments, a paleosol, and glacial till. Bevier soils are on the narrow ridgetops. Gara soils formed in glacial till in areas below the Bevier soils.

The major flood plains in the county are along the Chariton and Salt Rivers. The Chariton River occupies a valley that is as much as 3 miles wide in some areas. The poorly drained Zook soils make up the major part of the flood plain along the river. Numerous tributaries drain the dissected ridges west of the river. These smaller streams have deposited loamy and silty sediments on narrow flood plains. Floris and Dockery soils formed in these alluvial deposits adjacent to the natural stream channels. Vesser and Arbela soils are on the higher flood plains along the tributaries. In some areas the downcutting of streams has exposed limestone, sandstone, and shale bedrock. Chariton and Gifford soils are on the high Pleistocene stream terraces along the valley sides.

The Salt River has fewer tributaries and a steeper gradient than the Chariton River. The dominant soils in areas along the Salt River and its tributaries are Dockery soils on low flood plains and Vesser soils on the higher flood plains along the tributaries.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface

down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses under different levels of management.

Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

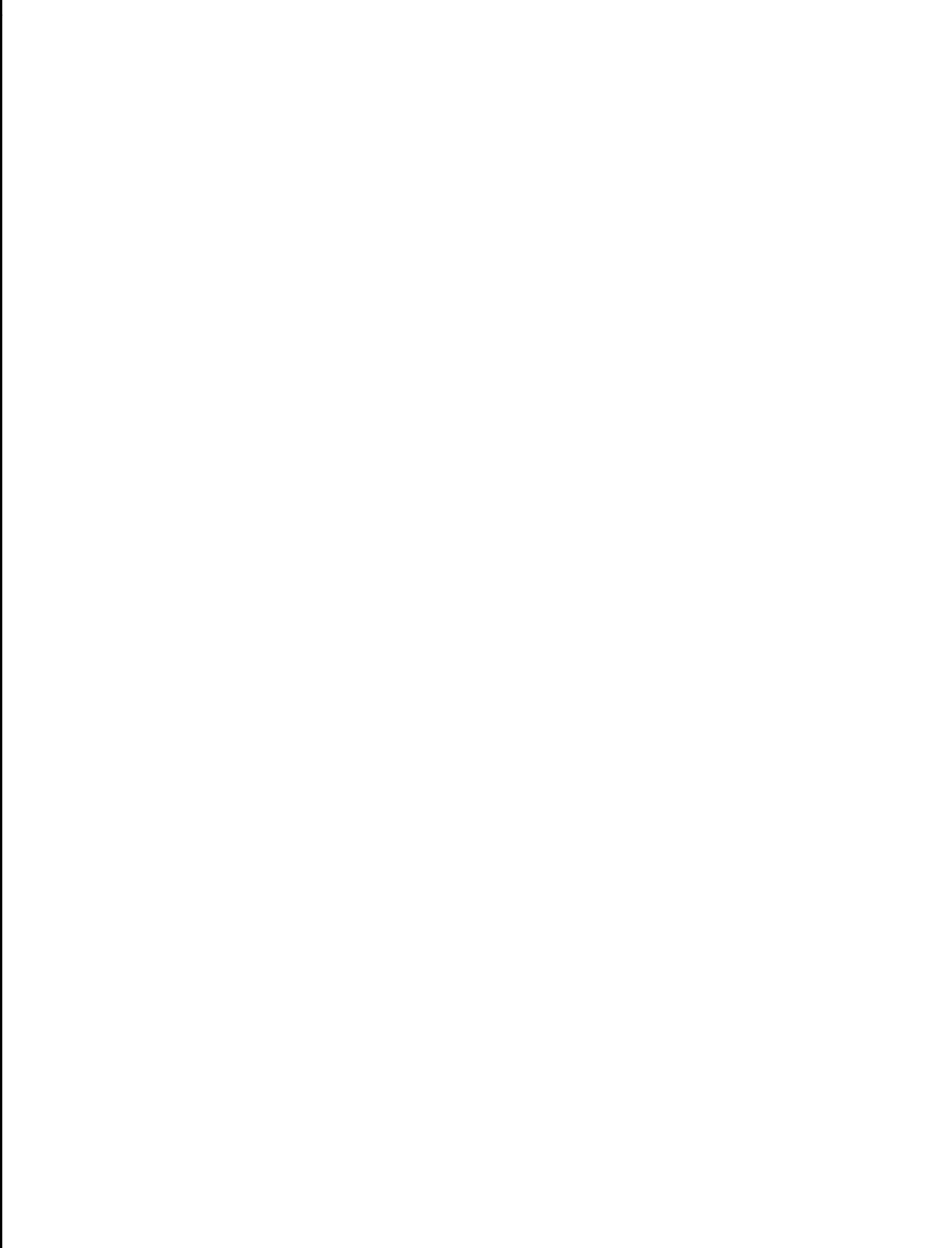
A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by two or three kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in

their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes.

Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.



General Soil Map Units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The descriptions, names, and delineations of the soils identified on the general soil map of this county do not fully agree with those of the soils identified on the maps of adjacent counties published at a different date. Differences are the result of additional soil data, variations in the intensity of mapping, and correlation decisions that reflect local conditions. In some areas combining small acreages of similar soils that respond to use and management in much the same way is more practical than mapping these soils separately and giving them different names.

Soil Descriptions

1. Armstrong-Adco-Leonard Association

Very deep, very gently sloping to moderately sloping, somewhat poorly drained and poorly drained, loamy and silty soils; on uplands

This association consists of soils on upland ridges that have long side slopes and narrow, branching drainageways. The ridges generally are uniform in elevation. They are in the upper reaches of watershed basins. Slopes range from 1 to 9 percent.

This association makes up about 22 percent of the

county. It is about 53 percent Armstrong and similar soils, 27 percent Adco soils, 17 percent Leonard soils, and 3 percent soils of minor extent (fig. 2).

The somewhat poorly drained, moderately sloping Armstrong soils are on convex side slopes and ridgetops. Typically, the surface layer is very dark grayish brown loam. The upper part of the subsoil is brown and yellowish brown, mottled clay. The lower part is dark yellowish brown and yellowish brown, mottled clay loam.

The somewhat poorly drained, very gently sloping Adco soils are on ridgetops above the Leonard and Armstrong soils. Typically, the surface layer is very dark gray silt loam. The subsurface layer is grayish brown silt loam. The upper part of the subsoil is dark grayish brown, grayish brown, and brown, mottled silty clay. The lower part is light brownish gray and strong brown, mottled silty clay loam. The substratum is light brownish gray and strong brown, mottled silty clay loam.

The poorly drained, gently sloping Leonard soils are on the concave side slopes and head slopes of drainageways between the Adco and Armstrong soils. Typically, the surface layer is very dark grayish brown silty clay loam. The upper part of the subsoil is gray, mottled silty clay. The next part is dark grayish brown and grayish brown, mottled silty clay and silty clay loam. The lower part is gray, mottled silty clay loam and silty clay.

Of minor extent in this association are the poorly drained Putnam soils on the higher, broader, nearly level ridgetops above the Adco soils.

The soils in this association are used mainly for cultivated crops. Some small areas are used for pasture or hay. These soils are suited to corn, soybeans, grain sorghum, and winter wheat and to grasses and legumes that are tolerant of wetness. The hazard of erosion and surface wetness during spring and winter are the main management concerns in cultivated areas. Overgrazing and grazing when the soils are wet are the major concerns in managing pasture.

These soils are suited to building site development, sewage lagoons, and local roads and streets. The shrink-swell potential, the potential for frost action,

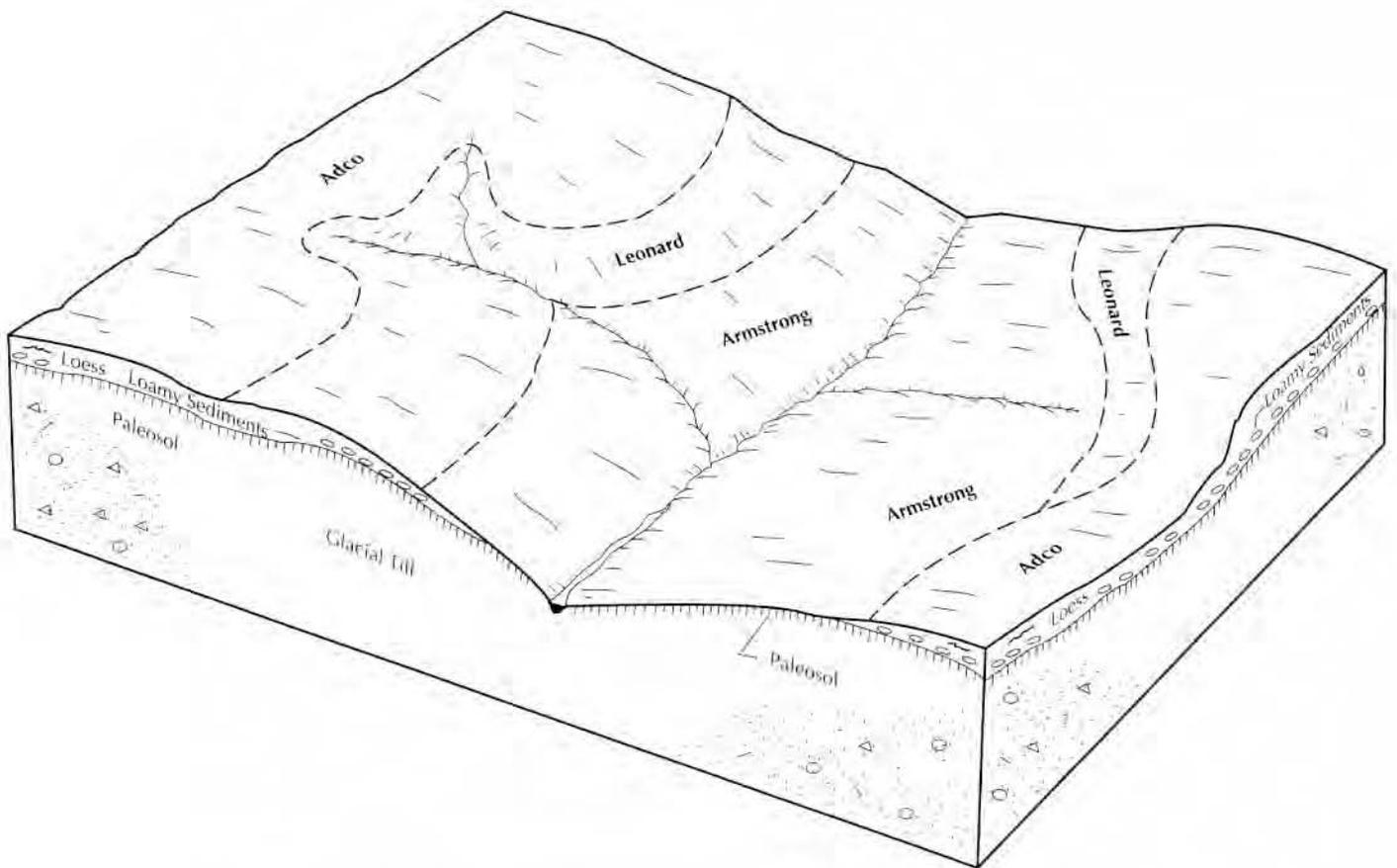


Figure 2.—Typical pattern of soils and parent material in the Armstrong-Adco-Leonard association.

wetness, and low strength are the major limitations. The soils are unsuited to conventional septic tank absorption fields because of restricted permeability.

2. Gara-Armstrong Association

Very deep, moderately sloping to moderately steep, moderately well drained and somewhat poorly drained, loamy soils; on uplands

This association consists of soils on convex upland ridges and side slopes adjacent to minor drainageways. Slopes range from 5 to 20 percent.

This association makes up about 30 percent of the county. It is about 46 percent Gara and similar soils, 44 percent Armstrong and similar soils, and 10 percent soils of minor extent (fig. 3).

The moderately well drained, strongly sloping and moderately steep Gara soils are on highly dissected side slopes. Typically, the surface layer is very dark grayish brown fine sandy loam. The upper part of the subsoil is dark yellowish brown, mottled clay loam. The

lower part is yellowish brown, dark yellowish brown, and light gray, mottled loam.

The somewhat poorly drained, moderately sloping and strongly sloping Armstrong soils are on the upper side slopes and on low ridgetops. Typically, the surface layer is very dark grayish brown clay loam. The subsoil is brown and yellowish brown, mottled clay in the upper part and dark yellowish brown and yellowish brown, mottled clay loam in the lower part.

Of minor extent in this association are Bevier, Dockery, Vanmeter, Vesser, and Vigar soils. The somewhat poorly drained Bevier soils are on narrow, convex ridgetops. The nearly level, somewhat poorly drained Dockery soils are on flood plains. The moderately deep, moderately well drained Vanmeter soils are on the lower side slopes and foot slopes. The nearly level, poorly drained Vesser soils are on high flood plains at the base of the sloping uplands. The moderately well drained Vigar soils are on foot slopes at the base of the sloping uplands.

The soils in this association are used mainly for

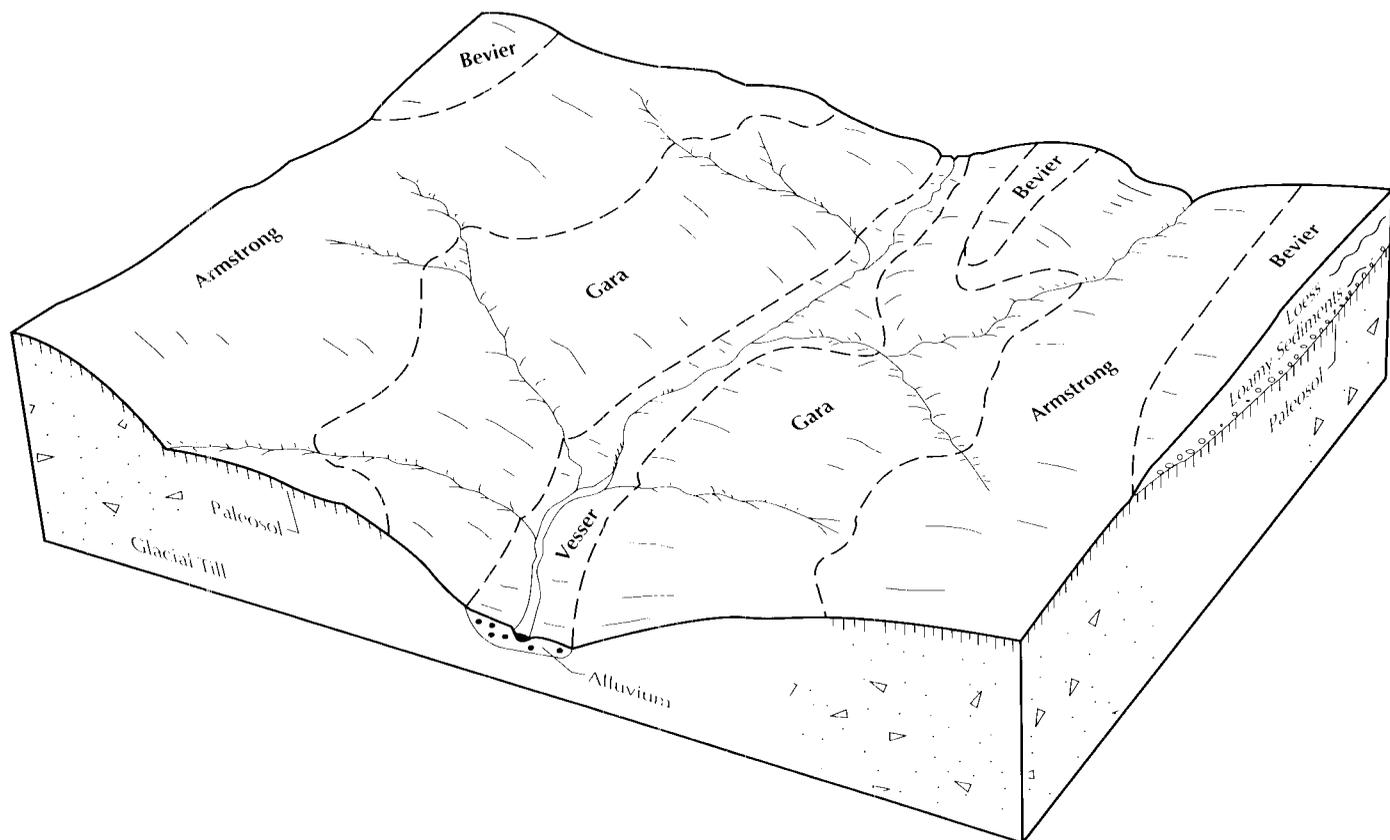


Figure 3.—Typical pattern of soils and parent material in the Gara-Armstrong association.

pasture or hay. Some areas have been used as cropland, and a few areas are wooded. The native vegetation consists of prairie grasses in the less sloping areas and hardwoods in the steeper, more dissected areas. The steeper soils generally are unsuited to cultivated crops because of the slope and a severe hazard of erosion. They are best suited to pasture and hay. The hazard of erosion and the damage caused by overgrazing are the main concerns in managing pasture.

The soils in this association are suited to building site development and sewage lagoons. The slope, wetness, and the shrink-swell potential are the main limitations. The soils are unsuited to conventional septic tank absorption fields because of restricted permeability.

3. Winnegan-Gorin-Gara Association

Very deep, moderately sloping to steep, moderately well drained and somewhat poorly drained, loamy and silty soils; on uplands

This association consists of soils on long, narrow, convex ridgetops and steep side slopes adjacent to the

major drainageways in the uplands. Slopes range from 5 to 35 percent.

This association makes up about 33 percent of the county. It is about 47 percent Winnegan and similar soils, 18 percent Gorin and similar soils, 16 percent Gara and similar soils, and 19 percent soils of minor extent (fig. 4).

The moderately well drained, moderately sloping to steep Winnegan soils are on side slopes and narrow, convex ridgetops. Typically, the surface layer is very dark grayish brown loam. The subsurface layer is brown loam. The subsoil is dark yellowish brown clay in the upper part and dark yellowish brown, strong brown, and grayish brown, mottled clay loam in the lower part.

The somewhat poorly drained, moderately sloping Gorin soils are on convex ridgetops. Typically, the surface layer is dark grayish brown silt loam. The upper part of the subsoil is dark yellowish brown silty clay loam. The next part is brown, mottled silty clay and yellowish brown, mottled silty clay loam. The lower part is coarsely mottled brown and grayish brown silt loam and yellowish brown, mottled silty clay loam.

The moderately well drained, steep Gara soils are on

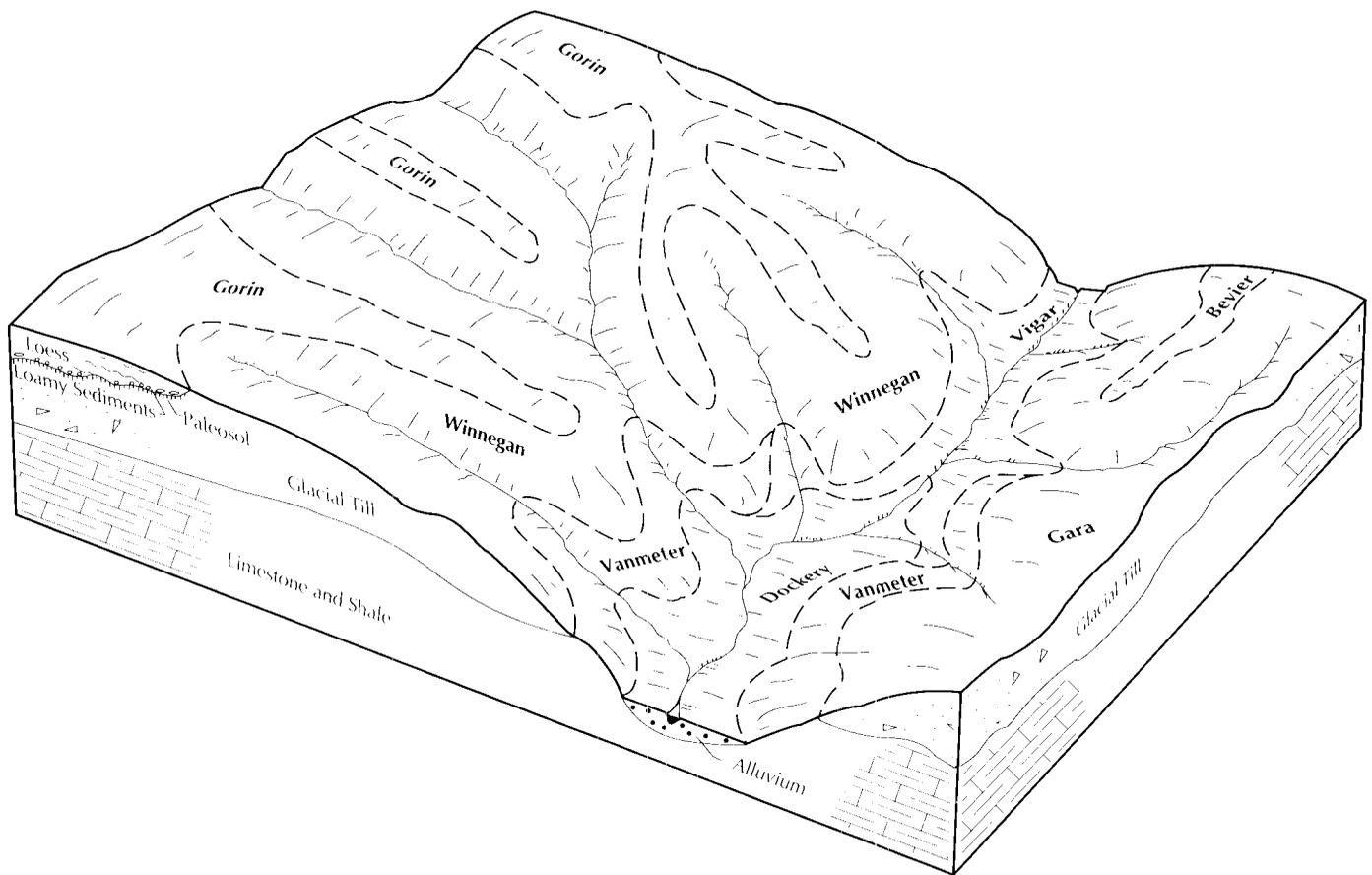


Figure 4.—Typical pattern of soils and parent material in the Winnegan-Gorin-Gara association.

highly dissected side slopes. Typically, the surface layer is very dark grayish brown fine sandy loam. The subsoil is dark yellowish brown, mottled clay loam in the upper part and yellowish brown, dark yellowish brown, and light gray, mottled loam in the lower part.

Of minor extent in this association are Bevier, Dockery, Floris, Vanmeter, and Vigar soils. Bevier soils are similar to the Gorin soils. The moderately well drained Floris and somewhat poorly drained Dockery soils are on narrow flood plains and are occasionally flooded. The moderately deep, moderately well drained Vanmeter soils are on the lower side slopes and foot slopes. The moderately well drained Vigar soils are on toe slopes and are subject to rare flooding.

The soils in this association generally are wooded. Some areas are used for pasture or hay. The steeper Winnegan and Gara soils generally are unsuited to cultivated crops because of a severe hazard of erosion.

Large areas of the soils in this association are poorly suited to pasture because of the highly dissected, steep slopes. Some of the less sloping areas are suitable for

pasture. The hazard of erosion and the damage caused by overgrazing are the main concerns in managing pasture.

The soils in this association are suited to trees. The native vegetation consists of hardwoods. An equipment limitation and seedling mortality are the main concerns in managing woodland.

The Gorin soils are suitable for building site development and some kinds of onsite waste disposal. Restricted permeability, the shrink-swell potential, and wetness are the main limitations. The Gara and Winnegan soils generally are not used for building site development or onsite waste disposal because of the slope.

4. Purdin-Armstrong Association

Very deep, moderately sloping to steep, moderately well drained and somewhat poorly drained, loamy soils; on uplands

This association consists of soils on long, narrow, convex ridgetops and steep side slopes adjacent to the

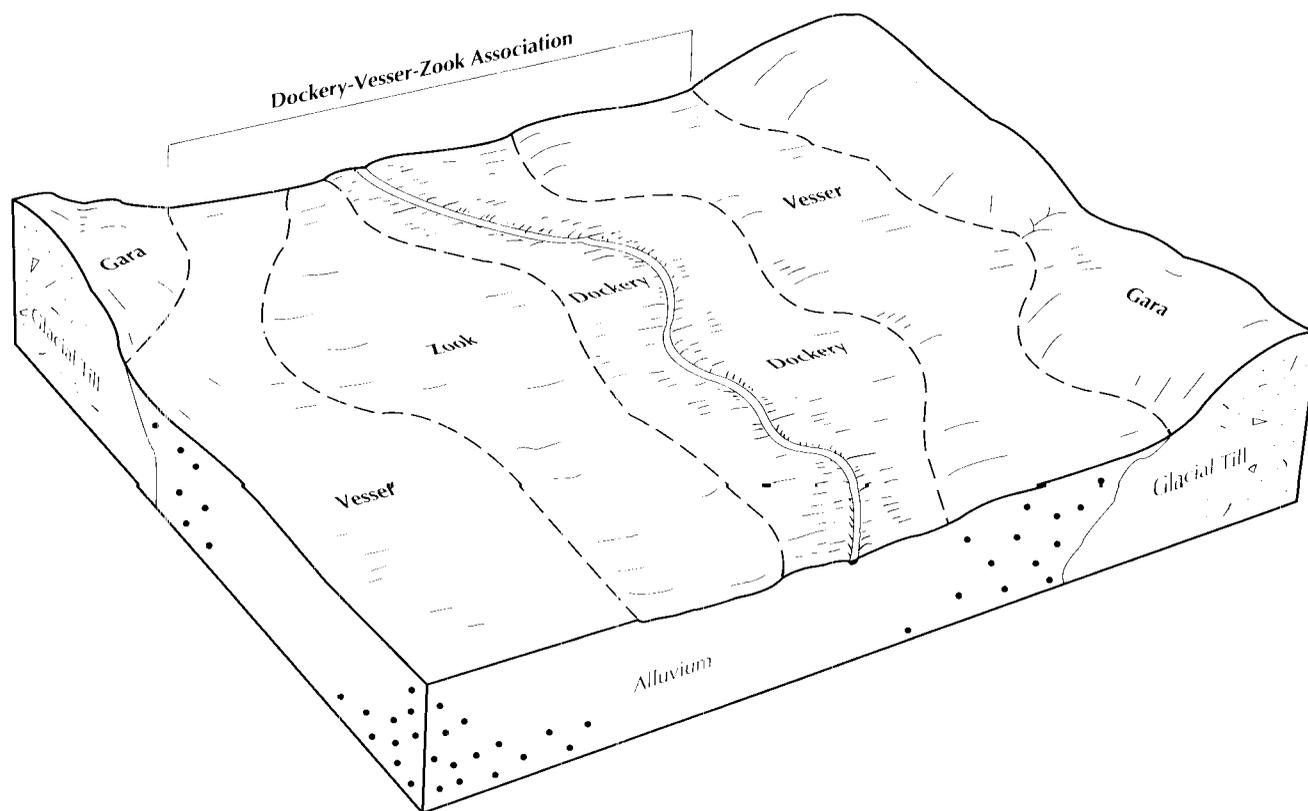


Figure 5.—Typical pattern of soils and parent material in the Dockery-Vesser-Zook association.

major drainageways. Slopes range from 5 to 35 percent.

This association makes up about 4 percent of the county. It is about 77 percent Purdin and similar soils, 14 percent Armstrong and similar soils, and 9 percent soils of minor extent.

The moderately well drained, moderately sloping to steep Purdin soils are on side slopes and narrow, convex ridgetops. Typically, the surface layer is very dark grayish brown clay loam. The subsoil is dark yellowish brown and yellowish brown clay loam in the upper part and yellowish brown and light olive brown, mottled clay loam in the lower part.

The somewhat poorly drained, moderately sloping and strongly sloping Armstrong soils are on the upper side slopes and on low ridgetops. Typically, the surface layer is very dark grayish brown loam. The upper part of the subsoil is brown and yellowish brown, mottled clay. The lower part is dark yellowish brown and yellowish brown, mottled clay loam.

Of minor extent in this association are Bevier, Dockery, Excello, and Vigar soils. The gently sloping Bevier soils are on narrow ridgetops. The nearly level

Dockery and Excello soils are on narrow flood plains and are occasionally flooded. Vigar soils are on foot slopes adjacent to narrow drainageways and flood plains and are subject to rare flooding.

The soils in this association generally are used for pasture. Some areas are wooded. The steeper Purdin soils are unsuited to cultivated crops because of a severe hazard of erosion.

In most areas the soils in this association are suited to pasture. Pasture management is difficult, however, because of the slope. The hazard of erosion and the damage caused by overgrazing are the main concerns in managing pasture.

These soils are suited to trees. Only a few areas support stands of hardwoods. An equipment limitation and seedling mortality are the main concerns in managing woodland.

The moderately sloping Armstrong soils are suited to building site development and some kinds of onsite waste disposal. Restricted permeability, the shrink-swell potential, and wetness are the major limitations. The steeper soils in this association generally are not used for building site development or onsite waste disposal

because of the slope and wetness.

5. Dockery-Vesser-Zook Association

Very deep, nearly level, somewhat poorly drained and poorly drained, silty soils; on flood plains

This association consists of soils on flood plains. Slopes range from 0 to 2 percent.

This association makes up about 11 percent of the county. It is about 31 percent Dockery and similar soils, 30 percent Vesser soils, 25 percent Zook and similar soils, and 14 percent soils of minor extent (fig. 5).

The somewhat poorly drained Dockery soils are near the original stream channels. Typically, the surface layer is very dark grayish brown silt loam. The substratum is brown and light brownish gray silt loam and loam.

The poorly drained Vesser soils are in the higher areas on the flood plains. Typically, the surface layer is very dark gray silt loam. The subsurface layer is very dark gray, grayish brown, and dark grayish brown silt loam. The subsoil is dark gray and very dark grayish brown silty clay loam.

The poorly drained Zook soils are in backswamp areas. They are farther from the original stream channels than the Dockery soils. Typically, the surface

layer and subsurface layer are very dark gray and black silty clay loam. The subsoil is black silty clay loam. It is mottled in the lower part.

Of minor extent in this association are the moderately well drained Vigar and Floris soils. Vigar soils are on foot slopes at the base of the more sloping uplands. They are at the slightly higher elevations adjacent to the flood plains. Floris soils are on flood plains adjacent to the original stream channels.

The soils in this association are used mainly as cropland. Some areas are used for pasture or hay or are wooded. The poorly drained Zook soils are often tilled in the fall. The somewhat poorly drained Dockery soils can be worked and planted to crops earlier in the spring than the Zook soils. Flooding from local tributaries or levee breaks is the main hazard.

In most areas the soils in this association are suited to pasture and hay. The damage caused by grazing when the soils are wet is the main concern in managing pasture.

These soils are suited to timber production. Only a few areas support stands of hardwoods. Seedling mortality and an equipment limitation are the main concerns in managing woodland.

These soils are unsuited to building site development and onsite waste disposal because of flooding.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under the heading "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Gara fine sandy loam, 14 to 20 percent slopes, eroded, is a phase of the Gara series.

Some map units are made up of two or more major soils. These map units are called soil complexes or undifferentiated groups.

A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Gorin-Winnegan complex, 5 to 14 percent slopes, eroded, is an example.

An *undifferentiated group* is made up of two or more

soils that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils in the mapped areas are not uniform. An area can be made up of only one of the major soils, or it can be made up of all of them. Dockery and Tice silt loams, occasionally flooded, is an undifferentiated group in this survey area.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

The descriptions, names, and delineations of the soils identified on the detailed soil maps of this county do not fully agree with those of the soils identified on the maps of adjacent counties published at a different date. Differences are the result of additional soil data, variations in the intensity of mapping, and correlation decisions that reflect local conditions. In some areas combining small acreages of similar soils that respond to use and management in much the same way is more practical than mapping these soils separately.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Soil Descriptions

14C2—Armstrong loam, 5 to 9 percent slopes, eroded. This very deep, moderately sloping, somewhat poorly drained soil is on low, narrow, convex ridgetops and side slopes in the uplands. Individual areas generally are crescent shaped or long, narrow, and branching and range from about 10 to more than 200 acres in size.

The typical sequence, depth, and composition of the

layers in this soil are as follows—

Surface layer:

0 to 6 inches; very dark grayish brown, friable loam

Subsoil:

6 to 16 inches; brown and yellowish brown, mottled, firm clay

16 to 47 inches; dark yellowish brown and yellowish brown, mottled, very firm clay loam

47 to 60 inches; dark yellowish brown, mottled, firm clay loam

In some areas, the surface layer is silt loam or silty clay loam and the upper part of the subsoil has a lower content of sand and pebbles. In other areas grayish brown mottles are at a lower depth.

Included with this soil in mapping are small areas of the poorly drained Leonard soils and the severely eroded Armstrong soils. Leonard soils are on head slopes and side slopes above the Armstrong soil. Also included are some areas of severely eroded soils on the steepest parts of the unit. Included soils make up about 10 percent of the unit.

Important properties of the Armstrong soil—

Permeability: Slow

Surface runoff: Medium

Available water capacity: Moderate

Organic matter content: Moderate

Depth to a perched water table: 1 to 3 feet

Shrink-swell potential: High

Potential for frost action: High

Most areas are used for cultivated crops or for pasture or hay. A few areas are wooded. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer is friable and can be easily tilled throughout a moderate range in moisture content. Erosion is a severe hazard in cultivated areas. It has removed about one-half of the original topsoil. Several systems can be used to minimize the hazard of erosion. The commonly used practices are conservation tillage systems that leave a protective cover of crop residue on the surface, winter cover crops, grassed waterways, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops.

This soil is well suited to ladino clover and moderately well suited to birdsfoot trefoil, alsike clover, crownvetch, tall fescue, timothy, switchgrass, big bluestem, and indiagrass. The species that are tolerant of wetness grow best. Erosion control during seedbed preparation is the main management concern. Timely tillage and a quickly established ground cover reduce the hazard of erosion.

A few areas support hardwoods. This soil is suited to

trees. Seedling mortality is the main management concern. Planting container-grown nursery stock or reinforcement planting while seedlings are dormant in spring increases the seedling survival rate.

This soil is suited to building site development. The shrink-swell potential and the wetness are limitations on sites for dwellings. Designing and constructing basement walls, foundations, and footings with adequately reinforced concrete and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing drainage tile around the footings and underneath basement floors minimizes the damage caused by excessive wetness. Land grading may be needed because of the slope. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways minimize the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the restricted permeability and the wetness. Properly constructed sewage lagoons can function adequately if the site is leveled.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action limit this soil as a site for local roads and streets. Strengthening the roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by wetness and frost action.

The land capability classification is IIIe. Based on white oak as the indicator species, the woodland ordination symbol is 3C.

14D2—Armstrong clay loam, 9 to 14 percent slopes, eroded. This very deep, strongly sloping, somewhat poorly drained soil is on side slopes in the uplands. Individual areas generally are crescent shaped and range from about 15 to more than 100 acres in size.

The typical sequence, depth, and composition of the layers in this soil are as follows—

Surface layer:

0 to 5 inches; very dark grayish brown, friable clay loam

Subsoil:

5 to 18 inches; brown and dark yellowish brown, mottled, firm clay loam

18 to 40 inches; grayish brown, mottled, firm clay

40 to 60 inches; yellowish brown, light brownish gray, and grayish brown, firm clay loam

In some areas, the surface layer is loam, silt loam, or



Figure 6.—Orchardgrass pasture in an area of Armstrong clay loam, 9 to 14 percent slopes, eroded.

silty clay loam and the upper part of the subsoil has a lower content of sand and pebbles. In other areas grayish brown mottles are at a lower depth.

Included with this soil in mapping are small areas of the steeply sloping Gara soils, areas of severely eroded soils, and areas of the nearly level Vesser soils. Gara soils are on the lower side slopes. The severely eroded soils have a surface layer that is lighter colored than that of the Armstrong soil. They are in convex areas. Vesser soils are occasionally flooded and are on narrow flood plains. Included soils make up about 10 percent of the unit.

Important properties of the Armstrong soil—

Permeability: Slow

Surface runoff: Rapid

Available water capacity: Moderate

Organic matter content: Moderate

Depth to a perched water table: 1 to 3 feet

Shrink-swell potential: High

Potential for frost action: High

Most areas are used for hay or pasture (fig. 6) or for cultivated crops. Some areas are wooded. If erosion-control measures are applied, this soil is suited to cultivated crops grown on a limited basis. Corn, soybeans, winter wheat, and grain sorghum are the most commonly grown row crops. Erosion is a severe hazard. It has removed about one-half of the original topsoil. The surface layer is mixed with subsoil material. It is friable, however, and can be easily tilled throughout a moderate range in moisture content. Several systems can be used to minimize the hazard of erosion. The commonly used practices are conservation tillage systems that leave a protective cover of crop residue on the surface, winter cover crops, grassed waterways, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops.

This soil is well suited to ladino clover and moderately well suited to birdsfoot trefoil, timothy, switchgrass, alsike clover, crownvetch, tall fescue, big bluestem, and indiagrass. The species that are tolerant of wetness grow best. Erosion control during seedbed preparation is the main management concern. Timely tillage and a quickly established ground cover reduce the hazard of erosion.

Some areas support hardwoods. This soil is suited to trees. Seedling mortality is the main management concern. Planting container-grown nursery stock or reinforcement planting while seedlings are dormant in early spring increases the seedling survival rate.

This soil is suited to building site development. The shrink-swell potential, the wetness, and the slope are limitations on sites for dwellings. Designing and constructing basement walls, foundations, and footings with adequately reinforced concrete and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing drainage tile around the footings and underneath basement floors minimizes the damage caused by excessive wetness. Land grading is needed because of the slope. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways minimize the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the restricted permeability and the wetness. Properly constructed sewage lagoons can function adequately if the site is leveled.

Low strength, the shrink-swell potential, the slope, the wetness, and the potential for frost action limit this soil as a site for local roads and streets. Strengthening the roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by wetness and frost action. Designing the roads and streets so that they conform to the natural slope of the land minimizes the need for cutting and filling.

The land capability classification is IVe. Based on white oak as the indicator species, the woodland ordination symbol is 3C.

16C—Bevier silty clay loam, 3 to 8 percent slopes.

This very deep, gently sloping and moderately sloping, somewhat poorly drained soil is on narrow, convex ridgetops in the uplands. Individual areas are long and narrow and range from about 15 to more than 100 acres in size.

The typical sequence, depth, and composition of the layers in this soil are as follows—

Surface layer:

0 to 7 inches; very dark gray, friable silty clay loam

Subsoil:

7 to 10 inches; dark grayish brown, mottled, friable silty clay loam

10 to 22 inches; dark grayish brown and brown, mottled, firm silty clay

22 to 30 inches; grayish brown, mottled, firm silty clay loam

30 to 37 inches; light brownish gray and yellowish brown, mottled, friable loam

37 to 60 inches; multicolored, mottled, firm clay loam

In some areas the surface layer is silt loam. In other areas the surface layer and the upper part of the subsoil have more sand and gravel.

Included with this soil in mapping are small areas of the strongly sloping Armstrong, Purdin, and Gara soils. These soils are on the lower side slopes. They make up about 5 percent of the unit.

Important properties of the Bevier soil—

Permeability: Slow

Surface runoff: Medium

Available water capacity: Moderate

Organic matter content: Moderate

Depth to a perched water table: 2 to 4 feet

Shrink-swell potential: High

Potential for frost action: High

Most areas are used for pasture or hay or for cultivated crops. A few areas are used for timber. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. Erosion is a major hazard. The surface layer is sticky when wet and can be easily tilled only within a somewhat narrow range in moisture content. Several systems can be used to minimize the hazard of erosion. The commonly used practices are conservation tillage systems that leave a protective cover of crop residue on the surface, winter cover crops, terraces, underground tile outlets and grassed waterways, contour farming, and a conservation cropping system that includes close-growing pasture and hay crops. Most areas are smooth and can be farmed on the contour. Returning crop residue to the soil and regularly adding other organic material improve fertility, minimize crusting, and increase the available water capacity and the rate of water infiltration.

This soil is well suited to ladino clover and moderately well suited to tall fescue, timothy, lespedeza, birdsfoot trefoil, indiagrass, and switchgrass. The species that are tolerant of wetness grow best. Erosion control during seedbed preparation is the main management concern. Timely tillage and a

quickly established ground cover reduce the hazard of erosion.

A few areas support native hardwoods. This soil is suited to trees. Seedling mortality is the main management concern. Planting container-grown nursery stock or reinforcement planting can increase the seedling survival rate.

This soil is suited to building site development. The shrink-swell potential and the wetness are limitations on sites for dwellings. Designing and constructing basement walls, foundations, and footings with adequately reinforced concrete and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing drainage tile around the footings and underneath basement floors minimizes the damage caused by excessive wetness. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways minimize the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the restricted permeability and the wetness. Properly constructed sewage lagoons can function adequately if the site is leveled.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action limit this soil as a site for local roads and streets. Strengthening the roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by wetness and frost action.

The land capability classification is IIIe. Based on white oak as the indicator species, the woodland ordination symbol is 3C.

17E2—Purdin clay loam, 14 to 20 percent slopes, eroded. This very deep, moderately steep, moderately well drained soil is on side slopes in the uplands. Individual areas are irregularly shaped and range from about 25 to more than 300 acres in size.

The typical sequence, depth, and composition of the layers in this soil are as follows—

Surface layer:

0 to 6 inches; very dark gray and very dark grayish brown, friable clay loam

Subsoil:

6 to 11 inches; dark yellowish brown and dark brown, friable clay loam

11 to 23 inches; yellowish brown, firm clay loam

23 to 60 inches; yellowish brown and light olive brown, mottled, firm clay loam

In some areas the surface is loam or silt loam.

Included with this soil in mapping are small areas of Vigar soils, small areas of the somewhat poorly drained Excello and poorly drained Zook soils, and some areas of severely eroded soils. Vigar soils have less clay in the subsoil than the Purdin soil. They are on foot slopes. Excello and Zook soils are on narrow flood plains. The severely eroded soils are in convex areas. Included soils make up about 8 percent of the unit.

Important properties of the Purdin soil—

Permeability: Slow

Surface runoff: Rapid

Available water capacity: Moderate

Organic matter content: Moderately low

Depth to a perched water table: 2.0 to 3.5 feet

Shrink-swell potential: High

Potential for frost action: Moderate

Most areas have been cultivated in the past but are now used for hay or pasture. Some areas are wooded, and a few areas are used for cultivated crops. This soil generally is unsuited to cultivated crops because of the slope and a severe hazard of erosion. Erosion has removed about one-half or more of the original topsoil. The surface layer is mixed with subsoil material.

This soil is well suited to red clover, ladino clover, birdsfoot trefoil, tall fescue, crownvetch, red fescue, redbud, timothy, and switchgrass. It is moderately well suited to alfalfa, orchardgrass, smooth bromegrass, big bluestem, and indiangrass. Erosion during seedbed preparation and the erosion caused by overgrazing are the main management concerns. If the soil is tilled when pasture or hay crops are reseeded, conservation tillage systems that leave a protective cover of crop residue on the surface, winter cover crops, grassed waterways, and contour tillage are needed to minimize erosion. Timely seedbed preparation helps to ensure rapid plant growth and a good ground cover. Timely deferment of grazing, rotational grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage and help to control erosion.

This soil is suited to trees. The main concerns in **managing timber** are an equipment limitation and the hazard of erosion. Because of the slope, logging roads and skid trails should be constructed on the contour. Installing culverts and water bars as necessary minimizes erosion. Most of the existing stands require thinning and selective cutting of undesirable trees. These practices improve the habitat for woodland wildlife, especially white-tailed deer and wild turkey.

This soil generally is not used for building site development or onsite waste disposal because of the slope.

Low strength, the shrink-swell potential, the potential

for frost action, and the slope limit this soil as a site for local roads and streets. Strengthening the roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by wetness and frost action. The roads should be designed so that they conform to the natural slope of the land. Some cutting and filling may be needed.

The land capability classification is VIe. Based on white oak as the indicator species, the woodland ordination symbol is 3R.

17F2—Purdin clay loam, 20 to 35 percent slopes, eroded. This very deep, steep, moderately well drained soil is on highly dissected side slopes in the uplands. Individual areas are irregularly shaped and range from about 25 to more than 300 acres in size.

The typical sequence, depth, and composition of the layers in this soil are as follows—

Surface layer:

0 to 6 inches; very dark grayish brown, friable clay loam

Subsoil:

6 to 20 inches; brown and dark yellowish brown, firm clay

20 to 46 inches; dark yellowish brown and yellowish brown, firm clay loam

46 to 60 inches; yellowish brown and light brownish gray, firm clay loam

In some areas the surface layer and the upper part of the subsoil have a lower content of sand and pebbles.

Included with this soil in mapping are small areas of Vigar soils, small areas of the poorly drained Excello soils, and areas of severely eroded soils. Vigar soils have less clay in the subsoil than the Purdin soil. They are on foot slopes. Excello soils are on narrow flood plains. The severely eroded soils are in convex areas. Included soils make up about 5 percent of the unit.

Important properties of the Purdin soil—

Permeability: Slow

Surface runoff: Rapid

Available water capacity: Moderate

Organic matter content: Moderately low

Depth to a perched water table: 2.0 to 3.5 feet

Shrink-swell potential: High

Potential for frost action: Moderate

Most areas are used as pasture. Some areas are wooded. This soil generally is unsuited to cultivated crops because of the slope and a severe hazard of

erosion. Erosion has removed about one-half of the original topsoil. The surface layer is mixed with subsoil material.

This soil is well suited to red clover, ladino clover, birdsfoot trefoil, tall fescue, crownvetch, red fescue, redtop, timothy, and switchgrass. It is moderately well suited to alfalfa, orchardgrass, smooth brome grass, big bluestem, and indiagrass. Erosion during seedbed preparation and the erosion caused by overgrazing are the main management concerns. If the soil is tilled when pasture or hay crops are reseeded, conservation tillage systems that leave a protective cover of crop residue on the surface, winter cover crops, and grassed waterways are needed to minimize erosion. Timely seedbed preparation helps to ensure rapid plant growth and a good ground cover. Timely deferment of grazing, rotational grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage and help to control erosion.

This soil is suited to trees. The main concerns in managing timber are an equipment limitation and the hazard of erosion. Roads and skid trails should be constructed on the contour or in the less sloping areas near drainageways or on ridgetops. In the steeper areas the logs should be yarded up or down the slope. Installing culverts and water bars as necessary minimizes erosion. Most of the existing stands require thinning and selective cutting of undesirable trees. These practices improve the habitat for woodland wildlife, especially white-tailed deer and wild turkey.

This soil generally is not used for building site development because of the slope.

Low strength, the shrink-swell potential, the potential for frost action, and the slope limit this soil as a site for local roads and streets. Strengthening the roads and streets with crushed rock or other suitable base material minimizes the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by shrinking and swelling and by frost action. Cutting and filling and careful selection of sites for the roads may be needed because of the slope.

The land capability classification is VIe. Based on white oak as the indicator species, the woodland ordination symbol is 3R.

19E—Vanmeter loam, 9 to 20 percent slopes. This moderately deep, strongly sloping and moderately steep, moderately well drained soil is on side slopes in the uplands. Individual areas generally are long and narrow and range from about 10 to more than 100 acres in size.

The typical sequence, depth, and composition of the

layers in this soil are as follows—

Surface layer:

0 to 6 inches; dark grayish brown, friable loam

Subsoil:

6 to 24 inches; brown and grayish brown, firm clay

24 to 32 inches; mottled olive gray and dark gray, firm clay

Bedrock:

32 to 60 inches; clayey shale

In some areas the surface layer is silt loam or silty clay loam. In a few areas the depth to bedrock is more than 40 inches.

Included with this soil in mapping are small areas of the nearly level Dockery and Floris soils. These soils are at the lower elevations on narrow flood plains. Also included are areas where limestone and shale bedrock crops out on some of the steeper slopes adjacent to drainageways. Included areas make up about 2 to 5 percent of the unit.

Important properties of the Vanmeter soil—

Permeability: Very slow

Surface runoff: Rapid

Available water capacity: Low

Organic matter content: Moderately low

Depth to a water table: More than 6 feet

Depth to bedrock: 20 to 40 inches

Shrink-swell potential: High

Potential for frost action: Moderate

Most areas are used for pasture or hay. Some areas are used for timber. Because of the slope and a severe hazard of erosion, this soil generally is unsuited to cultivated crops. It is moderately well suited to birdsfoot trefoil, lespedeza, red fescue, orchardgrass, big bluestem, and indiagrass. Shallow-rooted species that are tolerant of droughtiness should be selected for planting. Erosion is a severe hazard when the pasture or hayland is seeded. If the soil is tilled when pasture or hay crops are reseeded, conservation tillage systems that leave a protective cover of crop residue on the surface, winter cover crops, grassed waterways, and contour tillage are needed to minimize erosion. Timely tillage and a quickly established ground cover are necessary to minimize erosion. Timely deferment of grazing, rotational grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage.

Some areas support stands of native hardwoods. This soil is suited to trees. The main concerns in managing timber are the hazard of erosion, an equipment limitation, seedling mortality, and windthrow.

Building logging roads on the contour and installing culverts and water bars as necessary minimize erosion. Operating equipment in the less steep areas of the unit minimizes the equipment limitation caused by the slope. Hand planting of seedlings and either container-grown nursery stock or reinforcement planting while seedlings are dormant in early spring may be necessary to improve the stands. The shale or limestone bedrock restricts root penetration and thus increases the hazard of windthrow. Selective cutting and timely harvesting of mature trees reduce this hazard. Most of the existing stands require thinning and selective cutting of undesirable trees. These practices improve the habitat for woodland wildlife, especially white-tailed deer and wild turkey.

This soil generally is not used for building site development because of the slope, the depth to bedrock, and the high shrink-swell potential.

The depth to bedrock, low strength, the shrink-swell potential, the potential for frost action, and the slope limit this soil as a site for local roads and streets. If possible, the roads should be constructed in areas where removal of bedrock is not needed. In some areas blasting may be necessary to remove the bedrock. Strengthening the roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by frost action.

The land capability classification is V1e. Based on white oak as the indicator species, the woodland ordination symbol is 2C.

19F—Vanmeter silty clay loam, 20 to 40 percent slopes. This moderately deep, steep and very steep, moderately well drained soil is on side slopes in the uplands. Individual areas generally are long and narrow and range from about 10 to more than 150 acres in size.

The typical sequence, depth, and composition of the layers in this soil are as follows—

Surface layer:

0 to 4 inches; dark grayish brown, friable silty clay loam

Subsoil:

4 to 6 inches; dark grayish brown, friable silty clay

6 to 19 inches; olive gray and pale olive, friable clay

19 to 39 inches; olive gray and olive, firm silty clay

Bedrock:

39 to 60 inches; clayey shale

In some areas the surface layer is loam or silt loam.

In a few areas the depth to bedrock is more than 40 inches.

Included with this soil in mapping are small areas of the occasionally flooded Dockery and frequently flooded Floris soils. These soils are on narrow, nearly level flood plains along small streams. Also included are areas where limestone and shale bedrock crops out on some of the steeper slopes adjacent to drainageways. Included areas make up about 3 to 5 percent of the unit.

Important properties of the Vanmeter soil—

Permeability: Very slow

Surface runoff: Rapid

Available water capacity: Low

Organic matter content: Moderately low

Depth to a water table: More than 6 feet

Depth to bedrock: 20 to 40 inches

Shrink-swell potential: High

Potential for frost action: Moderate

Most areas support stands of native hardwoods. Some areas are used as pasture. Because of the slope and a severe hazard of erosion, this soil is unsuited to cultivated crops. It is suited to trees. The main concerns in managing timber are the hazard of erosion, an equipment limitation, seedling mortality, and windthrow. Because of the slope, logging roads and skid trails should be constructed on the contour. In the steepest areas the logs should be yarded up and down the slope. Installing culverts and water bars as necessary helps to control erosion. Hand planting of seedlings and reinforcement planting may be necessary to improve the stands. Selective cutting and timely harvesting of mature trees reduce the hazard of windthrow. Most of the existing stands require thinning and selective cutting of undesirable trees. These practices improve the habitat for woodland wildlife, especially white-tailed deer and wild turkey.

The less sloping areas of this soil are moderately well suited to birdsfoot trefoil, lespedeza, red fescue, orchardgrass, big bluestem, and indiagrass. Shallow-rooted species that are tolerant of droughtiness should be selected for planting. Erosion control is a serious management concern when the pasture is seeded. If the soil is tilled when pasture crops are reseeded, conservation tillage systems that leave a protective cover of crop residue on the surface, winter cover crops, and grassed waterways are needed to minimize erosion. Timely tillage and a quickly established ground cover also help to control erosion. Timely deferment of grazing, rotational grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage.

This soil generally is not used for building site

development, onsite waste disposal, or local roads and streets because of the slope, the depth to bedrock, and the shrink-swell potential.

The land capability classification is VIIe. Based on white oak as the indicator species, the woodland ordination symbol is 2R.

22B—Adco silt loam, 1 to 3 percent slopes. This very deep, very gently sloping, somewhat poorly drained soil is on the tops of ridges in the uplands. Individual areas are long and branching and range from about 50 to more than 500 acres in size.

The typical sequence, depth, and composition of the layers in this soil are as follows—

Surface layer:

0 to 6 inches; very dark gray, friable silt loam

Subsurface layer:

6 to 13 inches; grayish brown, friable silt loam

Subsoil:

13 to 45 inches; dark grayish brown, grayish brown, and brown, mottled, firm silty clay

45 to 58 inches; light brownish gray, mottled, firm silty clay loam

Substratum:

58 to 60 inches; light brownish gray and strong brown, mottled, firm silty clay loam

In some areas the surface layer is silty clay loam.

Important soil properties—

Permeability: Very slow

Surface runoff: Medium

Available water capacity: Moderate

Organic matter content: Moderate

Depth to a perched water table: 2 to 4 feet

Shrink-swell potential: High

Potential for frost action: High

Most areas are used for cultivated crops or for hay or pasture. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer can be easily tilled throughout a fairly wide range in moisture content. Unless protected by a crop or surface mulch, however, the surface tends to crust or puddle after periods of heavy rainfall, especially in areas where the plow layer contains subsoil material. Erosion is a major hazard. Several systems can be used to minimize the hazard of erosion. The commonly used practices are conservation tillage systems that leave a protective cover of crop residue on the surface, winter cover crops, terraces, underground tile outlets and grassed waterways, contour farming, and a conservation cropping system that includes close-growing pasture or

hay crops. Returning crop residue to the soil and regularly adding other organic material improve fertility, minimize crusting, and increase the available water capacity and the rate of water infiltration.

This soil is well suited to ladino clover and moderately well suited to tall fescue, timothy, lespedeza, birdsfoot trefoil, indiagrass, and switchgrass. The species that are tolerant of wetness grow best. Erosion control during seedbed preparation is the main management concern. Timely tillage and a quickly established ground cover reduce the hazard of erosion. Timely deferment of grazing, rotational grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage and minimize erosion.

This soil is suitable for building site development. The wetness and the shrink-swell potential are limitations on sites for dwellings. Designing and constructing basement walls, foundations, and footings with adequately reinforced concrete and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing drainage tile around footings and foundations minimizes the damage caused by excessive wetness. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways minimize the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the restricted permeability and the wetness. Properly constructed sewage lagoons can function adequately if the site is leveled.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action limit this soil as a site for local roads and streets. Strengthening the roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by wetness and frost action.

The land capability classification is 1Ie. No woodland ordination symbol is assigned.

23D2—Gorin-Winnegan complex, 5 to 14 percent slopes, eroded. These very deep soils are in the uplands. The moderately sloping, somewhat poorly drained Gorin soil is on ridgetops, and the moderately sloping and strongly sloping, moderately well drained Winnegan soil is on the upper side slopes of ridges. Individual areas are long, narrow, and branching and range from about 25 to more than 150 acres in size. They are about 80 percent Gorin and similar soils and 20 percent Winnegan soil.

The typical sequence, depth, and composition of the

layers in the Gorin soil are as follows—

Surface layer:

0 to 6 inches; dark grayish brown, very friable silt loam

Subsoil:

6 to 13 inches; dark yellowish brown, firm silty clay loam

13 to 22 inches; brown, mottled, firm silty clay

22 to 33 inches; yellowish brown, mottled, very firm silty clay loam

33 to 49 inches; brown and grayish brown, firm silt loam

49 to 60 inches; yellowish brown, mottled, firm clay loam

In some areas the surface layer and the upper part of the subsoil have a higher content of sand and pebbles.

Important properties of the Gorin soil—

Permeability: Slow

Surface runoff: Medium

Available water capacity: Moderate

Organic matter content: Low

Depth to a perched water table: 2 to 4 feet

Shrink-swell potential: High

Potential for frost action: High

The typical sequence, depth, and composition of the layers in the Winnegan soil are as follows—

Surface layer:

0 to 5 inches; dark grayish brown, friable silt loam

Subsoil:

5 to 12 inches; strong brown, mottled, firm clay loam

12 to 27 inches; strong brown and yellowish brown, mottled, firm clay

27 to 60 inches; yellowish brown and light gray, mottled, firm clay loam

Important properties of the Winnegan soil—

Permeability: Slow

Surface runoff: Medium

Available water capacity: Moderate

Organic matter content: Low

Depth to a perched water table: 2.0 to 3.5 feet

Shrink-swell potential: High

Potential for frost action: Moderate

Included with these soils in mapping are small areas of the more steeply sloping Winnegan soils on the edges and lower parts of the unit. These included soils make up about 3 to 7 percent of the unit.

Most areas are used for pasture, hay, or timber. Some of the larger areas, particularly on the broader

foot slopes, are used for cultivated crops. Roads or trails extend through many areas of this unit.

The Gorin and Winnegan soils are well suited to ladino clover and moderately well suited to alsike clover, crownvetch, tall fescue, big bluestem, and indiagrass. The species that are tolerant of wetness grow best. Erosion control during seedbed preparation is the main management concern. Timely tillage and a quickly established ground cover reduce the hazard of erosion. Timely deferment of grazing, rotational grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage and minimize erosion.

These soils are suited to cultivated crops grown on a limited basis in rotation with pasture and hay crops. The surface layer is friable and can be easily tilled throughout a moderate range in moisture content. Erosion is a severe hazard. It has removed about one-half of the original topsoil. The surface layer is mixed with subsoil material. Several systems can be used to minimize the hazard of erosion. The commonly used practices are conservation tillage systems that leave a protective cover of crop residue on the surface, winter cover crops, and crop rotations that include hay and pasture crops. Insufficient soil moisture during the summer is often a limitation in areas used for row crops. High plant populations of corn and grain sorghum should be avoided. The soils are naturally quite acid and low in fertility. As a result, applications of lime and fertilizer are needed. Returning crop residue to the soils and regularly adding other organic material improve fertility, minimize crusting, and increase the available water capacity and the rate of water infiltration.

A few areas support hardwoods. These soils are suited to trees. Seedling mortality is the main management concern. Planting container-grown nursery stock or reinforcement planting while seedlings are dormant in early spring increases the seedling survival rate.

These soils are suited to building site development. The shrink-swell potential and the wetness are limitations on sites for dwellings. Designing and constructing basement walls, foundations, and footings with adequately reinforced concrete and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing drainage tile around the footings and underneath basement floors minimizes the damage caused by excessive wetness. Reinforced concrete, expansion joints, and a sand and gravel base for sidewalks and driveways minimize the damage caused by frost action and by shrinking and swelling.

These soils are unsuited to conventional septic tank absorption fields because of the restricted permeability and the wetness. Properly constructed sewage lagoons

can function adequately if the site is leveled.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action limit these soils as sites for local roads and streets. Strengthening the roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by wetness and frost action.

The land capability classification is IIIe in areas of the Gorin soil and IVe in areas of the Winnegan soil. Based on white oak as the indicator species, the woodland ordination symbol is 3C in areas of the Gorin soil and 3A in areas of the Winnegan soil.

24D2—Gara loam, 9 to 14 percent slopes, eroded.

This very deep, strongly sloping, moderately well drained soil is on side slopes in the uplands. Individual areas generally are crescent shaped and range from about 15 to more than 200 acres in size.

The typical sequence, depth, and composition of the layers in this soil are as follows—

Surface layer:

0 to 6 inches; very dark grayish brown, friable loam

Subsoil:

6 to 11 inches; brown and yellowish brown, firm loam

11 to 17 inches; yellowish brown, firm clay loam

17 to 60 inches; yellowish brown, mottled, firm clay loam and loam

In some areas the surface layer and the upper part of the subsoil have a lower content of sand and pebbles.

Included with this soil in mapping are areas of the moderately steep Gara soils on the edges of the unit. These soils make up about 8 to 10 percent of the unit.

Important properties of the Gara soil—

Permeability: Moderately slow

Surface runoff: Rapid

Available water capacity: High

Organic matter content: Moderate

Depth to a water table: More than 6 feet

Shrink-swell potential: Moderate

Potential for frost action: Moderate

Most areas are used for pasture or hay. A few areas are used for timber or crop production. If erosion is controlled, this soil is suited to cultivated crops grown on a limited basis in rotation with pasture and hay crops. Erosion is a severe hazard. It has removed about one-half of the original topsoil. The surface layer is mixed with subsoil material. It is friable, however, and

can be easily tilled throughout a moderate range in moisture content. Corn, soybeans, winter wheat, and grain sorghum are the most commonly grown crops. Several systems can be used to minimize the hazard of erosion. The commonly used practices are conservation tillage systems that leave a protective cover of crop residue on the surface, winter cover crops, grassed waterways, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops. Returning crop residue to the soil or adding other organic material improves fertility and tilth and increases the rate of water infiltration.

This soil is well suited to red clover, birdsfoot trefoil, tall fescue, and switchgrass. It is moderately well suited to alfalfa, orchardgrass, smooth brome grass, big bluestem, and indiangrass. Erosion is a severe hazard, especially during seedbed preparation and in overgrazed areas. Timely seedbed preparation helps to ensure rapid plant growth and a good ground cover and thus helps to control erosion. The seedbed should be prepared on the contour. Timely deferment of grazing, rotational grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage and minimize erosion.

This soil is well suited to trees. No major hazards or limitations affect timber management.

This soil is suited to building site development. The shrink-swell potential is a limitation on sites for dwellings. Designing and constructing basement walls, foundations, and footings with adequately reinforced concrete and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways minimize the damage caused by frost action and by shrinking and swelling.

This soil generally is not used for conventional septic tank absorption fields because of the restricted permeability. Properly constructed sewage lagoons can function adequately if the site is leveled.

Low strength, the shrink-swell potential, and the potential for frost action limit this soil as a site for local roads and streets. Strengthening the roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by frost action. Designing the roads and streets so that they conform to the natural slope of the land minimizes the need for cutting and filling.

The land capability classification is IVe. Based on white oak as the indicator species, the woodland ordination symbol is 3A.

24E2—Gara fine sandy loam, 14 to 20 percent slopes, eroded. This very deep, moderately steep, moderately well drained soil is on side slopes in the uplands. Individual areas are irregularly shaped and range from about 25 to more than 500 acres in size.

The typical sequence, depth, and composition of the layers in this soil are as follows—

Surface layer:

0 to 5 inches; very dark grayish brown, friable fine sandy loam

Subsoil:

5 to 16 inches; dark yellowish brown, friable clay loam

16 to 30 inches; dark yellowish brown, mottled, firm clay loam

30 to 36 inches; yellowish brown, mottled, firm loam

36 to 60 inches; yellowish brown, dark yellowish brown, and light gray, firm loam

In some areas the soil is darker colored in the subsoil and is less sloping.

Included with this soil in mapping are small areas of the poorly drained Vesser soils. Also included are areas of severely eroded soils. Vesser soils are on narrow flood plains. The severely eroded soils are in convex areas. Included soils make up about 8 percent of the unit.

Important properties of the Gara soil—

Permeability: Moderately slow

Surface runoff: Rapid

Available water capacity: High

Organic matter content: Moderate

Depth to a water table: More than 6 feet

Shrink-swell potential: Moderate

Potential for frost action: Moderate

Most areas have been cultivated in the past but are now used for hay or pasture (fig. 7). Some areas are wooded, and a few are used for cultivated crops. This soil generally is unsuited to cultivated crops because of the slope and a severe hazard of erosion. Erosion has removed one-half or more of the original topsoil. The surface layer is mixed with subsoil material.

This soil is well suited to red clover, birdsfoot trefoil, tall fescue, and switchgrass. It is moderately well suited to alfalfa, orchardgrass, smooth brome grass, big bluestem, and indiangrass. Erosion is a severe hazard, especially during seedbed preparation and in overgrazed areas. If the soil is tilled when pasture or hay crops are reseeded, conservation tillage systems that leave a protective cover of crop residue on the surface, winter cover crops, grassed waterways, and contour tillage are needed to minimize erosion. Timely



Figure 7.—A pastured area of Gara fine sandy loam, 14 to 20 percent slopes, eroded.

seedbed preparation helps to ensure rapid plant growth and a good ground cover. Timely deferment of grazing, rotational grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage and help to control erosion.

This soil is suited to trees. The main concerns in managing timber are an equipment limitation and the hazard of erosion. Because of the slope, logging roads and skid trails should be constructed on the contour. Installing culverts and water bars as necessary helps to

control erosion. Most of the existing stands require thinning and selective cutting of undesirable trees. These practices improve the habitat for woodland wildlife, especially white-tailed deer and wild turkey.

This soil generally is not used for building site development or onsite waste disposal because of the slope.

Low strength, the shrink-swell potential, the potential for frost action, and the slope limit this soil as a site for local roads and streets. Strengthening the roads with crushed rock or other suitable base material minimizes

the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by frost action. The roads should be designed so that they conform to the natural slope of the land. Some cutting and filling may be needed.

The land capability classification is VIe. Based on white oak as the indicator species, the woodland ordination symbol is 3R.

24F2—Gara fine sandy loam, 20 to 35 percent slopes, eroded. This very deep, steep, moderately well drained soil is on dissected, uneven side slopes in the uplands. Individual areas are irregularly shaped and range from about 25 to more than 300 acres in size.

The typical sequence, depth, and composition of the layers in this soil are as follows—

Surface layer:

0 to 6 inches; very dark grayish brown and yellowish brown, friable fine sandy loam

Subsoil:

6 to 19 inches; yellowish brown, firm clay loam

19 to 49 inches; yellowish brown, mottled, firm clay loam and loam

49 to 60 inches; coarsely mottled yellowish brown and grayish brown, firm loam

In some areas the surface layer and the upper part of the subsoil have a lower content of sand and pebbles. In other areas the soil is darker colored in the subsoil and is less sloping.

Included with this soil in mapping are small areas of the poorly drained Vesser soils. These soils are on narrow flood plains. They make up about 3 to 5 percent of the unit.

Important properties of the Gara soil—

Permeability: Moderately slow

Surface runoff: Rapid

Available water capacity: High

Organic matter content: Moderate

Depth to a water table: More than 6 feet

Shrink-swell potential: Moderate

Potential for frost action: Moderate

Most areas are used as pasture. Some areas are wooded. This soil generally is unsuited to cultivated crops because of the slope and a severe hazard of erosion. Erosion has removed one-half or more of the original topsoil. The surface layer is mixed with subsoil material.

This soil is well suited to red clover, birdsfoot trefoil, tall fescue, and switchgrass. It is moderately well suited

to orchardgrass, smooth brome grass, big bluestem, and indiagrass. Erosion during seedbed preparation and the erosion caused by overgrazing are the main management concerns. If the soil is tilled when pasture or hay crops are reseeded, conservation tillage systems that leave a protective cover of crop residue on the surface, winter cover crops, and grassed waterways are needed to reduce the hazard of erosion. Timely seedbed preparation helps to ensure rapid plant growth and a good ground cover. Timely deferment of grazing, rotational grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage.

This soil is suited to trees. The main concerns in managing timber are an equipment limitation and the hazard of erosion. Because of the slope, logging roads and skid trails should be constructed on the contour. Installing culverts and water bars as necessary minimizes erosion. Most of the existing stands require thinning and selective cutting of undesirable trees. These practices improve the habitat for woodland wildlife, especially white-tailed deer and wild turkey.

This soil generally is not used for building site development or onsite waste disposal because of the slope.

Low strength, the shrink-swell potential, the potential for frost action, and the slope limit this soil as a site for local roads and streets. Designing the roads and streets so that they conform to the natural slope of the land minimizes the need for cutting and filling. Strengthening the roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by frost action.

The land capability classification is VIe. Based on white oak as the indicator species, the woodland ordination symbol is 3R.

26B2—Leonard silty clay loam, 2 to 6 percent slopes, eroded. This very deep, gently sloping, poorly drained soil is on the concave side slopes and head slopes of drainageways in the uplands. Individual areas generally are crescent shaped and range from about 15 to more than 100 acres in size.

The typical sequence, depth, and composition of the layers in this soil are as follows—

Surface layer:

0 to 6 inches; very dark grayish brown, friable silty clay loam

Subsoil:

6 to 24 inches; gray and dark grayish brown,

mottled, firm silty clay
 24 to 52 inches; grayish brown and gray, mottled,
 firm silty clay loam
 52 to 60 inches; gray, mottled, firm silty clay

In some areas the surface layer is silt loam. In other areas sand and gravel are in the surface layer and the upper part of the subsoil.

Included with this soil in mapping are small areas of the strongly sloping Armstrong soils. These soils generally are on the lower parts of the unit. They make up less than 5 percent of the unit.

Important properties of the Leonard soil—

Permeability: Slow

Surface runoff: Medium

Available water capacity: Moderate

Organic matter content: Moderate

Depth to a perched water table: 0.5 foot to 2.0 feet

Shrink-swell potential: High

Potential for frost action: High

Most areas are used for cultivated crops or for hay or pasture. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer is sticky when wet and can be easily tilled only within a somewhat narrow range in moisture content. Erosion is a severe hazard. It has removed about one-half of the original topsoil. The surface layer is mixed with subsoil material. Several systems can be used to minimize the hazard of erosion. The commonly used practices are conservation tillage systems that leave a protective cover of crop residue on the surface, winter cover crops, contour farming, stripcropping, and grassed waterways and terraces that have suitable outlets. Many areas have slopes that are long and smooth enough to be farmed on the contour and terraced. Returning crop residue to the soil and regularly adding other organic material improve fertility, minimize crusting, and increase the available water capacity and the rate of water infiltration.

This soil is moderately well suited to hay and pasture. It is moderately well suited to switchgrass and birdsfoot trefoil and is moderately suited to alsike clover, tall fescue, big bluestem, and indiagrass. The shallow-rooted species that are tolerant of wetness grow best. Erosion control during seedbed preparation is the major problem. Timely tillage and a quickly established ground cover help to prevent excessive erosion. Restricted use during wet periods helps to keep the pasture in good condition. Timely deferment of grazing, rotational grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage and minimize erosion.

This soil is suitable for building site development. The shrink-swell potential and the wetness are the major limitations on sites for dwellings. Designing and constructing basement walls, foundations, and footings with adequately reinforced concrete and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing drainage tile around the footings and underneath basement floors minimizes the damage caused by excessive wetness. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways minimize the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the restricted permeability and the wetness. Properly constructed sewage lagoons can function adequately if the site is leveled.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action limit this soil as a site for local roads and streets. Strengthening the roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by wetness and frost action.

The land capability classification is IIIe. No woodland ordination symbol is assigned.

28E2—Winnegan loam, 14 to 20 percent slopes, eroded. This very deep, moderately steep, moderately well drained soil is on dissected, uneven side slopes in the uplands. Individual areas are irregularly shaped and range from about 25 to more than 250 acres in size.

The typical sequence, depth, and composition of the layers in this soil are as follows—

Surface layer:

0 to 5 inches; brown and dark grayish brown, friable loam

Subsoil:

5 to 18 inches; yellowish brown, friable loam and firm clay loam

18 to 28 inches; yellowish brown, mottled, firm clay loam

28 to 39 inches; strong brown and light brownish gray, mottled, firm clay loam

39 to 60 inches; yellowish brown, light brownish gray, and brown, firm loam

In some areas, the surface layer is silt loam and the upper part of the subsoil is silty clay loam

Included with this soil in mapping are small areas of Floris, Dockery, and Vanmeter soils. The nearly level Floris and Dockery soils are on flood plains. The

moderately deep Vanmeter soils are in narrow bands on the lower parts of side slopes adjacent to the Floris and Dockery soils. Included soils make up about 4 to 6 percent of the unit.

Important properties of the Winnegan soil—

Permeability: Slow

Surface runoff: Rapid

Available water capacity: Moderate

Organic matter content: Moderately low

Depth to a perched water table: 2.0 to 3.5 feet

Shrink-swell potential: High

Potential for frost action: Moderate

Most areas are used for hay or pasture. Some areas are wooded. This soil generally is unsuited to cultivated crops because of the slope and a severe hazard of erosion. Erosion has removed about one-half of the original topsoil. The surface layer is mixed with subsoil material. Many areas that have been cultivated in the past are reseeded to grasses, which reduce the hazard of further erosion.

This soil is well suited to birdsfoot trefoil, crownvetch, red fescue, and switchgrass and moderately well suited to indiangrass. Erosion during seedbed preparation and the erosion caused by overgrazing are the main hazards. If the soil is tilled when pasture or hay crops are reseeded, conservation tillage systems that leave a protective cover of crop residue on the surface, winter cover crops, and contour tillage are needed to minimize erosion. Timely seedbed preparation helps to ensure rapid plant growth and a good ground cover. The seedbed should be prepared on the contour. Timely deferment of grazing, rotational grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage.

Some areas support hardwoods. This soil is suited to trees. The main concerns in managing timber are an equipment limitation and the hazard of erosion. Because of the slope, logging roads and skid trails should be constructed on the contour. Installing culverts and water bars as necessary minimizes erosion. Most of the existing stands require thinning and selective cutting of undesirable trees. These practices improve the habitat for woodland wildlife, especially white-tailed deer and wild turkey.

This soil generally is not used for building site development or onsite waste disposal because of the slope and the restricted permeability.

Low strength, the shrink-swell potential, the wetness, the potential for frost action, and the slope limit this soil as a site for local roads and streets. Strengthening the roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they

shed water, constructing roadside ditches, and installing culverts minimize the damage caused by wetness and frost action. Designing the roads and streets so that they conform to the natural slope of the land minimizes the need for cutting and filling.

The land capability classification is VIe. Based on white oak as the indicator species, the woodland ordination symbol is 3R.

28F—Winnegan loam, 20 to 35 percent slopes. This very deep, steep, moderately well drained soil is on highly dissected, uneven side slopes in the uplands. Individual areas are irregularly shaped and range from about 25 to more than 500 acres in size.

The typical sequence, depth, and composition of the layers in this soil are as follows—

Surface layer:

0 to 2 inches; very dark grayish brown, friable loam

Subsurface layer:

2 to 4 inches; brown, friable loam

Subsoil:

4 to 26 inches; dark yellowish brown, firm clay and clay loam

26 to 60 inches; mottled dark yellowish brown, strong brown, and grayish brown, firm clay loam and loam

In some areas, the surface layer is silt loam and the upper part of the subsoil is silty clay loam

Included with this soil in mapping are small areas of Floris, Dockery, and Vanmeter soils. Floris and Dockery soils on narrow flood plains. The moderately deep Vanmeter soils are in narrow bands on the lower parts of side slopes adjacent to the Floris soils. Included soils make up about 3 to 6 percent of the unit.

Important properties of the Winnegan soil—

Permeability: Slow

Surface runoff: Rapid

Available water capacity: Moderate

Organic matter content: Low

Depth to a perched water table: 2.0 to 3.5 feet

Shrink-swell potential: High

Potential for frost action: Moderate

Most areas are wooded. Some areas are used as pasture (fig. 8). Because of the slope and a severe hazard of erosion, this soil is unsuited to cultivated crops. It is well suited to ladino clover, birdsfoot trefoil, red clover, tall fescue, timothy, crownvetch, red fescue, and switchgrass. It is moderately well suited to orchardgrass, smooth brome grass, big bluestem, and indiangrass. Erosion is a hazard, especially during



Figure 8.—A pastured area of Winnegan loam, 20 to 35 percent slopes. Brush and weed control is necessary.

seedbed preparation and in overgrazed areas. If the soil is tilled when pasture or hay crops are reseeded, conservation tillage systems that leave a protective cover of crop residue on the surface and winter cover crops are needed to minimize erosion. Timely seedbed preparation helps to ensure rapid plant growth and a good ground cover. Timely deferment of grazing, rotational grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage.

Most areas support native hardwoods. This soil is suited to trees. The main concerns in managing timber are an equipment limitation and the hazard of erosion. Because of the slope, logging roads and skid trails should be constructed on the contour. Installing culverts

and water bars as necessary helps to control erosion. Most of the existing stands require thinning and selective cutting of undesirable trees. These practices improve the habitat for woodland wildlife, especially white-tailed deer and wild turkey.

This soil generally is not used for building site development or onsite waste disposal because of the slope and the restricted permeability.

Low strength, the shrink-swell potential, the wetness, the potential for frost action, and the slope limit this soil as a site for local roads and streets. Designing the roads and streets so that they conform to the natural slope of the land minimizes the need for cutting and filling. Strengthening the roads with crushed rock or other suitable base material minimizes the damage

caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by wetness and frost action.

The land capability classification is VIIe. Based on white oak as the indicator species, the woodland ordination symbol is 3R.

31—Putnam silt loam. This very deep, nearly level, poorly drained soil is on broad upland divides. Individual areas are generally oval and range from about 15 to more than 500 acres in size.

The typical sequence, depth, and composition of the layers in this soil are as follows—

Surface layer:

0 to 8 inches; very dark grayish brown, friable silt loam

Subsurface layer:

8 to 15 inches; grayish brown, friable silt loam

Subsoil:

15 to 35 inches; dark grayish brown and grayish brown, mottled, firm silty clay

35 to 60 inches; light brownish gray and strong brown, mottled, firm silty clay loam

In some areas the subsurface layer is less than 6 inches thick.

Important soil properties—

Permeability: Very slow

Surface runoff: Slow

Available water capacity: Moderate

Organic matter content: Moderate

Depth to a perched water table: 0.5 foot to 1.5 feet

Shrink-swell potential: High

Potential for frost action: Moderate

Most areas are used for cultivated crops or for hay or pasture. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer can be easily tilled throughout a fairly wide range in moisture content. Crusting and puddling are severe hazards after periods of heavy rainfall, however, unless the surface is protected by a crop or surface mulch. The wetness is the major limitation. Shallow surface ditches and land grading help to remove excess water. Applying a system of conservation tillage and harvesting while the soil is at a proper moisture content or the ground is frozen help to maintain soil structure and internal drainage. Returning crop residue to the soil and regularly adding other organic material help to maintain the content of organic matter and soil structure, improve fertility, minimize crusting, and increase the available

water capacity and the rate of water infiltration.

This soil is moderately well suited to birdsfoot trefoil, reed canarygrass, and switchgrass. The species that are tolerant of wetness grow best. Timely deferment of grazing, rotational grazing, and applications of lime and fertilizer increase the quantity and improve the quality of forage. Shallow surface ditches and land grading minimize the plant damage caused by wetness and frost heaving.

This soil is suitable for building site development. The wetness and the shrink-swell potential are limitations on sites for dwellings. Designing and constructing basement walls, foundations, and footings with adequately reinforced concrete and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing drainage tile around footings and foundations helps to prevent the damage caused by excessive wetness. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways minimize the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the restricted permeability and the wetness. Properly designed sewage lagoons can function adequately on this soil.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action limit this soil as a site for local roads and streets. Strengthening the roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by wetness and frost action.

The land capability classification is IIw. No woodland ordination symbol is assigned.

40—Arbela silty clay loam, occasionally flooded.

This very deep, nearly level, poorly drained soil is on low stream terraces and high flood plains. It is flooded for brief periods. Individual areas are long and narrow or irregularly shaped and range from about 15 to more than 100 acres in size.

The typical sequence, depth, and composition of the layers in this soil are as follows—

Surface layer:

0 to 10 inches; very dark gray, friable silty clay loam

Subsurface layer:

10 to 20 inches; gray, friable silty clay loam

Subsoil:

20 to 30 inches; grayish brown, mottled, firm silty clay

30 to 54 inches; dark grayish brown, mottled, firm silty clay loam and silty clay
 54 to 60 inches; grayish brown, mottled, firm silty clay loam

In some areas the subsoil has less than 35 percent clay and is darker colored.

Included with this soil in mapping are small areas of the somewhat poorly drained Tice and Dockery soils. These soils are in the slightly lower positions on the edges of the unit. They make up about 5 percent of the unit.

Important properties of the Arbela soil—

Permeability: Moderately slow

Surface runoff: Slow

Available water capacity: High

Organic matter content: Moderate

Depth to an apparent water table: 0 to 1.5 feet

Shrink-swell potential: Moderate

Potential for frost action: High

Most areas are cultivated. A few areas are used for pasture or hay. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer can be easily tilled throughout a fairly wide range in moisture content. Unless protected by a crop or surface mulch, however, the surface tends to crust or puddle after periods of heavy rainfall, especially in areas where the plow layer contains subsoil material. The wetness is the major limitation. Diversions constructed at the base of the adjacent uplands help to keep excess water from away from this soil. Surface drains help to remove the excess water. This water is not likely to affect yields but interferes with cultivation and harvesting activities.

This soil is suited to hay and pasture mixtures that include varieties that are tolerant of wetness, such as reed bluegrass, birdsfoot trefoil, and ladino clover. Deep-rooted legumes, such as alfalfa, generally do not grow well because of the seasonal high water table. Proper stocking rates and deferment of grazing during wet periods help to prevent deterioration of the pasture. Rotational grazing and applications of lime and fertilizer increase the quantity and improve the quality of forage.

This soil is unsuited to building site development and onsite waste disposal because of the flooding.

Low strength, the shrink-swell potential, the wetness, the potential for frost action, and the flooding limit this soil as a site for local roads and streets. Constructing the roads on raised, well compacted fill material and strengthening the base with crushed rock or other suitable material minimize the damage caused by flooding, shrinking and swelling, and low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the

damage caused by wetness and frost action.

The land capability classification is IIw. No woodland ordination symbol is assigned.

43—Chariton silt loam. This very deep, nearly level, poorly drained soil is on high stream terraces. Individual areas generally are fan shaped and range from about 10 to more than 150 acres in size.

The typical sequence, depth, and composition of the layers in this soil are as follows—

Surface layer:

0 to 9 inches; very dark grayish brown, friable silt loam

Subsurface layer:

9 to 16 inches; grayish brown, friable silt loam

Subsoil:

16 to 48 inches; grayish brown, mottled, firm silty clay and silty clay loam

Substratum:

48 to 60 inches; grayish brown, strong brown, and dark gray, firm clay loam and loam

In some areas the light colored subsurface layer is less than 5 inches thick.

Important soil properties—

Permeability: Slow

Surface runoff: Slow

Available water capacity: Moderate

Organic matter content: Moderate

Depth to a perched water table: 0 to 1.5 feet

Shrink-swell potential: High

Potential for frost action: High

Most areas are used for cultivated crops. A few areas are used for pasture or hay. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer can be easily tilled throughout a fairly wide range in moisture content. Unless protected by a crop or surface mulch, however, the surface tends to crust or puddle after periods of heavy rainfall, especially in areas where the plow layer contains subsoil material. The wetness is the major limitation. Diversions constructed at the base of the adjacent uplands help to keep excess water from flowing onto this soil. Shallow surface ditches and land grading help to remove the excess water. This water is not likely to affect yields but interferes with cultivation and harvesting activities.

This soil is suited to hay and pasture. Pasture and hay mixtures that include varieties that are tolerant of wetness, such as bluegrass, birdsfoot trefoil, and ladino clover, grow well. Deep-rooted legumes, such as alfalfa, generally do not grow well because of the seasonal

high water table. Proper stocking rates and deferment of grazing during wet periods help to prevent deterioration of the pasture. Rotational grazing and applications of lime and fertilizer increase the quantity and improve the quality of forage.

This soil is suited to building site development. The wetness and the shrink-swell potential are limitations on sites for dwellings. The damage caused by shrinking and swelling can be minimized by using adequately reinforced concrete in footings, foundations, and basement walls and by backfilling with sand and gravel. Constructing the dwellings on raised, well compacted fill material and installing drainage tile around footings and foundations minimize the damage caused by excessive wetness. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways minimize the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the restricted permeability and the wetness. Properly constructed sewage lagoons can function adequately if the site is leveled.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action limit this soil as a site for local roads and streets. Strengthening the roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by wetness and frost action.

The land capability classification is IIw. No woodland ordination symbol is assigned.

44B—Gifford silty clay loam, 2 to 5 percent slopes.

This very deep, gently sloping, poorly drained soil is on the lower side slopes of high stream terraces. Individual areas generally are fan shaped and range from about 15 to more than 150 acres in size.

The typical sequence, depth, and composition of the layers in this soil are as follows—

Surface layer:

0 to 8 inches; black, friable silty clay loam

Subsurface layer:

8 to 11 inches; dark grayish brown, mottled, friable silty clay loam

Subsoil:

11 to 19 inches; dark grayish brown, mottled, firm silty clay

19 to 60 inches; gray and grayish brown, mottled, firm silty clay loam

In some areas the subsurface layer is grayish brown

silt loam. In other areas sand and gravel are in the surface layer and the upper part of the subsoil.

Important soil properties—

Permeability: Very slow

Surface runoff: Medium

Available water capacity: Moderate

Organic matter content: Moderately low

Depth to a perched water table: 0.5 foot to 2.0 feet

Shrink-swell potential: High

Potential for frost action: Moderate

Most areas are used for cultivated crops or for hay or pasture. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer can be easily tilled throughout a fairly wide range in moisture content. Unless protected by a crop or surface mulch, however, the surface tends to crust or puddle after periods of heavy rainfall, especially in areas where the plow layer contains subsoil material. Erosion is a severe hazard. Several systems can be used to minimize the hazard of erosion. The commonly used practices are conservation tillage systems that leave a protective cover of crop residue on the surface, winter cover crops, terraces, underground tile outlets and grassed waterways, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops. Returning crop residue to the soil and regularly adding other organic material improve fertility, minimize crusting, and increase the available water capacity and the rate of water infiltration.

Pasture and hay mixtures that include varieties that are tolerant of wetness, such as bluegrass, birdsfoot trefoil, and ladino clover, grow well on this soil. Deep-rooted legumes, such as alfalfa, generally do not grow well because of the seasonal high water table. Erosion control during seedbed preparation is the main management concern. Timely tillage and a quickly established ground cover reduce the hazard of erosion. Timely deferment of grazing, rotational grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage.

This soil is suitable for building site development. The wetness and the shrink-swell potential are limitations on sites for dwellings. Designing and constructing basement walls, foundations, and footings with adequately reinforced concrete and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing drainage tile around footings and foundations minimizes the damage caused by excessive wetness. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways minimize the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the restricted permeability and the wetness. Properly constructed sewage lagoons can function adequately if the site is leveled.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action limit this soil as a site for local roads and streets. Strengthening the roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by wetness and frost action.

The land capability classification is IIe. No woodland ordination symbol is assigned.

44C2—Gifford silty clay loam, 5 to 9 percent slopes, eroded. This very deep, moderately sloping, poorly drained soil is on the lower side slopes of high stream terraces. Individual areas are long and narrow or fan shaped and range from about 15 to more than 50 acres in size.

The typical sequence, depth, and composition of the layers in this soil are as follows—

Surface layer:

0 to 4 inches; grayish brown and dark brown, friable silty clay loam

Subsoil:

4 to 10 inches; dark grayish brown, mottled, friable silty clay

10 to 60 inches; grayish brown and gray, mottled, firm silty clay and silty clay loam

In some areas the soil has a subsurface layer. In other areas the surface layer and the upper part of the subsoil have a higher content of sand and pebbles.

Included with this soil in mapping are small areas of soils that are subject to flooding. These soils are on the lower edges of the unit. Also included are areas where slopes are more than 9 percent. Included soils make up about 4 to 10 percent of the unit.

Important properties of the Gifford soil—

Permeability: Very slow

Surface runoff: Medium

Available water capacity: Moderate

Organic matter content: Moderately low

Depth to a perched water table: 0.5 foot to 2.0 feet

Shrink-swell potential: High

Potential for frost action: Moderate

Most areas are used for cultivated crops or for hay or pasture. This soil is suited to corn, soybeans, winter

wheat, and grain sorghum. The surface layer can be easily tilled throughout a fairly wide range in moisture content. Unless protected by a crop or surface mulch, however, the surface tends to crust or puddle after periods of heavy rainfall, especially in areas where the plow layer contains subsoil material. Erosion is a severe hazard. It has removed one-half or more of the original topsoil. The surface layer is mixed with subsoil material. Several systems can be used to minimize the hazard of erosion. The commonly used practices are conservation tillage systems that leave a protective cover of crop residue on the surface, winter cover crops, grassed waterways, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops. Returning crop residue to the soil and regularly adding other organic material improve fertility, minimize crusting, and increase the available water capacity and the rate of water infiltration.

This soil is well suited to ladino clover and moderately well suited to birdsfoot trefoil, alsike clover, crownvetch, tall fescue, timothy, switchgrass, big bluestem, and indiagrass. The species that are tolerant of wetness grow best. Erosion control during seedbed preparation is the main management concern. Timely tillage and a quickly established ground cover reduce the hazard of erosion. Timely deferment of grazing, rotational grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage.

This soil is suited to building site development. The shrink-swell potential, the wetness, and the slope are limitations on sites for dwellings. Designing and constructing basement walls, foundations, and footings with adequately reinforced concrete and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing drainage tile around the footings and underneath basement floors minimizes the damage caused by excessive wetness. Land grading may be needed because of the slope. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways minimize the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the restricted permeability and the wetness. Properly constructed sewage lagoons can function adequately if the site is leveled.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action limit this soil as a site for local roads and streets. Strengthening the roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing

culverts minimize the damage caused by wetness and frost action.

The land capability classification is IIIe. No woodland ordination symbol is assigned.

46—Vesser silt loam, occasionally flooded. This very deep, nearly level, poorly drained soil is on high flood plains. It is flooded for brief periods. Individual areas are long and narrow or irregularly shaped and range from about 15 to more than 100 acres in size.

The typical sequence, depth, and composition of the layers in this soil are as follows—

Surface layer:

0 to 10 inches; very dark gray, friable silt loam

Subsurface layer:

10 to 18 inches; very dark gray, friable silt loam

18 to 41 inches; grayish brown and dark grayish brown, friable silt loam

Subsoil:

41 to 60 inches; dark gray and very dark grayish brown, mottled, firm silty clay loam

In some areas the subsoil is darker and has more clay. In other areas the subsurface layer is not so gray.

Included with this soil in mapping are small areas of the frequently flooded Floris soils. These soils are in the slightly lower positions on the edges of the unit. They make up about 5 percent of the unit.

Important properties of the Vesser soil—

Permeability: Moderate

Surface runoff: Slow

Available water capacity: High

Organic matter content: Moderate

Depth to an apparent water table: 1 to 3 feet

Shrink-swell potential: Moderate

Potential for frost action: High

Most areas are cultivated. A few areas are used for pasture or hay. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer can be easily tilled throughout a fairly wide range in moisture content. Unless protected by a crop or surface mulch, however, the surface tends to crust or puddle after periods of heavy rainfall, especially in areas where the plow layer contains subsoil material. The wetness is the major limitation. Diversions constructed at the base of the adjacent uplands help to keep excess water from moving onto this soil. Surface drains help to remove the excess water. This water is not likely to affect yields but interferes with cultivation and harvesting activities.

This soil is suited to hay and pasture. Pasture and hay mixtures that include varieties that are tolerant of

wetness, such as reed canarygrass and alsike clover, grow well. Deep-rooted legumes, such as alfalfa, generally do not grow well because of the seasonal high water table. Proper stocking rates and deferment of grazing during wet periods help to prevent deterioration of the pasture. Rotational grazing and applications of lime and fertilizer increase the quantity and improve the quality of forage.

This soil is not suited to building site development or onsite waste disposal because of the occasional flooding.

Low strength, the shrink-swell potential, the wetness, the potential for frost action, and the flooding limit this soil as a site for local roads and streets. Constructing the roads on raised, well compacted fill material and strengthening the base with crushed rock or other suitable material minimize the damage caused by flooding, shrinking and swelling, and low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by wetness and frost action.

The land capability classification is IIw. No woodland ordination symbol is assigned.

47—Zook silty clay loam, occasionally flooded, overwash. This very deep, nearly level, poorly drained soil is on narrow flood plains and in broad, low areas on the larger flood plains. It is flooded for brief periods. Individual areas are irregularly shaped and range from about 50 to more than 300 acres in size.

The typical sequence, depth, and composition of the layers in this soil are as follows—

Surface layer:

0 to 9 inches; very dark gray, friable silty clay loam

Subsurface layer:

9 to 31 inches; very dark gray and black, firm silty clay loam

Subsoil:

31 to 60 inches; black, firm silty clay loam that is mottled in the lower part

In some areas the surface layer and subsurface layer are silt loam. In other areas the soil has been protected from flooding by levees.

Important soil properties—

Permeability: Slow

Surface runoff: Very slow

Available water capacity: Moderate

Organic matter content: High

Depth to an apparent water table: 0 to 2 feet

Shrink-swell potential: High

Potential for frost action: High



Figure 9.—Reed canarygrass in an area of Zook silty clay loam, occasionally flooded, overwash.

Most areas are used for cultivated crops. Some areas are used for hay or pasture. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer is sticky when wet and can be easily tilled only within a somewhat narrow range in moisture content. Unless protected by a crop or surface mulch, the surface tends to crust or puddle after periods of heavy rainfall. Flooding delays planting and interferes with harvesting during most years. It commonly damages the crops. If flooding in the fall interferes with harvesting, it may be necessary to harvest the crops when the ground is frozen. Field ditches can improve

surface drainage if adequate outlets are available. Land grading is needed in extremely wet areas. Diversions constructed at the base of the uplands or on the foot slopes of stream terraces can keep excess water from flowing onto this soil. Conservation tillage systems that leave a protective cover of crop residue on the surface help to maintain the content of organic matter, improve tilth, and increase the rate of water infiltration.

This soil is best suited to the pasture and hay species that are tolerant of wetness and flooding, such as reed canarygrass and alsike clover (fig. 9). Deep-rooted legumes, such as alfalfa, generally do not grow

well because of the seasonal high water table and the flooding. Proper stocking rates and deferment of grazing during wet periods help to keep the pasture in good condition. Timely deferment of grazing, rotational grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage.

This soil is unsuited to building site development and onsite waste disposal because of the flooding.

The flooding, low strength, the shrink-swell potential, the wetness, and the potential for frost action limit this soil as a site for local roads and streets. Constructing the roads on raised, well compacted fill material and strengthening the roads with crushed rock or other suitable base material minimize the damage caused by flooding, shrinking and swelling, and low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by wetness and by frost action.

The land capability classification is IIw. No woodland ordination symbol is assigned.

49—Dockery and Tice silt loams, occasionally flooded. These very deep, nearly level, somewhat poorly drained soils are on flood plains. They are flooded for brief periods. Individual areas are long and narrow and range from about 25 to more than 200 acres in size.

The typical sequence, depth, and composition of the layers in the Dockery soil are as follows—

Surface layer:

0 to 8 inches; very dark grayish brown, friable silt loam

Substratum:

8 to 17 inches; brown, friable silt loam

17 to 60 inches; brown and light brownish gray, friable silt loam and loam

In some areas the content of sand is more than 15 percent throughout the soil.

Important properties of the Dockery soil—

Permeability: Moderate

Surface runoff: Slow

Available water capacity: Very high

Organic matter content: Moderate

Depth to an apparent water table: 2 to 3 feet

Shrink-swell potential: Moderate

Potential for frost action: High

The typical sequence, depth, and composition of the layers in the Tice soil are as follows—

Surface layer:

0 to 9 inches; very dark gray, friable silt loam

Subsurface layer:

9 to 20 inches; very dark gray, friable silt loam

Subsoil:

20 to 30 inches; dark grayish brown, friable silt loam

Substratum:

30 to 60 inches; dark grayish brown, mottled, friable silt loam

In some areas the surface layer is loam.

Important properties of the Tice soil—

Permeability: Moderate

Surface runoff: Slow

Available water capacity: Very high

Organic matter content: Moderate

Depth to an apparent water table: 1.5 to 3.0 feet

Shrink-swell potential: Moderate

Potential for frost action: High

Included with these soils in mapping are small areas of the poorly drained Zook soils. These soils are on the lowest parts of the unit. They make up about 7 percent of the unit.

Most areas are used for cultivated crops or for hay or pasture. These soils are suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer is friable and can be easily tilled throughout a moderate range in moisture content. Flooding is the main hazard. It delays planting or interferes with harvesting. It causes moderate crop damage during some years, but summer annual crops commonly are damaged only to a minor extent. Because of the flooding, harvesting should be delayed in some years until the ground is frozen.

These soils are moderately well suited to tall fescue, red clover, birdsfoot trefoil, and switchgrass. Flooding is the main hazard. The species that are tolerant of wetness and flooding grow best. Timely deferment of grazing, rotational grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage and help to control erosion.

A few small areas support native hardwoods. These soils are suited to trees. No major problems limit timber management. The trees should not be planted or harvested during periods when the soils are subject to flooding. Selective cutting and timely harvesting of mature trees help to obtain the maximum growth potential.

These soils are unsuitable for building site development and onsite waste disposal because of the flooding.

The flooding, the wetness, the shrink-swell potential, and the potential for frost action limit these soils as sites for local roads and streets. Constructing the roads

on raised, well compacted, coarse textured fill material and strengthening the base with crushed rock or other suitable material minimize the damage caused by flooding and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by wetness and frost action.

The land capability classification is IIw. Based on pin oak as the indicator species, the woodland ordination symbol is 4A.

54B—Vigar loam, 2 to 5 percent slopes, rarely flooded. This very deep, gently sloping, moderately well drained soil is on toe slopes at the base of the more sloping uplands. It is flooded for very brief periods. Individual areas are long and narrow or fan shaped and range from about 15 to more than 50 acres in size.

The typical sequence, depth, and composition of the layers in this soil are as follows—

Surface layer:

0 to 12 inches; black, friable loam

Subsurface layer:

12 to 19 inches; very dark grayish brown, friable loam

Subsoil:

19 to 52 inches; very dark grayish brown, dark grayish brown, and dark yellowish brown, mottled, friable and firm clay loam

52 to 60 inches; dark yellowish brown, mottled, firm loam

In some areas the surface layer and the upper part of the subsoil are silt loam. In other areas they are lighter colored.

Important soil properties—

Permeability: Moderately slow

Surface runoff: Medium

Available water capacity: High

Organic matter content: Moderate

Depth to an apparent water table: 2 to 3 feet

Shrink-swell potential: Moderate

Potential for frost action: High

Most areas are used for cultivated crops or for hay or pasture. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer is friable and can be easily tilled throughout a moderate range in moisture content. Erosion is a hazard. Several systems can be used to minimize erosion. The commonly used practices are conservation tillage systems that leave a protective cover of crop residue on the surface, winter cover crops, terraces, underground tile outlets and

grassed waterways, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops.

This is well suited to ladino clover and moderately well suited to tall fescue, timothy, lespedeza, birdsfoot trefoil, indiagrass, and switchgrass. The species that are tolerant of wetness grow best. Erosion control during seedbed preparation is the main management concern. Timely tillage and a quickly established ground cover reduce the hazard of erosion. Timely deferment of grazing, rotational grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage and help to control erosion.

This soil generally is not used for building site development because of the wetness and the flooding. The shrink-swell potential is a severe limitation on sites for dwellings. Dwellings constructed on this soil should be built above the known level of flooding or on raised, well compacted fill material. Drainage tile should be installed around footings and foundations to minimize the damage caused by excessive wetness. The damage caused by shrinking and swelling can be minimized by using adequately reinforced concrete in footings, foundations, and basement walls and by backfilling with sand and gravel. Reinforcement steel, expansion joints, and a sand or gravel base for sidewalks and driveways minimize the damage caused by shrinking and swelling and by frost action.

This soil generally is not used for conventional septic tank absorption fields because of the restricted permeability and the wetness. Properly constructed sewage lagoons can function adequately if the site is leveled and the berms and bottom of the lagoons are sealed with slowly permeable material, which helps to control seepage.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action limit this soil as a site for local roads and streets. Strengthening the roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by wetness and frost action.

The land capability classification is IIe. No woodland ordination symbol is assigned.

55B—Vigar-Zook-Excello complex, 0 to 5 percent slopes. These very deep soils are on flood plains and toe slopes. The gently sloping, moderately well drained Vigar soil is on the toe slopes. The nearly level, poorly drained Zook and somewhat poorly drained Excello soils are on the flood plains. The Vigar and Zook soils

are subject to rare flooding of very brief duration, and the Excello soil is occasionally flooded for brief periods. Individual areas are long, narrow, and branching and range from about 5 to more than 25 acres in size. They are about 40 percent Vigar soil, 35 percent Zook soil, and 25 percent Excello and similar soils.

The typical sequence, depth, and composition of the layers in the Vigar soil are as follows—

Surface layer:

0 to 5 inches; black, friable loam

Subsurface layer:

5 to 12 inches; black, friable loam

Subsoil:

12 to 19 inches; black, firm loam

19 to 30 inches; very dark gray, mottled, firm loam

30 to 39 inches; dark grayish brown and very dark gray, mottled, firm clay loam

39 to 47 inches; brown, mottled, firm silty clay loam

47 to 60 inches; grayish brown and brown, mottled, firm silty clay loam

Important properties of the Vigar soil—

Permeability: Moderately slow

Surface runoff: Medium

Available water capacity: High

Organic matter content: Moderate

Depth to an apparent water table: 2 to 3 feet

Shrink-swell potential: Moderate

Potential for frost action: High

The typical sequence, depth, and composition of the layers in the Zook soil are as follows—

Surface layer:

0 to 10 inches; very dark gray, friable silty clay loam

Subsoil:

10 to 18 inches; black, friable silty clay

18 to 30 inches; black, firm silty clay loam

30 to 45 inches; very dark gray, firm silty clay

45 to 60 inches; dark gray, firm silty clay loam

In some areas the soil has a surface layer and subsurface layer of silt loam or loam.

Important properties of the Zook soil—

Permeability: Slow

Surface runoff: Slow

Available water capacity: Moderate

Organic matter content: High

Depth to an apparent water table: 0 to 2 feet

Shrink-swell potential: High

Potential for frost action: High

The typical sequence, depth, and composition of the

layers in the Excello soil are as follows—

Surface layer:

0 to 5 inches; very dark gray, friable loam

Subsurface layer:

5 to 10 inches; very dark gray, friable loam

Subsoil:

10 to 26 inches; very dark gray, friable loam

26 to 47 inches; very dark gray, mottled, friable loam

Substratum:

47 to 60 inches; very dark gray and gray, mottled, friable loam

In some areas the soil has less than 18 percent clay throughout. In other areas it has less than 15 percent sand throughout.

Important properties of the Excello soil—

Permeability: Moderate

Surface runoff: Slow

Available water capacity: High

Organic matter content: Moderate

Depth to an apparent water table: 1 to 3 feet

Shrink-swell potential: Moderate

Potential for frost action: High

Most areas are used for hay, pasture, or timber. Some areas are used for cultivated crops. In areas that are large enough to be cultivated, these soils are suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer is friable and can be easily tilled throughout a moderate range in moisture content. Erosion is a hazard on the gently sloping Vigar soil. Wetness is the main management concern on the Excello and Zook soils. Several systems can be used to minimize the hazard of erosion. The commonly used practices are conservation tillage systems that leave a protective cover of crop residue on the surface, winter cover crops, terraces, underground tile outlets and grassed waterways, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops. Diversions constructed at the edge of the uplands and shallow surface ditches can reduce the wetness of the Excello and Zook soils.

The soils in this unit are well suited to ladino clover and moderately well suited to tall fescue, timothy, lespedeza, birdsfoot trefoil, indiagrass, and switchgrass. The species that are tolerant of wetness grow best. Erosion is a hazard on the gently sloping Vigar soil, and erosion control during seedbed preparation is the main management concern. Timely tillage and a quickly established ground cover reduce the hazard of erosion. Timely deferment of grazing,

rotational grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage and minimize erosion.

These soils generally are not used for building site development because of the wetness and the flooding. The shrink-swell potential is a severe limitation on sites for dwellings. Dwellings constructed on the Vigar and Zook soils should be built above the known level of flooding or on raised, well compacted fill material. Drainage tile should be installed around footings and foundations to minimize the damage caused by wetness. The damage caused by shrinking and swelling can be minimized by using adequately reinforced concrete in footings, foundations, and basement walls and by backfilling with sand and gravel. Reinforcement steel, expansion joints, and a sand or gravel base for sidewalks and driveways minimize the damage caused by shrinking and swelling and by frost action.

These soils generally are not used for conventional septic tank absorption fields because of the restricted permeability, the wetness, and the flooding. Properly constructed sewage lagoons can function adequately if the site is leveled and the berms and bottom of the lagoons are sealed with slowly permeable material, which helps to control seepage.

Low strength, the shrink-swell potential, the wetness, the potential for frost action, and the flooding limit these soils as sites for local roads and streets. Constructing the roads and streets on well compacted fill material and strengthening the base with crushed rock or other suitable material minimize the damage caused by low strength, shrinking and swelling, and flooding. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by wetness and frost action.

The land capability classification is 1lw in areas of the Zook and Excello soils and 1le in areas of the Vigar soil. No woodland ordination symbol is assigned.

56—Wabash silty clay loam, occasionally flooded, overwash. This very deep, nearly level, poorly drained soil is on narrow flood plains and in broad, low areas on the larger flood plains. It is flooded for brief periods. Individual areas are long and narrow or large and oval and range from about 50 to more than 300 acres in size.

The typical sequence, depth, and composition of the layers in this soil are as follows—

Surface layer:

0 to 10 inches; very dark grayish brown, friable silty clay loam

Subsurface layer:

10 to 15 inches; very dark grayish brown,

mottled, firm silty clay

Subsoil:

15 to 60 inches; very dark gray and dark gray, mottled, firm silty clay

In some areas the subsoil is lighter colored. In other areas the soil has been protected from flooding by channelization and by levees.

Important soil properties—

Permeability: Very slow

Surface runoff: Slow

Available water capacity: Moderate

Organic matter content: High

Depth to an apparent water table: 0 to 1 foot

Shrink-swell potential: Very high

Potential for frost action: Moderate

Most areas are used for cultivated crops. Some areas are used for hay or pasture. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer is sticky when wet and can be easily tilled only within a narrow range in moisture content. Unless protected by a crop or surface mulch, the surface tends to crust or puddle after periods of heavy rainfall. Because of the slow runoff and the poor internal drainage, removing excess water from cultivated areas is difficult. Shallow surface ditches and land grading can improve surface drainage if adequate outlets are available. Diversions constructed at the base of the uplands or on the foot slopes of stream terraces can keep excess water from flowing onto this soil. Conservation tillage systems that leave a protective cover of crop residue on the surface help to maintain the content of organic matter, improve tilth, and increase the rate of water infiltration. Floodwater commonly damages crops in unprotected areas. The wetness delays planting and interferes with harvesting during most years. If flooding in the fall interferes with harvesting, it may be necessary to harvest the crops when the ground is frozen.

This soil is best suited to pasture or hay mixtures that include varieties that are tolerant of wetness and flooding, such as reed canarygrass and alsike clover. The soil is poorly suited to hay. Deep-rooted legumes, such as alfalfa, generally do not grow well because of the seasonal high water table and flooding. A surface drainage system improves the growth of the deeper rooted species. Proper stocking rates and deferment of grazing during wet periods help to prevent deterioration of the pasture. Timely deferment of grazing, rotational grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage.

This soil is unsuited to building site development and

onsite waste disposal because of the occasional flooding.

The flooding, low strength, the shrink-swell potential, the wetness, and the potential for frost action limit this soil as a site for local roads and streets. Constructing the roads on raised, well compacted fill material and strengthening the base with crushed rock or other suitable material minimize the damage caused by flooding, shrinking and swelling, and low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by wetness and frost action.

The land capability classification is IIIw. Based on pin oak as the indicator species, the woodland ordination symbol is 4W.

57—Floris loam, frequently flooded. This very deep, nearly level, moderately well drained soil is on flood plains along creeks and small rivers. It is flooded for brief periods. Individual areas are long and narrow and range from about 10 to more than 50 acres in size.

The typical sequence, depth, and composition of the layers in this soil are as follows—

Surface layer:

0 to 5 inches; dark grayish brown, friable loam

Substratum:

5 to 12 inches; brown, mottled, friable loam

12 to 24 inches; brown, friable fine sandy loam

24 to 45 inches; brown and light olive brown, friable loam

45 to 60 inches; dark grayish brown and dark yellowish brown, loose and friable, stratified loamy fine sand and silt loam

In some areas the surface layer and substratum are very dark grayish brown. In other areas the soil has more clay throughout.

Important soil properties—

Permeability: Moderate

Surface runoff: Slow

Available water capacity: Moderate

Organic matter content: Moderately low

Depth to an apparent water table: 3 to 5 feet

Shrink-swell potential: Low

Potential for frost action: Moderate

Most areas are used for hay, pasture, or timber. Some areas are used for cultivated crops, mainly corn, soybeans, winter wheat, and grain sorghum. In areas that are large enough to be farmed, this soil is suited to cultivated crops. The surface layer is friable and can be easily tilled throughout a wide range in moisture content. Flooding delays planting and interferes with

harvesting during some years. Summer annual crops commonly are damaged by floodwater only to a minor extent.

This soil is well suited to alsike clover and moderately well suited to tall fescue, red clover, birdsfoot trefoil, and switchgrass. Flooding is the main hazard. The species that are tolerant of flooding grow best. Timely deferment of grazing, rotational grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage.

This soil is suited to trees. Flooding is the only management concern affecting planting or harvesting. It limits the operation of equipment.

This soil is unsuited to building site development and onsite waste disposal because of the frequent flooding.

The flooding and the potential for frost action limit this soil as a site for local roads and streets. Constructing the roads on raised, well compacted fill material minimizes the damage caused by flooding and frost action. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by frost action.

The land capability classification is IIIw. Based on white oak as the indicator species, the woodland ordination symbol is 3W.

69—Floris silt loam, occasionally flooded. This very deep, nearly level, moderately well drained soil is on the flood plain along the Chariton River. It is near the original stream channel. It is flooded for very brief periods. Individual areas are irregularly shaped and range from about 15 to more than 100 acres in size.

The typical sequence, depth, and composition of the layers in this soil are as follows—

Surface layer:

0 to 8 inches; brown, friable silt loam

Substratum:

8 to 32 inches; brown, friable loam

32 to 43 inches; stratified brown and dark brown, mottled, friable fine sandy loam

43 to 60 inches; stratified brown, dark yellowish brown, and pale brown silt loam and fine sand

In some areas the substratum is not mottled.

Included with this soil in mapping are small areas of the poorly drained Zook soils. These soils are in low areas away from the stream channel. They make up about 6 percent of the unit.

Important properties of the Floris soil—

Permeability: Moderate

Surface runoff: Slow

Available water capacity: Moderate
Organic matter content: Moderately low
Depth to an apparent water table: 3 to 5 feet
Shrink-swell potential: Low
Potential for frost action: Moderate

Most areas are used for cultivated crops. A few areas are used for hay, pasture, or timber. This soil is well suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer is friable and can be easily tilled throughout a moderately wide range in moisture content.

This soil is well suited to tall fescue and switchgrass and moderately well suited to red clover and birdsfoot trefoil. The species that are tolerant of flooding grow best. Timely deferment of grazing, rotational grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage.

This soil is unsuited to building site development and onsite waste disposal because of the occasional flooding.

The flooding and the potential for frost action limit this soil as a site for local roads and streets. Constructing the roads on raised, well compacted fill material minimizes the damage caused by flooding and frost action. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by frost action.

The land capability classification is IIw. Based on white oak as the indicator species, the woodland ordination symbol is 3A.

71C—Plainfield loamy sand, 2 to 9 percent slopes.

This very deep, gently sloping and moderately sloping, excessively drained soil is on the side slopes of high stream terraces. Individual areas are oval or fan shaped and range from about 10 to more than 40 acres in size.

The typical sequence, depth, and composition of the layers in this soil are as follows—

Surface layer:

0 to 10 inches; very dark gray, friable loamy sand

Subsurface layer:

10 to 19 inches; very dark gray, friable loamy sand

Subsoil:

19 to 40 inches; very dark grayish brown and dark grayish brown, very friable loamy sand
 40 to 60 inches; yellowish brown, loose sand

In some areas the soil has bands of fine sandy loam and silt loam 6 to 12 inches thick.

Important soil properties—

Permeability: Rapid

Surface runoff: Slow

Available water capacity: Low

Organic matter content: Low

Depth to a water table: More than 6 feet

Shrink-swell potential: Low

Potential for frost action: Low

Most areas are used for cultivated crops. Yields are limited by the low available water capacity, and wind erosion is a hazard. The surface layer is friable and can be easily tilled throughout a wide range in moisture content. Conservation tillage systems that leave a protective cover of crop residue on the surface, winter cover crops, and crop rotations that include hay and pasture crops are effective in controlling erosion.

This soil is moderately well suited to crownvetch, lespedeza, tall fescue, orchardgrass, big bluestem, indiagrass, and switchgrass. The species that are tolerant of droughtiness grow best. Erosion control during seedbed preparation is the main management concern. Timely tillage and a quickly established ground cover help to prevent excessive erosion.

This soil generally is not used for building site development or onsite waste disposal, mainly because of the instability of cutbanks, a poor filtering capacity, and seepage. Because of droughtiness, establishing or maintaining lawns is difficult.

The land capability classification is IVs. Based on black oak as the indicator species, the woodland ordination symbol is 2S.

71F—Plainfield loamy sand, 20 to 40 percent slopes.

This very deep, steep and very steep, excessively drained soil is on dissected, uneven side slopes in the uplands. Individual areas are irregularly shaped and range from about 40 to more than 150 acres in size.

The typical sequence, depth, and composition of the layers in this soil are as follows—

Surface layer:

0 to 2 inches; very dark grayish brown, very friable loamy sand

Subsoil:

2 to 28 inches; dark yellowish brown, very friable sand
 28 to 60 inches; yellowish brown, loose sand

In some areas the subsoil has more silt.

Included with this soil in mapping are small areas of Gorin and Winnegan soils. These soils have less sand than the Plainfield soil. Gorin soils are on ridgetops. Winnegan soils are on side slopes. Included soils make up about 10 percent of the unit.

Important properties of the Plainfield soil—

Permeability: Rapid

Surface runoff: Medium

Available water capacity: Low

Organic matter content: Low

Depth to a water table: More than 6 feet

Shrink-swell potential: Low

Potential for frost action: Low

Most areas are wooded. Some areas are used as pasture. Because of the slope, droughtiness, and a severe hazard of erosion, this soil is unsuited to cultivated crops. It is moderately well suited to little bluestem, big bluestem, and indiangrass and is suited to lespedeza, orchardgrass, tall fescue, crownvetch, and switchgrass. Erosion is a severe hazard, especially during seedbed preparation and in overgrazed areas. If the soil is tilled when pasture or hay crops are reseeded, conservation tillage systems that leave a protective cover of crop residue on the surface, winter cover crops, and grassed waterways are needed to minimize erosion. Timely seedbed preparation helps to ensure rapid plant growth and a good ground cover. Timely deferment of grazing, rotational grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage and help to control erosion.

Most areas support stands of native hardwoods. This soil is best suited to trees. The main concerns in managing timber are an equipment limitation, seedling mortality, and the hazard of erosion. Building logging roads and skid trails on the contour and installing culverts and water bars as necessary help to control erosion. Hand planting of seedlings and either container-grown nursery stock or reinforcement planting while seedlings are dormant in early spring may be necessary to improve the stands. Most of the existing stands require thinning and selective cutting of undesirable trees. These practices improve the habitat for woodland wildlife, especially white-tailed deer and wild turkey.

This soil generally is not used for building site development, onsite waste disposal, or local roads and streets because of the slope and the high content of sand.

The land capability classification is VIIe. Based on black oak as the indicator species, the woodland ordination symbol is 2R.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the

supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban or built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal expenditure of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slopes range mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Natural Resources Conservation Service or the Missouri Cooperative Extension Service.

About 102,600 acres in Adair County, or more than 28 percent of the total acreage, meets the soil requirements for prime farmland. Scattered areas of this land are throughout the county, but most are in associations 1 and 5, which are described under the heading "General Soil Map Units." The main crops grown on this land are soybeans, corn, winter wheat, and grain sorghum.

A recent trend in land use in some parts of the county has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

The map units in the survey area that are considered prime farmland are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Some soils that have a seasonal high water table and all soils that are frequently flooded during the

growing season qualify as prime farmland only in areas where these limitations have been overcome by drainage measures or flood control. The need for these measures is indicated after the map unit name in table

5. Onsite evaluation is needed to determine whether or not these limitations have been overcome by corrective measures.

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help to prevent soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreational facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

Daniel A. Yager, district conservationist, Natural Resources Conservation Service, helped prepare this section.

General management needed for crops and pasture

is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Natural Resources Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under the heading "Detailed Soil Map Units." Specific information can be obtained from the local office of the Natural Resources Conservation Service or the Missouri Cooperative Extension Service.

Approximately 192,000 acres in Adair County, or nearly 53 percent of the total acreage, was used for crops and pasture in 1987. Of this total, about 70,000 acres was used as permanent pasture and 99,000 acres was used for cultivated crops, mainly corn, soybeans, winter wheat, and grain sorghum, or as meadow in a cropland rotation. The remaining 23,000 acres was used mainly for conservation purposes or was idle cropland. In 1987, about 65,000 acres was used for corn, soybeans, winter wheat, or grain sorghum. By 1990, only 50,000 acres was used for these crops. Some areas in the county are used for specialty crops, including apples, Christmas trees, and various garden vegetables.

Corn and soybeans are the field crops that are best suited to the soils and climate of the county. In 1989, soybeans were harvested on an estimated 36,300 acres and corn was harvested on 13,600 acres. Grain sorghum was grown on less than 500 acres. Winter wheat, the most common close-growing crop, was grown on about 6,800 acres (8).

The potential of the soils in Adair County for sustained production of food is good. About 102,600 acres in the county is prime farmland. In 1982, only about 18,200 acres, or 5 percent of the cropland and pasture, was adequately treated for conservation needs (18). The inadequately treated cropland was in areas on uplands where erosion is in excess of what is considered tolerable for sustained production. Marginal

land used for row crops should be converted to grassland, or adequate conservation systems should be applied.

The hazard of water erosion on most of the cropland can be minimized by a system of conservation practices designed for specific sites and situations. The most effective tool for predicting soil loss is the Universal Soil Loss Equation.

Erosion is the major problem on nearly all sloping cropland and overgrazed pasture in Adair County. All soils that have slopes of more than 2 percent are susceptible to erosion.

Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Loss of the surface layer is especially damaging on soils having a clayey subsoil. Second, erosion on farmland results in the sedimentation of streams, lakes, and ponds. Controlling erosion minimizes this pollution; improves the quality of water for municipal use, for recreation, and for fish and wildlife; and prolongs the useful life of ponds and lakes by reducing the amount of sedimentation.

On clayey spots in many fields, seedbed preparation and tillage are difficult because the original friable surface soil has been eroded away. These spots are in areas of Adco, Armstrong, Bevier, Gorin, and Leonard soils.

Erosion control protects the surface of the soil, helps to control runoff, and increases the rate of water infiltration. A cropping system that keeps a plant cover on the soil for extended periods helps to control erosion and preserves the productive capacity of the soil. Grasses and legumes grown for pasture and hay are effective in controlling erosion (fig. 10). Including legumes, such as clover and alfalfa, in the crop rotation improves tilth and provides nitrogen for the following crop.

Terraces reduce the length of slopes and thus help to control runoff and erosion. Special construction and management techniques are necessary if terrace systems are to be effective in most moderately sloping areas of the eroded Armstrong and Leonard soils. Cropping systems that provide a substantial plant cover are needed in conjunction with terraces on these soils.

Conservation tillage leaves a protective cover of crop residue on the surface and therefore helps to control runoff and erosion and increases the rate of water infiltration. Contour stripcropping helps to control erosion by maintaining a permanent plant cover in contoured strips. Grasses or grasses and legumes in the strips generally are used for hay. The areas between the strips are cultivated. In these areas row crops are planted on the contour. In some areas strips

of row crops are alternated with strips of close-grown crops, such as winter wheat.

Soil drainage and flood control are management concerns in all areas of the soils on flood plains in Adair County. Flooding can be a problem on Dockery, Floris, and Zook soils. The flooding commonly occurs during the period November through May. Vesser, Arbela, and Zook soils are naturally so wet that crop production is limited in some years. Putnam soils, which are on broad, nearly level ridgetops in the uplands, are very slowly permeable. When they receive excess water, these soils stay wet for long periods. Excess water can be removed from most soils by land grading and field ditches.

Soil fertility is naturally lower in most eroded soils than in other soils. Additional plant nutrients are needed on all soils if maximum crop production is to be achieved. Most of the soils in the county are naturally acid in the upper part of the root zone and require applications of ground limestone to raise the pH and calcium levels sufficiently for optimum plant growth. On all soils, additions of lime and fertilizer should be based on the results of soil tests, on the needs of the specific crop, and on the desired level of production.

Soil tilth is an important factor affecting the germination of seeds and the infiltration of water into the soil. Soils that have good tilth are granular and porous. In most cropped areas of the uneroded soils on uplands in the county, the surface layer is silt loam or silty clay loam. Generally, tillage and compaction weaken the structure of the soils that have a surface layer of silt loam. During periods of intensive rainfall, a crust forms on the surface. The crust is hard when dry. It reduces the rate of water infiltration and increases the runoff rate. Regularly adding crop residue, manure, or other organic material improves soil structure and tilth.

Most of the eroded soils on uplands in the county have more clay in the surface layer than corresponding uneroded soils. Also, tilth is poorer, the rate of water infiltration is slower, and runoff is more rapid. On the eroded soils, appropriate conservation systems are needed to minimize further erosion.

Some areas in the county are plowed in the fall. Fall plowing is a poor practice on most of the soils on uplands. These soils generally are sloping and are subject to erosion if they are plowed in the fall.

Few irrigation systems are currently being used in the county. Center-pivot and traveling-gun systems are used in some areas. Irrigation systems increase yields by supplying supplemental water during critical periods of crop growth. Irrigation facilitates double-cropping. For example, soybeans can be planted directly into wheat stubble. The irrigation system then supplies enough water to ensure germination and crop growth. The large



Figure 10.—Orchardgrass-red clover hay in an area of Winnegan loam, 14 to 20 percent slopes, eroded.

amount of crop residue on the surface protects the soil from erosion.

The pasture and hay crops that are suited to the soils and climate of the county include several legumes, cool-season grasses, and warm-season native grasses. Alfalfa and red clover are the most common legumes grown for hay. They also are planted in mixtures that include brome grass or orchardgrass. Birdsfoot trefoil can be grown alone or in mixtures that include brome grass, orchardgrass, tall fescue, and bluegrass. Big bluestem, indiagrass, and switchgrass are suitable

warm-season grasses. They grow well during periods in summer when the cool-season species are dormant. Warm-season grasses require different management techniques than cool-season grasses.

The less sloping areas of very deep, moderately well drained soils, such as Gara, Purdin, and Winnegan soils, are well suited to alfalfa. Other legumes and most grasses grow well on most of the soils on uplands in the county. Zook soils are subject to flooding and stay wet for long periods. They are best suited to short-season summer annuals or to species that are tolerant

of wetness. Alsike clover, ladino clover, birdsfoot trefoil, and reed canarygrass are examples of the species that are tolerant of wetness.

The major concerns in managing pasture are overgrazing and erosion. Controlled grazing helps to maintain maximum forage production. Keeping the grasses at a desirable height helps to control runoff and erosion.

Yields per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations also are considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Natural Resources Conservation Service or of the Missouri Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The

criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for woodland or for engineering purposes.

In the capability system, soils are generally grouped at three levels—capability class, subclass, and unit (16). Only class and subclass are used in this survey.

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. The classes are defined as follows:

Class I soils have few limitations or hazards that restrict their use.

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

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

Class IV soils have very severe limitations and hazards that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations or hazards that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations or hazards that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations or hazards that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w*, *s*, or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, woodland, wildlife habitat, or recreation.

The capability classification of the map units in this survey area is given in the section "Detailed Soil Map Units" and in the yields table.

Woodland Management and Productivity

Douglas C. Wallace, forester, Natural Resources Conservation Service, helped prepare this section.

Forests consist of more than trees. Together with soils and the associated plants and animals, they form an ecosystem with many valuable properties. Wood fiber, sustained water quality and quantity, wildlife habitat, and recreational activities are products or benefits derived from a productive forest ecosystem (12).

In 1986, approximately 18 percent of the acreage in Adair County was forested, according to the Missouri Department of Conservation. Tree species and growth rates vary, depending on site conditions, soil types, and past management (5).

The site characteristics that affect tree growth include aspect (the direction that a slope faces) and landscape position. These characteristics influence the amount of available sunlight, air drainage, soil temperature, soil moisture, and relative humidity. The best upland sites for tree growth generally are north and east aspects and low landscape positions, which are cooler and have better moisture conditions than other sites.

Soil properties fundamentally affect timber production. One-fourth or more of the mass of a tree is in the soil, which serves as a reservoir for moisture, provides an anchor for roots, and supplies essential plant nutrients. The soil properties that affect tree growth include reaction (pH), fertility, drainage, texture, structure, slope, and depth. Trees grow best on soils that do not have extremes of these properties and have an effective rooting depth of more than 40 inches.

Soil wetness is the result of a high water table, flooding, or ponding. It causes seedling mortality, limits the use of equipment, and increases the hazard of windthrow by restricting the rooting depth of some trees. On soils that have a perched water table, such as the somewhat poorly drained Armstrong soils, ruts form easily if wheeled skidders are used during wet periods. In areas where deep ruts have formed, lateral drainage tends to be restricted, tree roots can be damaged, and soil structure can be altered. On flooded or ponded soils, equipment should be used only during dry periods or during periods when the ground is frozen. Flooding is a problem on Dockery and Zook soils.

Slope can limit the use of forestry equipment. A slope of 15 percent or more limits the use of equipment in logging areas, on skid trails, in yarding areas, and on unsurfaced logging roads. Water erosion is a hazard in

these disturbed areas. Special erosion-control measures, such as water bars or dips, may be needed in these areas. Also, properly designing logging roads and skid trails can minimize the steepness and length of slopes and the concentration of water and thus can reduce the hazard of erosion. The use of equipment is hazardous on steep slopes. Operating the equipment on the contour reduces the hazard. In the steepest areas the logs should be moved uphill to skid trails and yarding areas.

Woodland productivity can be influenced by management activities. Productivity is increased by management that eliminates the factors causing timber stress. Generally, this management includes thinning young stands, harvesting mature trees, preventing fires, and excluding livestock. Fire and grazing have very negative impacts on forest growth and quality. Although forest fires are no longer a major problem in the county, about 30 percent of the woodland is subject to grazing. Grazing destroys the layer of leaves on the surface, compacts the soil, and eliminates or damages tree seedlings (fig. 11). Ungrazed and unburned woodland sites have the highest potential for optimum timber production.

Timbered areas have been extensively cleared in the Armstrong-Adco-Leonard, Purdin-Armstrong, and Gara-Armstrong associations, which are described under the heading "General Soil Map Units." Some areas in these associations remain wooded, primarily on steep side slopes and along narrow drainageways. The most common tree species are white oak, black oak, post oak, shagbark hickory, pin oak, and a small component of black walnut. Wooded areas of the Purdin-Armstrong and Gara-Armstrong associations have been heavily influenced by grazing and poor management, which have allowed low-quality species, such as shingle oak and shagbark hickory, to persist. Where protected, isolated stands of white oak and northern red oak are on north- and east-facing slopes.

The Winnegan-Gorin-Gara association has the largest acreage of upland forest in the county. Typical species are white oak, northern red oak, black oak, mockernut hickory, post oak, ash, and black walnut. Species composition and growth rates vary on different sites. Almost pure stands of vigorous white oak are on some north- and east-facing slopes. Lower quality, more slowly growing species, such as post oak, generally are on south-facing slopes and on ridgetops. The forested Winnegan soils are highly productive.

The Dockery-Vesser-Zook association supports bottom-land hardwoods than can grow on poorly drained and somewhat poorly drained soils. Most areas of the Dockery soils have been cleared of trees and are used for crop production. Typical tree species in areas



Figure 11.—Woodland that has been grazed in an area of Vesser silt loam, occasionally flooded.

that have not been cleared are green ash, pin oak, swamp white oak, sycamore, common hackberry, and river birch. The Zook and Vesser soils may support a high percentage of eastern cottonwood and silver maple. The better drained minor soils in this association support black walnut and shellbark hickory.

Table 7 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for an indicator tree species. The number indicates the volume, in cubic meters per hectare per year, which the indicator species can produce. The number 1 indicates low potential productivity; 2 and 3, moderate; 4 and 5, moderately high; 6 to 8, high; 9 to 11, very high; and 12 to 39, extremely high. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *R* indicates steep slopes; *X*, stoniness or rockiness; *W*, excess water in or on the soil; *T*, toxic substances in the soil; *D*, restricted rooting depth; *C*, clay in the upper part of the soil; *S*, sandy texture; and

F, a high content of rock fragments in the soil. The letter A indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: R, X, W, T, D, C, S, and F.

In table 7, *slight*, *moderate*, and *severe* indicate the degree of the major soil limitations to be considered in management.

Erosion hazard is the probability that damage will occur as a result of site preparation and cutting where the soil is exposed along roads, skid trails, and fire lanes and in log-handling areas. Forests that have been burned or overgrazed also are subject to erosion. Ratings of the erosion hazard are based on the percent of the slope. A rating of *slight* indicates that no particular prevention measures are needed under ordinary conditions. A rating of *moderate* indicates that erosion-control measures are needed in certain silvicultural activities. A rating of *severe* indicates that special precautions are needed to control erosion in most silvicultural activities.

Equipment limitation reflects the characteristics and conditions of the soil that restrict the use of the equipment generally needed in woodland management or harvesting. The chief characteristics and conditions considered in the ratings are slope, stones on the surface, rock outcrops, soil wetness, and texture of the surface layer. A rating of *slight* indicates that under normal conditions the kind of equipment and season of use are not significantly restricted by soil factors. Soil wetness can restrict equipment use, but the wet period does not exceed 1 month. A rating of *moderate* indicates that equipment use is moderately restricted because of one or more soil factors. If the soil is wet, the wetness restricts equipment use for a period of 1 to 3 months. A rating of *severe* indicates that equipment use is severely restricted either as to the kind of equipment that can be used or the season of use. If the soil is wet, the wetness restricts equipment use for more than 3 months.

Seedling mortality refers to the death of naturally occurring or planted tree seedlings, as influenced by the kinds of soil, soil wetness, or topographic conditions. The factors used in rating the soils for seedling mortality are texture of the surface layer, depth to a seasonal high water table and the length of the period when the water table is high, rock fragments in the surface layer, effective rooting depth, and slope aspect. A rating of *slight* indicates that seedling mortality is not likely to be a problem under normal conditions. Expected mortality is less than 25 percent. A rating of *moderate* indicates that some problems from seedling mortality can be expected. Extra precautions are advisable. Expected mortality is 25 to 50 percent. A rating of *severe* indicates that seedling mortality is a serious problem.

Extra precautions are important. Replanting may be necessary. Expected mortality is more than 50 percent.

Windthrow hazard is the likelihood that trees will be uprooted by the wind because the soil is not deep enough for adequate root anchorage. The main restrictions that affect rooting are a seasonal high water table and the depth to bedrock, a fragipan, or other limiting layers. A rating of *slight* indicates that under normal conditions no trees are blown down by the wind. Strong winds may damage trees, but they do not uproot them. A rating of *moderate* indicates that some trees can be blown down during periods when the soil is wet and winds are moderate or strong. A rating of *severe* indicates that many trees can be blown down during these periods.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index* and as a *volume* number. The site index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

The *volume*, a number, is the yield likely to be produced by the most important trees. This number, expressed as cubic feet per acre per year, indicates the amount of fiber produced in a fully stocked, even-aged, unmanaged stand.

The first species listed under *common trees* for a soil is the indicator species for that soil. It generally is the most common species on the soil and is the one that determines the ordination class.

Trees to plant are those that are suitable for commercial wood production.

Windbreaks and Environmental Plantings

Douglas C. Wallace, forester, Natural Resources Conservation Service, helped prepare this section.

Well designed farmstead, feedlot, and field windbreaks are needed throughout Adair County, especially in the prairie areas of the Armstrong-Adco-Leonard and Dockery-Vesser-Zook associations, which are described under the heading "General Soil Map Units." Windbreaks can reduce the amount of energy required to heat a home by 10 to 30 percent and can moderate the effects of cold winter winds, making living conditions more comfortable for humans and animals (22). Animals protected by windbreaks have shown significant weight gains over the winter. Also, research has shown that crop production increases if crops are protected by field windbreaks (11).

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 8 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 8 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Natural Resources Conservation Service, the Missouri Department of Conservation, or the Missouri Cooperative Extension Service or from a commercial nursery.

Recreation

The recreational facilities in Adair County include swimming pools, a golf course, game courts, skating rinks, picnic areas, campgrounds, hunting areas, a shooting preserve, a shooting range, hiking trails, fishing lakes and ponds, and recreation lakes. The demand for recreational facilities in the county is increasing.

The largest public recreational areas in the county are Thousand Hills State Park, which makes up 3,205 acres; Sugar Creek Forest, which makes up 2,609 acres; and Union Ridge Forest, which makes up 2,783 acres. These areas provide opportunities for fishing, boating, camping, hiking, and hunting. Thousand Hills State Park is noted for a petroglyph viewing area. Other public recreational areas are the Big Creek Wildlife Area, which makes up 1,201 acres; the Hazel Creek Lake Area, which makes up 1,300 acres; and Montgomery Woods, which makes up 322 acres. The State also maintains the Henry Truitt fishing access on the Chariton River.

The soils of the survey area are rated in table 9

according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and large stones on the surface. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation also are important. Soils subject to flooding are limited for recreational uses by the duration and intensity of flooding and the season when flooding occurs. In planning recreational facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or a combination of these measures.

The information in table 9 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 12 and interpretations for dwellings without basements and for local roads and streets in table 11.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils are gently sloping and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after

rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

Keith Jackson, biologist, Missouri Department of Conservation, helped prepare this section.

Adair County is one of 21 counties in Missouri that make up the Northeast Riverbreaks Zoogeographic Region (9). Because of a diversity of cover types, this region is one of the richest game areas in the State. As the transition zone between the prairie and the Ozark Border, the region has a variety and profusion of edge growth and thus provides excellent wildlife habitat (fig. 12). The major problems affecting the wildlife resources in the county have been identified as the conversion of woodland to grassland and cropland and the loss of hedgerows and brushy waterways. Also, tillage in fall rather than spring decreases the amount of food available to wildlife.

More than 240 fish and wildlife species have been recorded in Adair County. Another 120 species are thought inhabit the county. Many species migrate through the county in spring and fall. Some species, such as osprey, are rarely observed the county. The most common nongame species are red-winged blackbird, house wren, red-tailed hawk, red-sided garter snake, fathead minnow, western chorus frog, and deer mouse. The most common game species are bobwhite quail, white-tailed deer, eastern wild turkey, fox squirrel, gray squirrel, eastern cottontail rabbit, largemouth bass, channel catfish, bluegill, common snapping turtle, and raccoon.

The species in the county that have been designated as rare or endangered by the Federal government or the State of Missouri are bald eagle, Indian bat, sharp-sided hawk, upland sandpiper, Henslow's sparrow, least weasel, and Great Plains skink. An additional five rare

or endangered species are thought to inhabit the county.

The furbearer population in the county is good. Raccoon, muskrat, opossum, coyote, red fox, beaver, mink, and gray fox are the principal species trapped in the county.

The Armstrong-Adco-Leonard, Gara-Armstrong, Purdin-Armstrong, and Dockery-Vesser-Zook associations, which are described under the heading "General Soil Map Units," provide most of the openland wildlife habitat in the county. The Winnegan-Gorin-Gara association, however, also has some areas of hayland or grassland. Small stands of timber, waterways, hedgerows, fence rows, and other areas providing woody or brushy cover are throughout all of the associations. Such "hard cover" areas provide an important type of habitat that is rapidly disappearing in many parts of the intensively farmed sections of the State. The most common openland species are bobwhite quail, dickcissel, eastern meadowlark, and Franklin's ground squirrel.

The bobwhite quail is one of the county's most popular game species and is heavily hunted. The resident dove population is poor, and fall migratory flights of this bird are minimal. The population of ring-necked pheasant is good in the northern part of the county, and these birds are slowly expanding their range southward.

The Winnegan-Gorin-Gara association includes most of the woodland in the county. Parts of the other associations in the county also are wooded. About 18 percent of the acreage in the county provides some type of woodland wildlife habitat, which includes areas of the smaller brushy plant species (20). The most common woodland wildlife species are turkey, raccoon, short-tailed shrew, tufted titmouse, American toad, downy woodpecker, and white-breasted nuthatch.

A good population of deer has stimulated deer hunting among residents of the county. The turkey population is quite good, and this species is expanding its range. Hunter interest in this game bird is high. The population of squirrel is good, but hunting pressure is light. Woodcock are scarce and have generated little hunter interest because migratory flights of this game species are limited.

Nearly all of the wetland wildlife habitat in the county is in the Dockery-Vesser-Zook association on bottom land. The primary habitat for waterfowl is provided by this association and by the Thousand Hills Lake area, Spring Lake, and the Hazel Creek Lake Area. The reservoirs provide resting areas for Canada geese, snow geese, blue geese, mallard, pintail, scaup, and teal. The population of wood ducks is fair in areas where riparian timber is along the streams in the



Figure 12.—Woodland bordering a freshly tilled field in an area of Dockery and Tice silt loams, occasionally flooded, on bottom land. These fertile soils provide excellent habitat for wildlife.

county. River otters have been stocked by the Missouri Department of Conservation.

Good opportunities for fishing are available on the rivers, streams, lakes, and farm ponds in the county. The most important permanently flowing streams are the Chariton River, the Salt River, and Bear Creek. Anglers fish for channel catfish, carp, drum, bullheads, and sunfish.

The primary areas used for impoundment fishing in the county are Forest Lake, the Hazel Creek Reservoir, and Spring Lake. Forest Lake has 573 surface acres, the Hazel Creek Reservoir has 332 surface acres, and Spring Lake has 100 surface acres. These lakes are fished for largemouth bass, channel catfish, crappie, bluegill, carp, and flathead catfish. Numerous farm ponds and small lakes, most of which are stocked with largemouth bass, channel catfish, and bluegill, add to the total flat-water fishery.

The habitat for wildlife in all of the associations in the county can be improved. The practices that can improve the habitat include applying a system of conservation

tillage and other soil conservation measures on cropland, preserving the existing hedgerows and woody draws, planting windbreaks, increasing the extent of legumes and native prairie grasses grown for forage, excluding livestock from wooded areas, and establishing grass-legume mixtures or trees on marginal cropland.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 10, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that

are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flooding. Soil temperature and soil moisture also are considerations. Examples of grain and seed crops are corn, winter wheat, oats, millet, soybeans, and grain sorghum.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flooding, and slope. Soil temperature and soil moisture also are considerations. Examples of grasses and legumes are bluegrass, tall fescue, switchgrass, orchardgrass, bluestem, indiagrass, clover, alfalfa, trefoil, and crownvetch.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggartick, pokeweed, foxtail, croton, and partridge pea.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of

hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, cherry, apple, dogwood, hickory, blackberry, sumac, persimmon, Osage-orange, and eastern redcedar. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are crabapple, wild plum, hawthorn, and hazelnut.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, cedar, and juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, cutgrass, buttonbush, cattail, rushes, and sedges.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. Wildlife attracted to these areas include bobwhite quail, meadowlark, field sparrow, cottontail, red fox, woodchuck, and mourning dove.

Habitat for woodland wildlife consists of areas of woody deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, ruffed grouse, woodchuck, thrushes, woodpeckers, squirrels, gray fox, raccoon, and deer.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, herons, muskrat, mink, and beaver.

Engineering

This section provides information for planning land uses related to urban development and to water

management. Soils are rated for various uses, and the most limiting features are identified. Ratings are given for building site development, sanitary facilities, construction materials, and water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the

performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 11 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock or a very firm, dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrinking and swelling, and organic layers can cause the movement of footings. A high water table, depth to bedrock, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading

that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, potential for frost action, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 12 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 12 also shows the suitability of the soils for use as daily cover for landfill. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock, and flooding affect absorption of the effluent. Large stones and bedrock interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 12 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope and bedrock can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in

successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. Ease of excavation and revegetation should be considered.

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, soil reaction, and content of salts and sodium affect trench landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, rock fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to wind erosion.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock or the water table to permit revegetation. The soil material used as the final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 13 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good*, *fair*, or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet and have a water table at a depth of less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and *gravel* are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. In table 13, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is as much as 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight,

large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal high water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 14 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability in the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock or to other layers that affect the rate of water movement, permeability, depth to a high water table or depth of standing water if the soil is subject to ponding, slope, susceptibility to flooding, subsidence of organic layers, and the potential for frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or toxic substances in the root zone, such as salts, sodium, and sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock. The performance of a system is

affected by the depth of the root zone and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to help control water erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind erosion or water erosion, an excessively coarse texture, and restricted permeability

adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help to characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 15 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under the heading "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 13). "Loam," for example, is soil that is

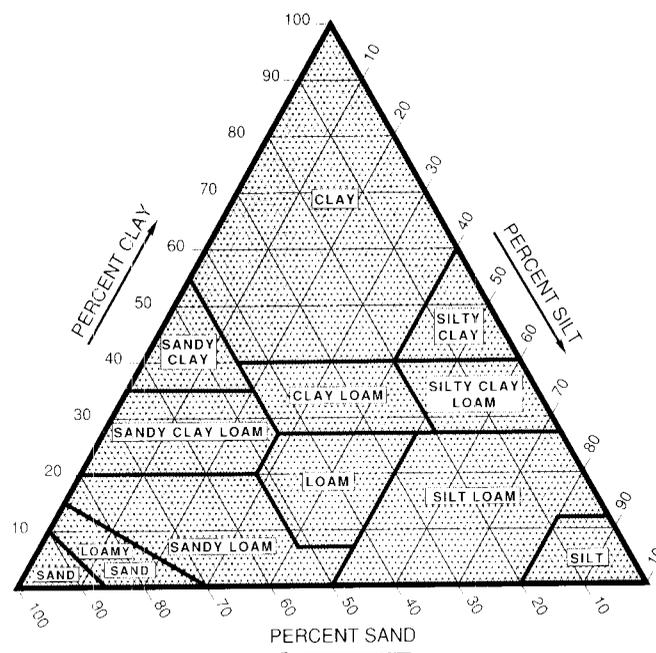


Figure 13.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (2) and the system adopted by the American Association of State Highway and Transportation Officials (1).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and

highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and plasticity index (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 16 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil

particles that are less than 0.002 millimeter in diameter. In this table, the estimated content of clay in each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (oven-dry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at $\frac{1}{3}$ -bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems and septic tank absorption fields.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for

fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion. Soils are grouped according to the following distinctions:

1. Coarse sands, sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Coarse sandy loams, sandy loams, fine sandy

loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

- 4L. Calcareous loams, silt loams, clay loams, and silty clay loams. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils are very slightly erodible. Crops can be grown if ordinary measures to control wind erosion are used.

7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils are very slightly erodible. Crops can be grown if ordinary measures to control wind erosion are used.

8. Soils that are not subject to wind erosion because of rock fragments on the surface or because of surface wetness.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 16, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 17 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the infiltration of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained

sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to two hydrologic groups in table 17, the first letter is for drained areas and the second is for undrained areas.

Flooding, the temporary inundation of an area, is caused by overflowing streams or by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 17 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions (the chance of flooding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year); and *frequent* that it occurs often under normal weather conditions (the chance of flooding is more than 50 percent in any year). Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, *long* if 7 days to 1 month, and *very long* if more than 1 month. Probable dates are expressed in months. About two-thirds to three-fourths of all flooding occurs during the stated period.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

Also considered are local information about the extent and levels of flooding and the relation of each

soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 are depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 17. Only saturated zones within a depth of about 6 feet are indicated.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

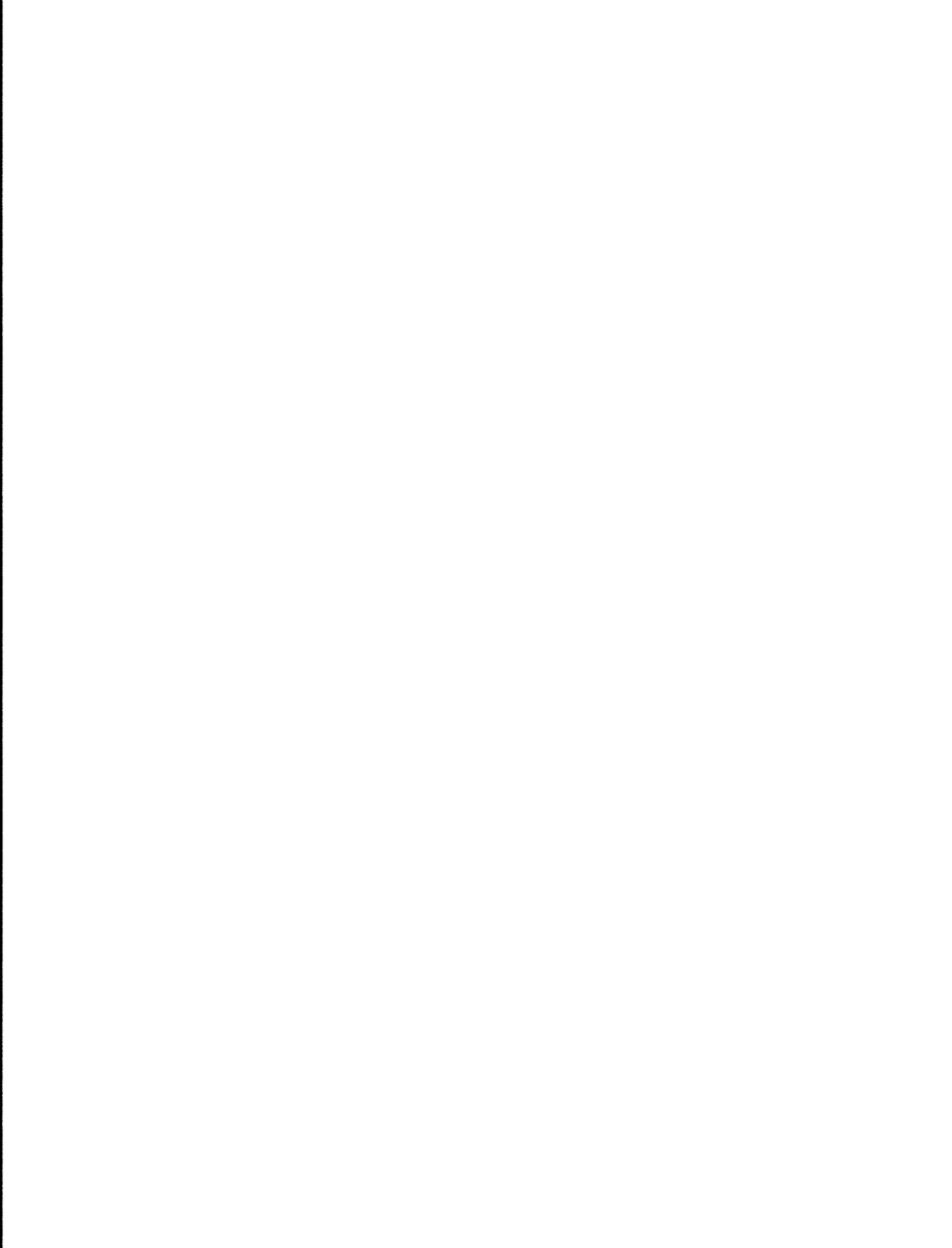
Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be

needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed

as *low, moderate, or high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion also is expressed as *low, moderate, or high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.



Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (17). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 18 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Eleven soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Alfisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Udalf (*Ud*, meaning humid, plus *alf*, from Alfisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Hapludalfs (*Hapl*, meaning minimal horizonation, plus *udalf*, the suborder of the Alfisols that has a udic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. An example is Oxyaquic Hapludalfs.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and

other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine, mixed, mesic Oxyaquic Hapludalfs.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual" (19). Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" (17). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Adco Series

The Adco series consists of very deep, somewhat poorly drained, very slowly permeable soils on uplands. These soils formed in loess or in loess and the underlying loamy sediments. Slopes range from 1 to 3 percent.

Typical pedon of Adco silt loam, 1 to 3 percent slopes, 60 feet south and 175 feet east of the northwest corner of sec. 35, T. 61 N., R. 14 W.

- Ap—0 to 6 inches; very dark gray (10YR 3/1) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; many fine roots; neutral; clear smooth boundary.
- E—6 to 13 inches; grayish brown (10YR 5/2) silt loam, pale brown (10YR 6/3) dry; weak medium platy structure parting to weak very fine subangular blocky; friable; many fine roots; moderately acid; clear smooth boundary.
- Bt1—13 to 18 inches; dark grayish brown (10YR 4/2) silty clay; common fine prominent red (2.5YR 4/6) and few fine prominent strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; firm; common fine roots; common distinct clay films on faces of peds; moderately acid; clear smooth boundary.
- Bt2—18 to 25 inches; brown (10YR 4/3) silty clay; few fine prominent strong brown (7.5YR 5/6) mottles; moderate medium angular blocky structure; firm; common fine roots; common distinct clay films on faces of peds; moderately acid; clear smooth boundary.
- Btg1—25 to 45 inches; grayish brown (10YR 5/2) silty clay; common medium prominent strong brown (7.5YR 5/8) mottles; weak medium subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; moderately acid; gradual smooth boundary.
- Btg2—45 to 50 inches; light brownish gray (10YR 6/2) silty clay loam; few medium prominent strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; firm; few distinct clay films on faces of peds; neutral; clear smooth boundary.
- 2BCg—50 to 58 inches; mottled light brownish gray (10YR 6/2) and strong brown (7.5YR 5/6) silty clay loam; weak fine subangular blocky structure; firm; common fine sand grains; neutral; clear smooth boundary.
- 2Cg—58 to 60 inches; mottled light brownish gray (10YR 6/2) and strong brown (7.5YR 5/6) silty clay loam; massive; firm; common sand grains; neutral.

Depth to the 2BC horizon or to a marked increase in content of sand is 40 to more than 60 inches. The Ap horizon has chroma of 1 or 2. The E horizon has value of 4 or 5 and chroma of 2 or 3. It is silt loam or silty clay loam. Some pedons have a BE horizon. This horizon has value of 4 or 5 and chroma of 2 or 3. It is silt loam or silty clay loam. The Bt horizon has value of 4 to 6 and chroma of 1 to 3. It is silty clay or silty clay

loam. The Btg horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2. The 2BCg horizon has hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 1 to 8. It is silty clay loam or silt loam.

Arbela Series

The Arbela series consists of very deep, poorly drained, moderately slowly permeable soils on high flood plains. These soils formed in alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Arbela silty clay loam, occasionally flooded, 1,400 feet east and 190 feet north of the southwest corner of sec. 9, T. 61 N., R. 13 W.

- Ap—0 to 10 inches; very dark gray (10YR 3/1) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate medium subangular blocky structure; friable; common medium roots; common prominent dark reddish brown (2.5YR 3/4) stains; slightly acid; abrupt smooth boundary.
- E—10 to 20 inches; gray (10YR 5/1) silty clay loam, light gray (10YR 7/1) dry; weak medium subangular blocky structure; friable; common fine roots; common distinct dark yellowish brown (10YR 4/4) stains; moderately acid; clear smooth boundary.
- Btg1—20 to 30 inches; grayish brown (10YR 5/2) silty clay; common fine prominent strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; few fine roots; many gray (10YR 5/1) silt coatings on faces of peds; common distinct clay films on faces of peds; very strongly acid; gradual smooth boundary.
- Btg2—30 to 45 inches; dark grayish brown (10YR 4/2) silty clay loam; common medium prominent strong brown (7.5YR 4/6) mottles; moderate medium subangular blocky structure; firm; common distinct clay films on faces of peds; very strongly acid; gradual smooth boundary.
- Btg3—45 to 54 inches; dark grayish brown (10YR 4/2) silty clay; common fine prominent strong brown (7.5YR 4/6) mottles; weak medium subangular blocky structure; firm; light brownish gray (10YR 6/2) silt coatings on faces of peds; common distinct clay films on faces of peds; common prominent black (N 2/0) stains; strongly acid; gradual smooth boundary.
- BCg—54 to 60 inches; grayish brown (10YR 5/2) silty clay loam; common medium prominent strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; firm; common prominent black (N 2/0) stains; moderately acid.

The A, E, and Btg horizons have chroma of 1 or 2. The E horizon has value of 4 or 5.

Armstrong Series

The Armstrong series consists of very deep, somewhat poorly drained, slowly permeable soils on uplands. These soils formed in a paleosol that weathered from glacial till. Slopes range from 5 to 14 percent.

Typical pedon of Armstrong loam, 5 to 9 percent slopes, eroded, 50 feet east and 1,700 feet south of the northwest corner of sec. 23, T. 64 N., R. 15 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; many fine roots; slightly acid; clear smooth boundary.

2Bt1—6 to 11 inches; brown (7.5YR 4/4) clay; common fine prominent red (2.5YR 4/6) mottles; weak fine subangular blocky structure; firm; many fine roots; few distinct clay films on faces of peds; about 1 percent fine gravel; strongly acid; clear smooth boundary.

2Bt2—11 to 16 inches; yellowish brown (10YR 5/4) clay; common fine distinct grayish brown (10YR 5/2) and common medium prominent red (2.5YR 4/6) mottles; weak medium angular blocky structure; firm; many fine roots; common distinct clay films on faces of peds; about 1 percent fine gravel; strongly acid; clear smooth boundary.

2Bt3—16 to 27 inches; dark yellowish brown (10YR 4/4) clay loam; common fine prominent red (2.5YR 4/6), common fine distinct light brownish gray (10YR 6/2), and common fine prominent strong brown (7.5YR 5/6) mottles; moderate medium angular blocky structure; very firm; common fine roots; common distinct clay films on faces of peds; common prominent black stains of iron and manganese oxide; about 1 percent fine gravel; moderately acid; gradual smooth boundary.

2Bt4—27 to 47 inches; yellowish brown (10YR 5/6) clay loam; common medium prominent gray (10YR 6/1) and common medium distinct dark yellowish brown (10YR 4/4) mottles; weak medium subangular blocky structure; very firm; few fine roots; common distinct clay films on faces of peds; common prominent stains of iron and manganese oxide; about 1 percent fine gravel; slightly acid; gradual smooth boundary.

2BC—47 to 60 inches; dark yellowish brown (10YR 4/4) clay loam; common fine distinct gray (10YR 6/1) and yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; common prominent black stains of iron and manganese oxide; about 1 percent fine gravel; neutral.

The depth to carbonates ranges from 42 to more

than 60 inches. The content of rock fragments is 1 to 4 percent in the B horizon.

The Ap horizon has chroma of 1 or 2. It is loam or clay loam. Some pedons have an E horizon. This horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is loam or silt loam. The Bt and 2Bt horizons have hue of 5YR to 10YR, value of 4 or 5, and chroma of 2 to 6. The 2BC horizon has hue of 10YR or 2.5Y and chroma of 3 to 6. Some pedons have a 2C horizon, which has hue of 2.5Y or 10YR, value of 4 to 6, and chroma of 3 to 6.

Bevier Series

The Bevier series consists of very deep, somewhat poorly drained, slowly permeable soils on uplands. These soils formed in loess and in the underlying loamy sediments and a paleosol that weathered from glacial till. Slopes range from 3 to 8 percent.

Typical pedon of Bevier silty clay loam, 3 to 8 percent slopes, 725 feet south and 3,000 feet east of the northwest corner of sec. 30, T. 63 N., R. 17 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; weak fine granular structure; friable; many very fine roots; neutral; abrupt smooth boundary.

BE—7 to 10 inches; dark grayish brown (10YR 4/2) silty clay loam; few fine distinct yellowish brown (10YR 5/6) mottles; weak fine granular structure; friable; many very fine roots; moderately acid; abrupt smooth boundary.

Bt1—10 to 17 inches; dark grayish brown (10YR 4/2) silty clay; common fine distinct yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; firm; few very fine roots; common distinct clay films on faces of peds; moderately acid; clear smooth boundary.

Bt2—17 to 22 inches; brown (10YR 5/3) silty clay; few fine prominent yellowish brown (10YR 5/8) and common fine distinct dark yellowish brown (10YR 3/6) mottles; weak fine and very fine subangular blocky structure; firm; common very fine roots; many very fine pores; common distinct clay films on faces of peds; slightly acid; abrupt smooth boundary.

Btg1—22 to 30 inches; grayish brown (10YR 5/2) silty clay loam; many fine prominent brown (7.5YR 5/4) mottles; weak fine subangular blocky structure; firm; common very fine roots; many very fine pores; few distinct clay films on faces of peds; slightly acid; abrupt smooth boundary.

2BCg—30 to 37 inches; light brownish gray (10YR 6/2) and yellowish brown (10YR 5/4) loam; common fine prominent yellowish brown (10YR 5/6) mottles;

weak coarse prismatic structure; friable; few very fine roots; about 30 percent sand; neutral; abrupt smooth boundary.

3Btgb1—37 to 46 inches; yellowish brown (10YR 5/4) and gray (10YR 5/1) clay loam; common fine prominent yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to weak very fine angular blocky; firm; very few very fine roots; common prominent clay films on faces of peds; about 1 percent fine gravel; about 27 percent sand; neutral; clear smooth boundary.

3Btgb2—46 to 60 inches; mottled yellowish brown (10YR 5/6 and 5/4), brown (7.5YR 5/2), gray (10YR 6/1), and dark yellowish brown (10YR 4/4) clay loam; moderate very fine angular blocky structure; firm; many prominent clay films on faces of peds; few fine accumulations of iron and manganese oxide; about 1 percent fine gravel; about 27 percent sand; neutral.

Depth to the 2BC horizon is 20 to 48 inches. The Ap horizon has chroma of 1 or 2. The BE horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 or 3. Some pedons have an E horizon, which has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2. The Bt horizon has value of 4 to 6 and chroma of 2 to 4. The Btg horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 4. The 2BCg and 3Btgb horizons have hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 1 to 6. They are silt loam, loam, clay loam, or silty clay loam. Some pedons have a 2Cg horizon.

Chariton Series

The Chariton series consists of very deep, poorly drained, slowly permeable soils on high stream terraces. These soils formed in loess and in the underlying alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Chariton silt loam, 100 feet south and 4,980 feet east of the northwest corner of sec. 16, T. 61 N., R. 13 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; many fine roots; neutral; clear smooth boundary.

E—9 to 16 inches; grayish brown (10YR 5/2) silt loam, gray (10YR 6/1) dry; weak medium platy structure parting to weak fine subangular blocky; friable; common fine roots; many very fine pores; common prominent strong brown (7.5YR 4/6) stains; moderately acid; clear smooth boundary.

Btg1—16 to 26 inches; grayish brown (10YR 5/2) silty clay; common medium prominent dark yellowish brown (10YR 4/6) mottles; weak fine subangular

blocky structure; firm; few fine roots; few very fine pores; common distinct clay films on faces of peds; moderately acid; clear smooth boundary.

Btg2—26 to 37 inches; grayish brown (2.5Y 5/2) silty clay; common medium and coarse prominent dark yellowish brown (10YR 4/6) mottles; weak fine angular blocky structure; firm; few fine roots; common prominent clay films on faces of peds; slightly acid; gradual smooth boundary.

Btg3—37 to 48 inches; grayish brown (2.5Y 5/2) silty clay loam; common coarse prominent dark yellowish brown (10YR 4/6) mottles; moderate fine subangular blocky structure; firm; few very fine pores; common distinct clay films on faces of peds; common prominent black accumulations of iron and manganese oxide; slightly acid; clear smooth boundary.

2Cg1—48 to 56 inches; mottled grayish brown (2.5Y 5/2), strong brown (7.5YR 5/8), and dark gray (10YR 4/1) clay loam; massive; firm; common very fine pores; neutral; clear smooth boundary.

2Cg2—56 to 60 inches; mottled dark gray (10YR 4/1) and strong brown (7.5YR 4/6) loam; massive; firm; neutral.

The content of clay is 48 to 60 percent in the particle-size control section. The Ap horizon has value of 2 or 3 and chroma of 1 or 2. Some pedons have a BE horizon. The E and BE horizons have value of 4 or 5 and chroma of 1 or 2. The upper part of the Btg horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. The lower part has hue of 10YR to 5Y, value of 4 or 5, and chroma of 1 or 2. The 2Cg horizon has hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 1 to 8. It is loam, fine sandy loam, sandy clay loam, or clay loam.

Dockery Series

The Dockery series consists of very deep, somewhat poorly drained, moderately permeable soils on flood plains. These soils formed in alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Dockery silt loam, in an area of Dockery and Tice silt loams, occasionally flooded, 5,180 feet south and 3,280 feet east of the northwest corner of sec. 9, T. 61 N., R. 13 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; moderate fine granular structure; friable; common fine roots; slightly acid; abrupt smooth boundary.

C1—8 to 17 inches; brown (10YR 5/3) silt loam; few fine faint light brownish gray (10YR 6/2) strata; massive; friable; few fine roots; common very fine

pores; moderately acid; clear smooth boundary.

C2—17 to 55 inches; alternating layers of brown (10YR 5/3), light brownish gray (10YR 6/2), and brown (10YR 4/3) silt loam; massive; friable; common very fine pores; moderately acid; clear smooth boundary.

C3—55 to 60 inches; alternating layers of brown (10YR 5/3), light brownish gray (10YR 6/2), and brown (10YR 4/3) loam; massive; common very fine pores; friable; moderately acid.

The Ap horizon has value of 3 or 4 and chroma of 2 or 3. The C horizon has value of 3 to 6 and chroma of 2 or 3. It is loam, silt loam, or silty clay loam.

Excello Series

The Excello series consists of very deep, somewhat poorly drained, moderately permeable soils on flood plains. These soils formed in alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Excello loam, in an area of Vigar-Zook-Excello complex, 0 to 5 percent slopes, 2,550 feet east and 2,950 feet south of the northwest corner of sec. 8, T. 61 N., R. 17 W.

Ap—0 to 5 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure parting to moderate fine granular; friable; many very fine and common fine roots; neutral; gradual smooth boundary.

A—5 to 10 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak very fine subangular blocky structure; friable; common very fine roots; many very fine pores; common clean yellowish brown (10YR 5/4) sand grains; neutral; clear smooth boundary.

Bg1—10 to 13 inches; very dark gray (10YR 3/1) loam that has thin bands of dark grayish brown (10YR 4/2) sandy loam, dark gray (10YR 4/1) with bands of grayish brown (10YR 5/2) dry; weak coarse prismatic structure parting to moderate fine angular blocky; friable; common very fine roots; common very fine pores; neutral; clear smooth boundary.

Bg2—13 to 26 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) and grayish brown (10YR 5/2) dry; weak coarse prismatic structure parting to weak very fine angular blocky; friable; few very fine roots; common very fine pores; thin strata of black (10YR 2/1) and yellowish brown (10YR 5/4) loamy sand; neutral; clear smooth boundary.

Bg3—26 to 47 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) and grayish brown (10YR 5/2) dry; common fine distinct dark yellowish brown (10YR 4/4) mottles; few medium prominent strong brown (7.5YR 4/6) mottles in bands of loamy sand; weak

coarse prismatic structure parting to weak very fine angular blocky; friable; few very fine roots; common very fine pores; brown (10YR 5/3) sand grains in bands; neutral; gradual smooth boundary.

Cg1—47 to 57 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; common fine distinct dark yellowish brown (10YR 4/4) and few fine prominent yellowish brown (10YR 5/6) mottles; massive; friable; few very fine roots; common very fine pores; neutral; clear smooth boundary.

Cg2—57 to 60 inches; gray (10YR 5/1) loam; many fine prominent yellowish red (5YR 5/8) mottles along old root channels; massive; friable; few very fine and few fine roots; common very fine pores; neutral.

Some pedons have a BA horizon. The Ap and BA horizons have hue of 10YR or are neutral in hue. They have value of 2 or 3 and chroma of 1 or less. The Bg horizon has hue of 10YR or is neutral in hue. It has value of 2 to 4 and chroma of 1 or less. It is loam, clay loam, sandy clay loam, or silty clay loam. The Cg horizon has hue of 10YR or is neutral in hue. It has value of 3 to 5 and chroma of 1 or less. It is loam, clay loam, or sandy clay loam.

Floris Series

The Floris series consists of very deep, moderately well drained, moderately permeable soils on flood plains. These soils formed in alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Floris loam, frequently flooded, 3,250 feet east and 1,150 feet south of the northwest corner of sec. 18, T. 61 N., R. 15 W.

Ap—0 to 5 inches; dark grayish brown (10YR 4/2) loam, pale brown (10YR 6/3) dry; weak fine granular structure; friable; many very fine roots; neutral; clear smooth boundary.

C1—5 to 12 inches; brown (10YR 4/3) loam; few fine prominent brown (7.5YR 4/4) and few fine prominent strong brown (7.5YR 4/6) mottles; moderate medium platy structure parting to weak very fine angular blocky; friable; common very fine roots; few very fine pores; neutral; clear smooth boundary.

C2—12 to 24 inches; brown (10YR 4/3) fine sandy loam; few fine prominent red (2.5YR 5/6) stains along root channels; appears massive but has weak bedding planes; friable; common very fine roots; few very fine pores; neutral; gradual smooth boundary.

2C3—24 to 34 inches; dark brown (10YR 4/3) and brown (10YR 5/3) loam; appears massive but has weak bedding planes; friable; common very fine

roots; many very fine pores; neutral; gradual smooth boundary.

2C4—34 to 45 inches; light olive brown (2.5Y 5/4) loam; few fine strong brown (7.5YR 5/6) stains; appears massive but has weak bedding planes; friable; common very fine roots; many very fine and few fine pores; neutral; abrupt smooth boundary.

2C5—45 to 60 inches; dark grayish brown (2/5Y 4/2) and dark yellowish brown (10YR 4/4) silt loam that has strata of loamy fine sand; common medium prominent reddish yellow (7.5YR 6/8) and common medium prominent grayish brown (2.5Y 5/2) mottles; appears massive but has weak bedding planes in the silt loam; single grain in the loamy fine sand; friable and loose; few very fine roots; common very fine pores; neutral.

The Ap horizon has value of 3 or 4 and chroma of 2 to 4. It is loam or silt loam. The C horizon has value of 3 to 5.

Floris silt loam, occasionally flooded, is a taxadjunct because it has more sand than is definitive for the series. This difference does not significantly affect the use and management of the soil. The soil is classified as a coarse-silty, mixed, nonacid, mesic Typic Udifluent.

Gara Series

The Gara series consists of very deep, moderately well drained, moderately slowly permeable soils on uplands. These soils formed in glacial till. Slopes range from 9 to 35 percent.

Typical pedon of Gara fine sandy loam, 14 to 20 percent slopes, eroded, 5,080 feet east and 475 feet south of the northwest corner of sec. 27, T. 64 N., R. 15 W.

Ap—0 to 5 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; many fine roots; about 5 percent dark yellowish brown (10YR 4/4) subsoil material; about 1 percent fine gravel; neutral; clear smooth boundary.

Bt1—5 to 16 inches; dark yellowish brown (10YR 4/4) clay loam; weak fine subangular blocky structure; friable; common fine roots; few distinct clay films on faces of peds; about 1 percent fine gravel; moderately acid; gradual smooth boundary.

Bt2—16 to 30 inches; dark yellowish brown (10YR 4/4) clay loam; few fine distinct yellowish brown (10YR 5/6) mottles; strong medium subangular blocky structure; firm; common fine roots; common distinct clay films on faces of peds; common prominent black stains of iron and manganese oxide; about 1

percent fine gravel; slightly acid; clear smooth boundary.

Bt3—30 to 36 inches; yellowish brown (10YR 5/6) loam; common medium prominent light gray (10YR 7/2) and common medium distinct dark yellowish brown (10YR 4/4) mottles; strong medium subangular blocky structure; firm; common prominent clay films on faces of peds; common prominent black stains of iron and manganese oxide; about 1 percent fine gravel; neutral; clear smooth boundary.

Bk—36 to 60 inches; mottled yellowish brown (10YR 5/6), dark yellowish brown (10YR 4/4), and light gray (10YR 7/2) loam; moderate medium prismatic structure parting to moderate medium angular blocky; firm; common masses of calcium carbonate; about 1 percent fine gravel; violent effervescence; moderately alkaline.

The content of rock fragments is 1 to 5 percent throughout the profile. The Ap horizon has chroma of 1 or 2. It is fine sandy loam or loam. The Bt horizon has hue of 10YR or 7.5YR and chroma of 3 to 6. The Bk horizon is loam or clay loam.

Gifford Series

The Gifford series consists of very deep, poorly drained, very slowly permeable soils on high stream terraces. These soils formed in loess and in the underlying alluvium. Slopes range from 2 to 9 percent.

Typical pedon of Gifford silty clay loam, 2 to 5 percent slopes, 675 feet east and 2,000 feet south of the northwest corner of sec. 28, T. 61 N., R. 16 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak very fine subangular blocky structure; friable; common fine and common very fine roots; common very fine pores; neutral; clear smooth boundary.

BE—8 to 11 inches; dark grayish brown (10YR 4/2) silty clay loam, gray (10YR 5/1 and 6/1) dry; common fine prominent yellowish brown (10YR 5/4) and common fine prominent olive yellow (2.5Y 6/6) mottles; weak very fine subangular blocky structure; friable; common very fine roots; few fine pores; common very dark brown organic coatings on faces of peds; slightly acid; abrupt smooth boundary.

Btg1—11 to 19 inches; dark grayish brown (10YR 4/2) silty clay; many fine prominent yellowish brown (10YR 5/6) mottles; weak very fine angular blocky structure; firm; few very fine roots; few pressure faces; few fine accumulations of iron and manganese oxide; many prominent clay films on faces of peds; slightly acid; gradual smooth boundary.

- Btg2—19 to 31 inches; gray (10YR 5/1) silty clay loam; many medium prominent yellowish brown (10YR 5/6) and few fine distinct dark yellowish brown (10YR 4/4) mottles; moderate medium prismatic structure parting to moderate fine angular blocky; firm; few very fine roots; common very fine tubular pores; few pressure faces; common distinct clay films on faces of peds; few coarse and medium accumulations of iron and manganese oxide; slightly acid; gradual smooth boundary.
- 2Btg3—31 to 43 inches; grayish brown (10YR 5/2) silty clay loam; common fine prominent light olive brown (2.5Y 5/4) and few medium distinct dark yellowish brown (10YR 4/4) mottles; moderate medium prismatic structure parting to moderate fine and medium angular blocky; firm; few very fine roots; many very fine tubular pores; many prominent clay films on faces of peds; few medium accumulations of iron and manganese oxide; about 17 percent sand; slightly acid; clear smooth boundary.
- 2Btg4—43 to 50 inches; grayish brown (2.5Y 5/2) silty clay loam; few fine prominent light olive brown (2.5Y 5/6) mottles; weak medium prismatic structure parting to moderate medium angular blocky; firm; few very fine roots; many very fine tubular pores; common distinct clay films in pores; few fine accumulations of iron and manganese oxide; about 7 percent sand; slightly acid; clear smooth boundary.
- 2BCg—50 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam; common fine prominent strong brown (7.5YR 4/6) and few fine prominent dark yellowish brown (10YR 4/6) mottles; weak medium prismatic structure parting to moderate medium and coarse angular blocky; firm; few very fine roots; many very fine tubular pores; few fine accumulations of iron and manganese oxide; common medium stains of iron and manganese oxide; about 20 percent sand; slightly acid.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. The Btg horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. It is silty clay or silty clay loam. The 2Btg horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2.

Gorin Series

The Gorin series consists of very deep, somewhat poorly drained, very slowly permeable soils on uplands. These soils formed in loess and in the underlying loamy sediments and a paleosol that weathered from glacial till. Slopes range from 5 to 9 percent.

Typical pedon of Gorin silt loam, in an area of Gorin-Winnegan complex, 5 to 14 percent slopes, eroded,

2,550 feet east and 1,600 feet south of the northwest corner of sec. 32, T. 64 N., R. 15 W.

- Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, pale brown (10YR 6/3) dry; weak fine granular structure; very friable; many fine roots; slightly acid; clear smooth boundary.
- Bt1—6 to 13 inches; dark yellowish brown (10YR 4/4) silty clay loam; dark grayish brown (10YR 4/2) material commonly in cracks and channels; moderate fine subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; moderately acid; gradual smooth boundary.
- Bt2—13 to 22 inches; brown (10YR 5/3) silty clay; common medium faint grayish brown (10YR 5/2) and common medium prominent strong brown (7.5YR 5/6) mottles; moderate medium angular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; moderately acid; clear smooth boundary.
- Bt3—22 to 33 inches; yellowish brown (10YR 5/4) silty clay loam; common medium prominent strong brown (7.5YR 5/6) and common fine distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; very firm; few fine roots; common distinct clay films on faces of peds; moderately acid; clear smooth boundary.
- 2Bt4—33 to 49 inches; brown (10YR 4/3) and grayish brown (10YR 5/2) silt loam; weak medium subangular blocky structure; firm; many very fine tubular pores; common distinct clay films on faces of peds; common prominent strong brown (7.5YR 5/8) stains around concretions; few fine concretions of iron and manganese oxide; about 15 percent sand; moderately acid; gradual smooth boundary.
- 3Btb—49 to 60 inches; yellowish brown (10YR 5/4) clay loam; few medium distinct light brownish gray (10YR 6/2) mottles; weak medium subangular blocky structure; firm; many very fine pores; common distinct clay films on faces of peds; few fine concretions of iron and manganese oxide; less than 1 percent fine gravel; moderately acid.

The Ap horizon has value of 3 or 4 and chroma of 1 or 2. Some pedons have an E horizon, which has hue of 10YR, value of 4 or 5, and chroma of 1 to 3. Some pedons have a BE horizon. The upper part of the Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. The lower part has hue of 7.5YR to 2.5Y, value of 4 or 5, and chroma of 2 to 6. The 2Bt and 3Bt horizons have hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 to 6. The 2Bt horizon is clay loam, silty clay loam, or silt loam. The 3Bt horizon is clay or clay loam.

Leonard Series

The Leonard series consists of very deep, poorly drained, slowly permeable soils on uplands. These soils formed in loess and in an underlying paleosol that weathered from glacial till. Slopes range from 2 to 6 percent.

Typical pedon of Leonard silty clay loam, 2 to 6 percent slopes, eroded, 350 feet east and 1,500 feet south of the northwest corner of sec. 34, T. 64 N., R. 15 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; few very fine roots; common very fine pores; slightly acid; clear smooth boundary.

Btg1—6 to 14 inches; gray (10YR 5/1) silty clay; common medium prominent strong brown (7.5YR 5/8) mottles; moderate fine subangular blocky structure; firm; few very fine roots; common very fine pores; common distinct clay films on faces of peds; moderately acid; clear smooth boundary.

Btg2—14 to 24 inches; dark grayish brown (2.5Y 4/2) silty clay; common fine prominent strong brown (7.5YR 5/8) and few fine prominent yellowish red (5YR 4/6) mottles; weak fine subangular blocky structure; firm; few very fine roots; many very fine pores; common distinct clay films on faces of peds; moderately acid; clear smooth boundary.

2Btg3—24 to 33 inches; grayish brown (2.5Y 5/2) silty clay loam; common fine prominent yellowish red (5YR 4/6) mottles; weak fine angular blocky structure; firm; few very fine roots; common very fine pores; many distinct clay films on faces of peds; about 15 percent sand; moderately acid; gradual smooth boundary.

2Btg4—33 to 42 inches; grayish brown (2.5Y 5/2) silty clay loam; few fine prominent strong brown (7.5YR 5/6) and few fine prominent yellowish red (5YR 4/6) mottles; strong very fine and fine angular blocky structure; firm; few very fine roots; few fine and many very fine pores; many distinct clay films on faces of peds; few fine concretions of iron and manganese oxide; about 12 percent sand; moderately acid; gradual smooth boundary.

2Btg5—42 to 52 inches; gray (5Y 5/1) silty clay loam; few medium prominent yellowish red (5YR 4/6) mottles; strong fine angular blocky structure; firm; few very fine roots; few fine and common very fine pores; many distinct clay films on faces of peds; few fine accumulations of iron and manganese oxide; about 12 percent sand; moderately acid; clear smooth boundary.

2Btg6—52 to 60 inches; gray (5Y 5/1) silty clay; common medium prominent yellowish red (5YR 4/6) mottles; moderate fine angular blocky structure; firm; many distinct clay films on faces of peds; about 12 percent sand; neutral.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. The upper part of the Btg horizon has hue of 10YR, value of 4 or 5, and chroma of 1 or 2. It is silty clay loam or silty clay. The lower part of the Btg horizon and the upper part of the 2Btg horizon have hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2. They are silty clay loam, silty clay, or clay. The lower part of the 2Btg horizon has hue of 10YR to 5Y, value of 5 or 6, and chroma of 1 or 2. It is silty clay, silty clay loam, or clay loam.

Plainfield Series

The Plainfield series consists of very deep, excessively drained, rapidly permeable soils on stream terraces and uplands. These soils formed in sandy glacial outwash. Slopes range from 2 to 40 percent.

Typical pedon of Plainfield loamy sand, 20 to 40 percent slopes, 5,000 feet east and 700 feet south of the northwest corner of sec. 4, T. 62 N., R. 16 W.

A—0 to 2 inches; very dark grayish brown (10YR 3/2) loamy sand, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; many very fine, many fine, and many medium roots; slightly acid; clear wavy boundary.

Bw1—2 to 6 inches; dark yellowish brown (10YR 4/4) sand; weak fine and medium granular structure; very friable; many very fine, many fine, and many medium roots; slightly acid; abrupt wavy boundary.

Bw2—6 to 28 inches; dark yellowish brown (10YR 4/4) sand; weak medium granular structure; very friable; common very fine and common fine roots; slightly acid; clear smooth boundary.

BC—28 to 45 inches; yellowish brown (10YR 5/6) sand; single grain; loose; common fine and common medium roots; slightly acid; gradual smooth boundary.

C—45 to 60 inches; yellowish brown (10YR 5/8 and 5/6) sand; single grain; loose; few fine and few medium roots; slightly acid.

Some pedons have an Ap horizon, which has hue of 10YR, value of 3 or 4, and chroma of 1 or 2. The Bw horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 3 to 6. The C horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 4 to 8. It is sand or loamy sand.

Plainfield loamy sand, 2 to 9 percent slopes, is a

taxadjunct because it has a mollic epipedon, which is not definitive for the series. This difference does not significantly affect the use and management of the soil. The soil is classified as a sandy, mixed, mesic Entic Hapludoll.

Purdin Series

The Purdin series consists of very deep, moderately well drained, slowly permeable soils on uplands. These soils formed in glacial till. Slopes range from 14 to 35 percent.

Typical pedon of Purdin clay loam, 14 to 20 percent slopes, eroded, 2,400 feet east and 800 feet south of the northwest corner of sec. 21, T. 61 N., R. 17 W.

- Ap—0 to 6 inches; very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) clay loam, dark gray (10YR 4/1) and dark grayish brown (10YR 4/2) dry; moderate very fine subangular blocky structure; friable; many very fine roots; about 5 percent subsoil material; about 2 percent fine gravel; neutral; clear smooth boundary.
- Bt1—6 to 11 inches; about 90 percent dark yellowish brown (10YR 4/4) and 10 percent dark brown (10YR 3/3) clay loam; moderate very fine angular blocky structure; friable; common very fine roots; common prominent clay films on faces of peds; about 2 percent fine gravel; neutral; abrupt smooth boundary.
- Bt2—11 to 18 inches; yellowish brown (10YR 5/6) clay loam; weak fine and very fine subangular blocky structure; firm; few very fine roots; common distinct clay films on faces of peds; about 1 percent fine gravel; neutral; clear smooth boundary.
- Bt3—18 to 23 inches; yellowish brown (10YR 5/6) clay loam; weak very fine and fine subangular blocky structure; firm; few very fine roots; few distinct clay films on faces of peds; about 2 percent fine gravel; neutral; clear smooth boundary.
- Bt4—23 to 27 inches; yellowish brown (10YR 5/6) clay loam; common medium and coarse prominent grayish brown (10YR 5/2) mottles; moderate medium prismatic structure parting to weak medium angular blocky; firm; few very fine roots; few distinct clay films on faces of peds; few fine accumulations of iron and manganese oxide; about 1 percent fine gravel; neutral; clear smooth boundary.
- Bk1—27 to 40 inches; light olive brown (2.5Y 5/6) and yellowish brown (10YR 5/6) clay loam; common medium prominent grayish brown (10YR 5/2) mottles; moderate medium prismatic structure parting to weak medium angular blocky; firm; strongly effervescent; common coarse soft accumulations of calcium carbonate; common fine

concretions of calcium carbonate; about 2 percent fine gravel; strong effervescence; slightly alkaline; gradual smooth boundary.

- Bk2—40 to 48 inches; light olive brown (2.5Y 5/6) clay loam; common fine prominent yellowish brown (10YR 5/8) and common fine prominent grayish brown (10YR 5/2) mottles; moderate coarse prismatic structure parting to weak medium angular blocky; firm; few very fine roots; common coarse accumulations of calcium carbonate; common fine concretions of calcium carbonate; common fine accumulations of iron and manganese oxide; about 2 percent fine gravel; strong effervescence; slightly alkaline; gradual smooth boundary.
- Bk3—48 to 60 inches; light olive brown (2.5Y 5/4) clay loam; many coarse distinct light brownish gray (2.5Y 6/2) mottles; moderate coarse prismatic structure; firm; common fine concretions of calcium carbonate; few medium accumulations of calcium carbonate; few fine accumulations of iron and manganese oxide; about 4 percent fine gravel; strong effervescence; slightly alkaline.

The depth to soft masses of calcium carbonate is 24 to 40 inches. The content of rock fragments is 1 to 5 percent throughout the profile.

The Ap or A horizon has value of 2 or 3 and chroma of 1 or 2. Some pedons have an E horizon. This horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. It is loam, silt loam, or clay loam. The Bt horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 3 to 6. It is clay loam or clay. The Bk horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 6. It is loam or clay loam.

Putnam Series

The Putnam series consists of very deep, poorly drained, very slowly permeable soils on broad ridges in the uplands. These soils formed in loess. Slopes are 0 to 1 percent.

Typical pedon of Putnam silt loam, 85 feet south and 1,200 feet east of the northwest corner of sec. 4, T. 61 N., R. 15 W.

- Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; many fine roots; slightly acid; clear smooth boundary.
- E—8 to 15 inches; grayish brown (10YR 5/2) silt loam; weak thin platy structure parting to weak fine granular; friable; many fine roots; slightly acid; clear smooth boundary.
- Btg1—15 to 20 inches; dark grayish brown (10YR 4/2) silty clay; few fine prominent strong brown (7.5YR

- 5/8) and red (2.5YR 4/6) mottles; moderate medium prismatic structure; firm; common fine roots; many prominent clay films on faces of peds; strongly acid; clear smooth boundary.
- Btg2—20 to 29 inches; dark grayish brown (10YR 4/2) silty clay; common medium prominent strong brown (7.5YR 5/8) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; common fine roots; many prominent clay films on faces of peds; common prominent black stains of iron and manganese oxide; strongly acid; gradual smooth boundary.
- Btg3—29 to 35 inches; grayish brown (10YR 5/2) silty clay; common fine prominent strong brown (7.5YR 5/8) and brown (7.5YR 4/4) mottles; moderate medium subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; common prominent black stains of iron and manganese oxide; strongly acid; gradual smooth boundary.
- Btg4—35 to 47 inches; light brownish gray (2.5Y 6/2) silty clay loam; common medium prominent brown (7.5YR 4/4) mottles; moderate medium subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; few fine accumulations of iron and manganese oxide; common prominent black stains of iron and manganese oxide; moderately acid; gradual smooth boundary.
- BCg—47 to 60 inches; light brownish gray (10YR 6/2) and strong brown (7.5YR 5/8) silty clay loam; weak medium subangular blocky structure; firm; common distinct clay films on vertical faces of peds; common prominent black stains of iron and manganese oxide; moderately acid.

The E horizon has value of 5 or 6 and chroma of 1 or 2. The Btg horizon has chroma of 1 or 2. Some pedons have a Cg horizon, which has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 1 or 2.

Tice Series

The Tice series consists of very deep, somewhat poorly drained, moderately permeable soils on flood plains. These soils formed in alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Tice silt loam, in an area of Dockery and Tice silt loams, occasionally flooded, 4,600 feet east and 1,900 feet south of the northwest corner of sec. 7, T. 61 N., R. 17 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak fine granular structure;

friable; many very fine roots; neutral; abrupt smooth boundary.

A—9 to 20 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak fine and medium angular blocky structure; friable; common very fine roots; few very fine pores; neutral; clear smooth boundary.

Bw—20 to 30 inches; dark grayish brown (10YR 4/2) silt loam; weak medium subangular blocky structure; friable; few very fine roots; few very fine pores; neutral; gradual smooth boundary.

Cg1—30 to 47 inches; dark grayish brown (10YR 4/2) silt loam; common fine prominent strong brown (7.5YR 5/6) mottles; massive; friable; few very fine roots; few very fine pores; neutral; gradual smooth boundary.

Cg2—47 to 60 inches; dark grayish brown (10YR 4/2) silt loam; common fine distinct gray (10YR 5/1) mottles; dominantly massive but some areas of moderate medium and fine angular blocky structure; friable; common very fine pores; slightly acid.

The Ap and A horizons have chroma of 1 or 2. The Bw horizon has value of 4 or 5 and chroma of 2 or 3.

Vanmeter Series

The Vanmeter series consists of moderately deep, moderately well drained, very slowly permeable soils on uplands. These soils formed in calcareous shale residuum. Slopes range from 9 to 40 percent.

Typical pedon of Vanmeter loam, 9 to 20 percent slopes, 1,250 feet south and 3,600 feet east of the northwest corner of sec. 32, T. 61 N., R. 16 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) loam, grayish brown (10YR 5/2) dry; moderate fine and very fine granular structure; friable; many very fine roots; slightly acid; abrupt smooth boundary.

Bw—6 to 19 inches; brown (7.5YR 4/4) clay; weak very fine subangular blocky structure; firm; common very fine roots; few fine concretions of iron and manganese oxide; neutral; clear smooth boundary.

Bk1—19 to 24 inches; grayish brown (2.5Y 5/2) clay; weak fine and very fine angular blocky structure; firm; many very fine roots; common fine accumulations of calcium carbonate; slight effervescence; slightly alkaline; clear smooth boundary.

Bk2—24 to 32 inches; mottled olive gray (5Y 5/2) and dark gray (5Y 4/1) clay; weak fine angular blocky structure with some thin plates and soft shale fragments; firm; few very fine roots; few coarse dark masses; few fine and medium concretions of calcium carbonate; slight effervescence; slightly alkaline; abrupt smooth boundary

Cr—32 to 60 inches; clayey shale bedrock.

The Ap horizon has value of 3 or 4 and chroma of 1 or 2. Some pedons have an A horizon. This horizon has hue of 10YR, value of 3, and chroma of 1. It is loam or silty clay loam. The Bw horizon has hue of 5YR to 2.5Y, value of 4 to 6, and chroma of 2 to 6. It is silty clay or clay. The Bk horizon has hue of 2.5Y or 5Y, value of 4 to 6, and chroma of 1 or 2.

Vesser Series

The Vesser series consists of very deep, poorly drained, moderately permeable soils on high flood plains. These soils formed in alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Vesser silt loam, occasionally flooded, 4,755 feet east and 2,280 feet south of the northwest corner of sec. 26, T. 64 N., R. 15 W.

Ap—0 to 10 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; common fine roots; neutral; clear smooth boundary.

A—10 to 18 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; common fine roots; slightly acid; clear smooth boundary.

E1—18 to 30 inches; grayish brown (10YR 5/2) silt loam, light brownish gray (10YR 6/2) and light gray (10YR 7/1) dry; weak thin platy structure; friable; few fine roots; common very fine pores; moderately acid; gradual smooth boundary.

E2—30 to 41 inches; dark grayish brown (10YR 4/2) silt loam, grayish brown (10YR 5/2) and light gray (10YR 7/1) dry; weak medium platy structure; friable; few fine roots; common very fine pores; few medium and fine accumulations of iron and manganese oxide; strongly acid; gradual smooth boundary.

Btg1—41 to 57 inches; dark gray (10YR 4/1) silty clay loam; few fine distinct brown (10YR 4/3) mottles; weak fine subangular blocky structure; firm; common very fine pores; many light gray (10YR 7/1) silt coatings on faces of peds; few faint clay films on faces of peds; few fine accumulations of iron and manganese oxide; strongly acid; clear smooth boundary.

Btg2—57 to 60 inches; very dark grayish brown (10YR 3/2) silty clay loam; few fine faint brown (10YR 4/3) mottles; moderate medium subangular blocky structure; firm; common distinct clay films on faces of peds; few fine accumulations of iron and manganese oxide; strongly acid.

The Ap horizon has value of 2 or 3 and chroma of 1

or 2. The E horizon has value of 3 to 5 and chroma of 1 or 2. The Btg horizon has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 1 or 2.

Vigar Series

The Vigar series consists of very deep, moderately well drained, moderately slowly permeable soils on foot slopes. These soils formed in colluvium. Slopes range from 2 to 5 percent.

Typical pedon of Vigar loam, 2 to 5 percent slopes, rarely flooded, 1,200 feet east and 2,300 feet south of the northwest corner of sec. 27, T. 63 N., R. 14 W.

Ap—0 to 12 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; many fine roots; neutral; gradual smooth boundary.

A—12 to 19 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure; friable; common fine roots; slightly acid; gradual smooth boundary.

Bt1—19 to 30 inches; very dark grayish brown (10YR 3/2) clay loam, grayish brown (10YR 5/2) dry; moderate medium subangular blocky structure; friable; common fine roots; common distinct clay films on faces of peds; slightly acid; gradual smooth boundary.

Bt2—30 to 39 inches; dark grayish brown (10YR 4/2) clay loam; common medium distinct dark yellowish brown (10YR 4/4) mottles; moderate medium subangular blocky structure; friable; common fine roots; common distinct clay films on faces of peds; about 1 percent fine gravel; slightly acid; gradual smooth boundary.

Bt3—39 to 52 inches; dark yellowish brown (10YR 4/4) clay loam; common medium distinct dark grayish brown (10YR 4/2) and common medium faint yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; common thick organic coatings in root channels; about 1 percent fine gravel; neutral; gradual smooth boundary.

BC—52 to 60 inches; dark yellowish brown (10YR 4/4) loam; common coarse distinct grayish brown (10YR 5/2) and few medium faint yellowish brown (10YR 5/4) mottles; weak medium subangular blocky structure; firm; few fine roots; few fine and few very fine pores; common distinct clay films in pores; common thick organic coatings in pores; about 1 percent fine gravel; neutral.

The A horizon has value of 2 or 3 and chroma of 1 or 2. Some pedons have a BA horizon, which has value of 3 or 4 and chroma of 2 or 3. The Bt horizon has value

of 3 to 5 and chroma of 2 to 4.

Wabash Series

The Wabash series consists of very deep, poorly drained, very slowly permeable soils on flood plains. These soils formed in alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Wabash silty clay loam, occasionally flooded, overwash, 4,700 feet east and 150 feet south of the northwest corner of sec. 33, T. 64 N., R. 16 W.

Ap—0 to 10 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark gray (10YR 4/1) dry; weak very fine granular structure; friable; many very fine roots; few fine pores; neutral; abrupt smooth boundary.

A—10 to 15 inches; very dark grayish brown (10YR 3/2) silty clay, dark grayish brown (10YR 4/2) dry; few fine faint gray (10YR 5/1) and common fine distinct brown (10YR 5/3) mottles; weak very fine subangular blocky and weak very fine granular structure; firm; few very fine roots; few fine and common very fine pores; few distinct discontinuous sheens on faces of peds; neutral; clear smooth boundary.

Bg1—15 to 22 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; common fine prominent dark yellowish brown (10YR 4/6) mottles; moderate very fine subangular blocky structure; firm; few very fine roots; few fine and few very fine pores; common distinct sheens on faces of peds; neutral; clear smooth boundary.

Bg2—22 to 31 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; common fine prominent yellowish brown (10YR 5/6) and common fine prominent dark yellowish brown (10YR 4/6) mottles; moderate very fine subangular blocky structure; firm; few very fine roots; few fine and very fine pores; common distinct sheens on faces of peds; few fine concretions of iron oxide; neutral; clear smooth boundary.

Bg3—31 to 38 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; common fine prominent yellowish brown (10YR 5/8) mottles; moderate very fine subangular blocky structure; very firm; few very fine roots; few fine and very fine pores; common prominent sheens on faces of peds; few distinct slickensides; few fine concretions of iron oxide; neutral; abrupt smooth boundary.

Bg4—38 to 49 inches; dark gray (10YR 4/1) silty clay; many fine prominent yellowish brown (10YR 5/8) and strong brown (7.5YR 5/8) mottles; moderate very fine angular blocky structure; very firm; few very fine roots; few fine and very fine pores; many

prominent sheens on faces of peds; few distinct slickensides; neutral; abrupt smooth boundary.

Bg5—49 to 60 inches; dark gray (10YR 4/1) silty clay, gray (10YR 5/1) dry; many fine prominent dark yellowish brown (10YR 4/6) and strong brown (7.5YR 4/6) mottles; weak very fine angular blocky structure; very firm; few very fine pores; common prominent and few distinct sheens on faces of peds; neutral.

The Ap and A horizons have hue of 10YR to 5Y or are neutral in hue. They have value of 2 or 3 and chroma of 2 or less. The Bg horizon has hue of 10YR to 5Y, value of 2 to 5, and chroma of 1 or 2. It is silty clay or clay.

Winnegan Series

The Winnegan series consists of very deep, moderately well drained, slowly permeable soils on uplands. These soils formed in glacial till. Slopes range from 5 to 35 percent.

Typical pedon of Winnegan loam, 20 to 35 percent slopes, 115 feet east and 225 feet south of the northwest corner of sec. 23, T. 61 N., R. 14 W.

A—0 to 2 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; many fine roots; about 1 percent fine gravel; slightly acid; clear smooth boundary.

E—2 to 4 inches; brown (10YR 5/3) loam; weak fine subangular blocky structure; friable; many fine roots; about 1 percent fine gravel; strongly acid; clear wavy boundary.

Bt1—4 to 16 inches; dark yellowish brown (10YR 4/4) clay; moderate medium subangular blocky structure; firm; common fine and medium roots; common distinct clay films on faces of peds; about 1 percent fine gravel; very strongly acid; gradual smooth boundary.

Bt2—16 to 26 inches; dark yellowish brown (10YR 4/4) clay loam; common medium prominent strong brown (7.5YR 5/6) and few medium distinct grayish brown (10YR 5/2) mottles; moderate medium angular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; about 1 percent fine gravel; slightly acid; gradual smooth boundary.

Btk—26 to 36 inches; mottled dark yellowish brown (10YR 4/4), strong brown (7.5YR 5/6), and grayish brown (2.5Y 5/2) clay loam; moderate medium subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; common masses of calcium carbonate; slight

effervescence; about 1 percent fine gravel; slightly alkaline; gradual smooth boundary.

Bk—36 to 60 inches; mottled dark yellowish brown (10YR 4/4), strong brown (7.5YR 5/6), and grayish brown (2.5Y 5/2) loam; moderate medium prismatic structure parting to weak medium angular blocky; firm; many masses of calcium carbonate; about 1 percent fine gravel; strong effervescence; slightly alkaline.

The depth to soft masses of calcium carbonate is 24 to 40 inches. The content of rock fragments is 1 to 5 percent throughout the profile.

The A horizon has value and chroma of 2 or 3. Some pedons have an Ap horizon. This horizon has value of 4 or 5 and chroma of 2 or 3. It is loam or silt loam. The E horizon has value of 4 to 6 and chroma of 2 to 4. It is loam, clay loam, or silt loam. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 8. The Bk horizon has hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 2 to 6. It is clay loam or loam.

Zook Series

The Zook series consists of very deep, poorly drained, slowly permeable soils on flood plains. These soils formed in alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Zook silty clay loam, occasionally flooded, overwash, 1,400 feet east and 230 feet south of the northwest corner of sec. 9, T. 61 N., R. 13 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine granular and weak medium subangular blocky structure; friable; common fine roots; neutral; clear smooth boundary.

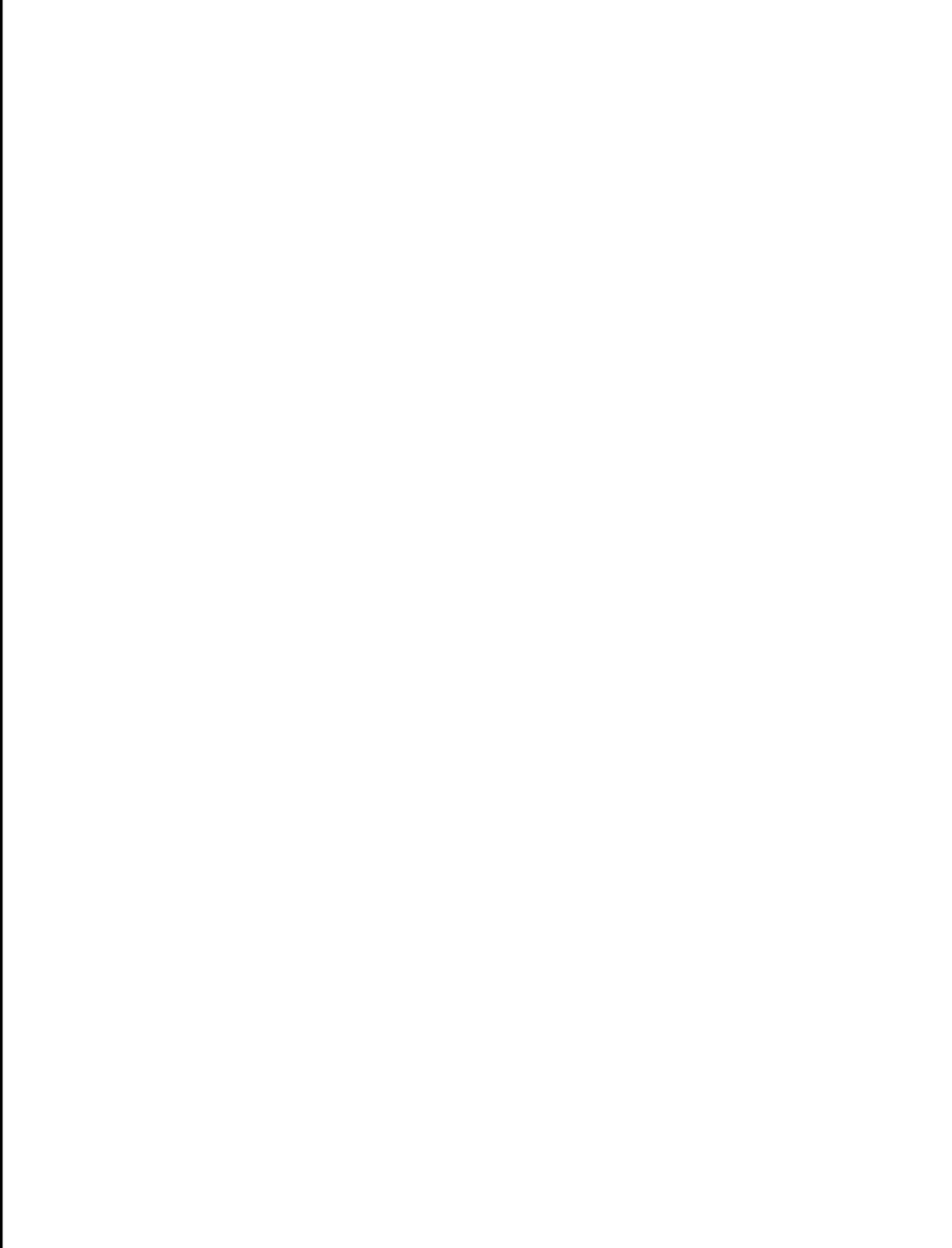
A1—9 to 15 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; firm; common fine roots; neutral; gradual smooth boundary.

A2—15 to 31 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; firm; common fine roots; neutral; gradual smooth boundary.

Bg1—31 to 52 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure parting to weak medium prismatic; firm; sheen on faces of peds; few fine roots; neutral; gradual smooth boundary.

Bg2—52 to 60 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; few fine distinct dark yellowish brown (10YR 4/4) and common fine faint dark grayish brown (10YR 4/2) mottles; moderate medium subangular blocky structure; firm; sheen on faces of peds; few fine roots; neutral.

The Bg horizon has hue of 10YR to 5Y or is neutral in hue. It is silty clay or silty clay loam. Some pedons have a Cg horizon. This horizon has hue of 10YR to 5Y and value of 2 to 4. It is silty clay or silty clay loam.



Formation of the Soils

Soil forms through processes that act on accumulated or deposited geologic material. The characteristics of a soil are determined by the type of parent material; the plant and animal life on and in the soil; the climate under which the soil has formed; the relief, or the lay of the land; and the length of time that the forces of soil formation have acted on the soil material. Human activities also affect soil formation.

Parent material affects the kind of soil profile that forms and, in extreme cases, determines it almost entirely. Plants and animals affect the content of organic matter, structure, and porosity of the soil. Climate determines the amount of water available for leaching and the soil temperature, which causes physical changes and influences the rate of chemical changes. Together, climate and plant and animal life act on the parent material that has accumulated through the weathering of rocks and slowly change it into a natural body that has genetically related horizons. Relief modifies the effects of the other factors. Finally, time is needed for the transformation of the parent material into a soil that has distinct horizons. Some time is always required for differentiation of soil horizons. Generally a long time is required for the formation of distinct horizons.

The effects of the factors of soil formation are so closely interrelated that few generalizations can be made about the effect of any one factor unless conditions about the other four are specified.

Parent Material

Parent material is the unconsolidated mass in which a soil forms. The characteristics of this material determine the limits of the chemical and mineralogical composition of the soils. The soils in Adair County formed in material weathered from bedrock; glacial till, or material deposited by glacial ice; loess, or material deposited by the wind; and alluvium, or material deposited by water. Some of the soils formed in more than one kind of parent material.

The residuum in the county consists of material weathered mainly from limestone and shale. Vanmeter soils formed in this material. They are on moderately

steep to very steep back slopes paralleling streams in the western part of the county.

Glacial till is a heterogeneous mass of sand, silt, clay, and rock that was mixed and moved by large masses of slowly moving ice. The glacial till in the county ranges from a few feet to more than 200 feet in thickness. These thick layers were deposited over bedrock. Gara and Winnegan soils formed in glacial till.

Loess is silty material that was transported by the wind from flood plains. It mantles most of the ridges in the county. It ranges from a few inches to 6 feet in thickness. In the areas of prairie along the Grand Divide, the loess was deposited on wide, nearly level to gently sloping divides and ridgetops. Adco and Putnam soils formed partly or entirely in the loess on these divides and ridgetops. The deposits of loess are thinner on narrow ridgetops. Gorin and Bevier soils formed in these deposits and in the underlying loamy sediments and a paleosol weathered from glacial till.

Alluvium was deposited on nearly level flood plains along streams in the county. Most of this material was eroded from the surrounding uplands. Zook soils formed in silty and clayey alluvium, and Dockery and Vesser soils formed in silty alluvium.

Plants and Animals

Organic matter is an important component of the soil. Plants, insects, animals, bacteria, and fungi provide the organic matter. Chemicals in the soil move from plant roots to the parts of the plants growing above the surface. As they return to the soil and decay, leaves and other parts of plants add nutrients and organic matter. Roots help to loosen the soil. When they decay, they leave channels for the movement of water and air.

A native vegetation of prairie grasses and trees has profoundly influenced soil formation in Adair County. The rooting habits, lifespan, and mineral composition of prairie grasses differ markedly from those of deciduous trees. The micro-organisms and animals associated with each also differ significantly.

Leaves, twigs, and logs, which tend to be acid, slowly decompose on the surface and add organic matter to soils in forested areas. These soils develop a

very thin, dark surface layer and a leached subsurface layer. In contrast, the organic matter added to soils that formed under prairie grasses is largely the residue from the yearly decay of annual and biennial plants. The tops of these plants decompose on the surface, but much of the organic material in the soils consists of roots. This material tends to have a higher mineral content than the forest residue. Thus, soils that formed under prairie grasses have a dark surface layer that is much thicker than that of the forest soils. Also, the prairie soils tend to be less acid.

Worms, insects, burrowing animals, and large animals affect soil formation. The effects of bacteria and fungi, which cause the rotting of organic material, improve tilth, and fix nitrogen in the soil, are more significant than the effects of animals. The population of organisms is directly related to the rate at which organic material decomposes in the soil. The kinds of organisms in a given area and their activity are determined by differences in vegetation.

In a remarkably short time, human activities have profoundly affected soil formation in the county. The major alterations have resulted from changes in vegetation, drainage, relief, and erosion. Prairie grasses have been replaced by cool-season grasses and row crops. Nearly all of the flood plains and many of the areas on uplands have been cleared and are cultivated. Fertilizers, pesticides, and lime have been applied, wet soils have been drained, and sloping soils have been terraced. A new cycle of soil formation has begun in areas where earthmoving equipment has completely rearranged soil profiles in the process of urban development. Many of these changes have increased the production of food and fiber. In terms of sustained productivity, however, the net effect of human activities in many areas of the county has been harmful. Accelerated erosion, for example, has reduced the potential productivity of many soils on uplands.

Climate

Climate has been an important factor in the formation of the soils in Adair County. Climate affects the rate of geologic erosion, which, in turn, affects the shape and character of landforms. The relative abundance of plants and animals and the species composition are altered by climatic changes. The climatic conditions that are typical in the county today favor the growth of trees rather than prairie grasses.

The climate in Adair County is subhumid midcontinental. It has changed little since the last period of glaciation. Changes in climate caused the glacial periods. During many years of cool temperatures and high precipitation, massive ice sheets formed. These ice

sheets moved across a mature bedrock topography of gently undulating hills and dissected plains, which were characterized by less relief than the current Ozark topography to the south (24). Warmer temperatures later resulted in the retreat of glacial ice. As the ice retreated, geologic erosion accelerated and very fine sand and silt were blown by the wind. Loess covered the county.

Extreme changes in climate occur very slowly. There were long intermediate periods when different types of vegetation grew in the county. Soils formed and were later covered by loess, truncated, mixed by erosion, or completely eroded away. Leonard soils, for example, formed in loess and in an underlying paleosol that weathered from glacial till.

The higher temperatures and rainfall of the current climate result in rapid chemical changes and rapid physical disintegration. If calcium carbonates and other soluble salts are removed from the soil by leaching, the level of fertility decreases. The current climate also results in the rapid breakdown of minerals, forming clay within the soil. As the clay is moved downward, it accumulates in the subsoil. This process is known as eluviation. Nearly all of the soils on uplands in the county show the effects of this process.

Relief

Relief refers to the general unevenness of the land surface, the variations in elevation, and the nature of the slopes between one elevation and another. The difference in elevation from a ridgetop to the adjacent flood plain varies, depending on the parent material and the position in the watershed.

Relief influences soil formation through its effect on drainage, runoff, and erosion and, to some extent, on exposure to sunlight and the wind. The length, shape, and gradient of slopes affect soil-water relationships. The amount of water entering and passing through the soil depends on the slope, the position on the landscape, the permeability in the soil, and the amount and intensity of rainfall.

Because they receive more direct sunrays, the soils on steep, south-facing slopes generally are more droughty than the soils on north-facing slopes. The droughtiness affects soil formation through its effect on the amount and kind of vegetation that grows on the soil, the susceptibility to erosion, and freezing and thawing.

On nearly level to gently sloping soils in the uplands, runoff is slow and most of the water that the soils receive passes through the profile. As a result, these soils are characterized by maximum profile development. Over long periods, a subsoil high in

content of clay forms under a leached subsurface layer. This kind of development has occurred in Putnam and Adco soils.

Time

Time allows climate, living organisms, and relief to affect the parent material. The degree to which the material is altered determines the age of a soil. Thus, the age of a soil can be inferred from the morphology of the soil.

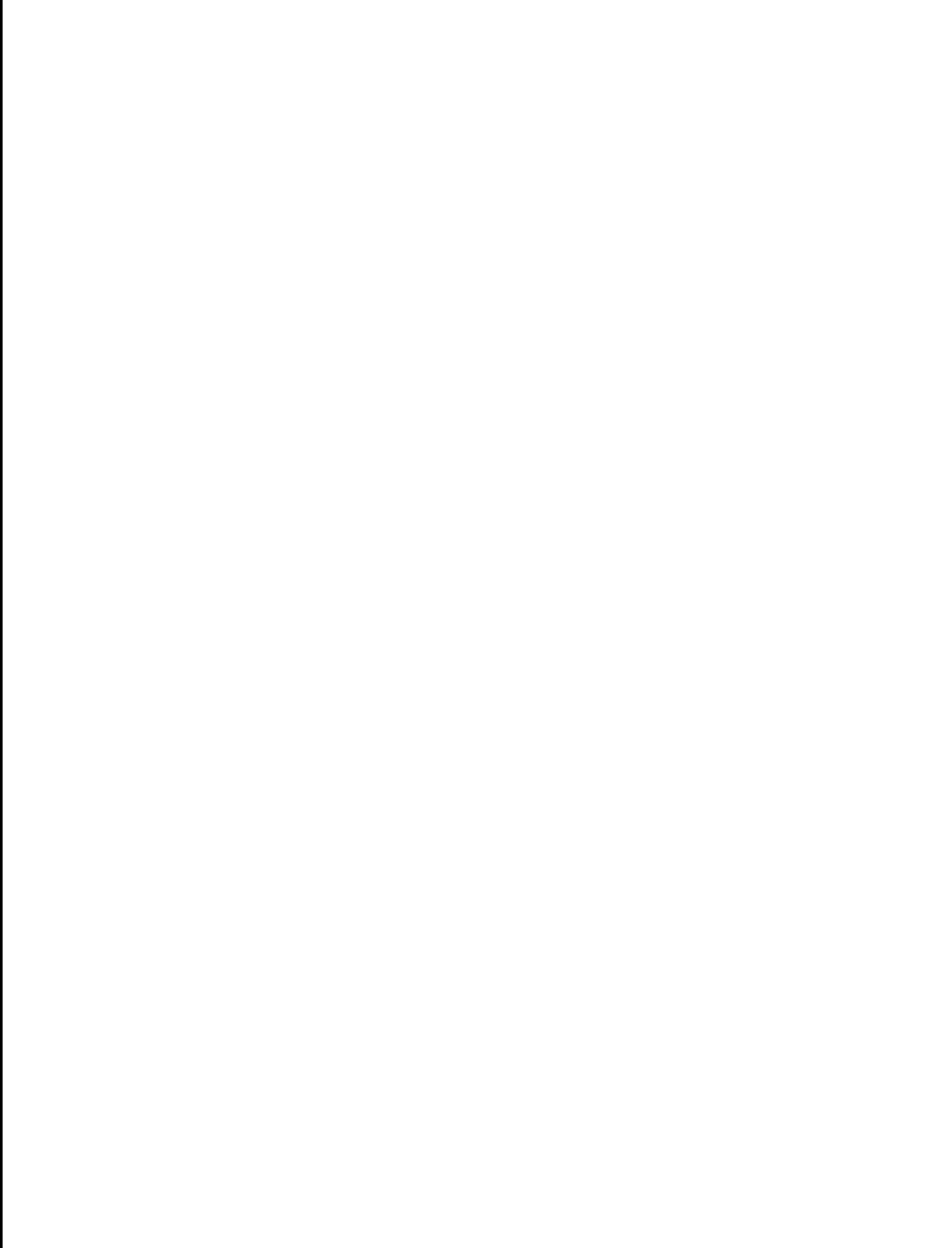
The most fertile and productive soils in the county formed in recent alluvium. They are young soils. Dockery, Floris, and Zook soils are examples.

Glaciers deposited parent material more than 1 million years ago. As the climatic changed, this glacial material was exposed to extreme weathering. The weathered glacial till (paleosol) is of late to early Sangamon age, or about 140,000 to 38,000 years old (13). Armstrong soils formed in this weathered material. On many of the lower back slopes, the paleosol eroded to the original unweathered glacial deposits. More recent soils formed on these surfaces. Examples are

Gara, Purdin, and Winnegan soils.

Loess, or wind-blown material consisting of fine soil particles (silt and clay), was deposited on uplands in the county. The loess has eroded from dissected slopes but remains on the nearly level to moderately sloping ridgetops and at the head of drainageways. Putnam and Adco soils formed in Wisconsin loess, which is probably 14,000 to 16,000 years old.

The soils on uplands in the county generally show evidence of maturity, as is indicated by a reduced level of fertility and a strongly expressed argillic horizon. These soils tend to be on the older landforms. The nearly level to gently sloping soils at the highest elevations are the oldest soils in the county. They are characterized by the maximum development of distinct horizons. Adco and Putnam soils are examples. The carbonates that originally were in the parent material have been leached to a great depth, leaving the soils quite acid throughout. Clay has formed through weathering and has been translocated by water into a distinct subsoil. A highly bleached subsurface layer has formed through the leaching of weatherable material.



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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon.

Commonly, such soil formed in recent alluvium or on steep, rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (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 moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Back slope. The geomorphic component that forms the steepest inclined surface and principal element of many hill slopes. Back slopes in profile typically range from gently sloping to very steep, are linear, and descend to a foot slope. In terms of gradational process, back slopes are erosional landforms produced mainly by mass wasting and running water.

Basal till. Compact glacial till deposited beneath the ice.

Base saturation. The degree to which material having

cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, and K), expressed as a percentage of the total cation-exchange capacity.

Bedding planes. Fine stratifications, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediments.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bench terrace. A raised, level or nearly level strip of earth constructed on or nearly on the contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce 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.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth.

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 oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are:

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a “wire” when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather

than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, 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 classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious.

Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons.

Well drained soils are commonly medium textured.

They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic

processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, for example, fire, that exposes the surface.

Erosion pavement. A layer of gravel or stones that remains on the surface after fine particles are removed by sheet or rill erosion.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the oven-dry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity*, *normal moisture capacity*, or *capillary capacity*.

Fine textured soil. Sandy clay, silty clay, or clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true

soil, from the unconsolidated parent material.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of the material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Head slope. The concave surface at the head of a drainageway where the flow of water converges downward toward the center and contour lines form concave curves.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and

deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

Less than 0.2	.....	very low
0.2 to 0.4	.....	low
0.4 to 0.75	.....	moderately low
0.75 to 1.25	.....	moderate
1.25 to 1.75	.....	moderately high
1.75 to 2.5	.....	high
More than 2.5	.....	very high

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are:

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

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.

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 so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are 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.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Interflue. The relatively undissected upland or ridge between two adjacent valleys having streams flowing in the same general direction or any elevated area between two drainageways that sheds water to the drainageways.

Landform. Any recognizable physical feature of the earth's surface having a characteristic shape and produced by natural causes. Examples are mountains, plateaus, plains, valleys, flood plains, and terraces. Together, the landforms make up the surface configuration of the earth.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by the wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

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 the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded 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 of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15

millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan*, *fragipan*, *claypan*, *plowpan*, and *traffic pan*.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called “a soil.” A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil, adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile.

Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow.....	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid.....	2.0 to 6.0 inches
Rapid.....	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or

pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Moderately acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Slightly 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.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Ridge. A long, narrow elevation of the land surface, generally having a sharp crest and steep sides and forming an extended upland between valleys.

Rill. A steep-sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 drawbar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called groundwater runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-sized particles.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shoulder. The geomorphic component that forms the

uppermost inclined surface at the top of a hill slope. It comprises the transitional zone from the back slope to the summit of an upland. The surface is dominantly convex in profile and erosional in origin.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Side slope. The slope bounding a drainageway and lying between the drainageway and the adjacent interfluvium. It is generally linear along the slope width, and overland flow is parallel down the slope.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. The slope classes in this survey are as follows:

Nearly level.....	0 to 2 percent
Very gently sloping.....	1 to 3 percent
Gently sloping.....	2 to 5 percent
Moderately sloping.....	5 to 9 percent
Strongly sloping.....	9 to 14 percent
Moderately steep.....	14 to 20 percent
Steep.....	20 to 35 percent
Very steep.....	more than 35 percent

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Small stones (in tables). Rock fragments less than 3

inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and 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, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the substratum. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of rock fragments in a soil. Generally, it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind erosion and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects

the soil from wind erosion and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Breaking up a compact subsoil by pulling a special chisel through the soil.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Summit. A general term for the top, or highest level, of an upland feature, such as a ridge or hill.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

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 water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

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."

Thin layer (in tables). A layer of otherwise suitable soil material that is too thin for the specified use.

Till plain. An extensive area of nearly level to undulating soils underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily

rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial meltwater. In nonglaciated regions, alluvium deposited by heavily loaded streams.

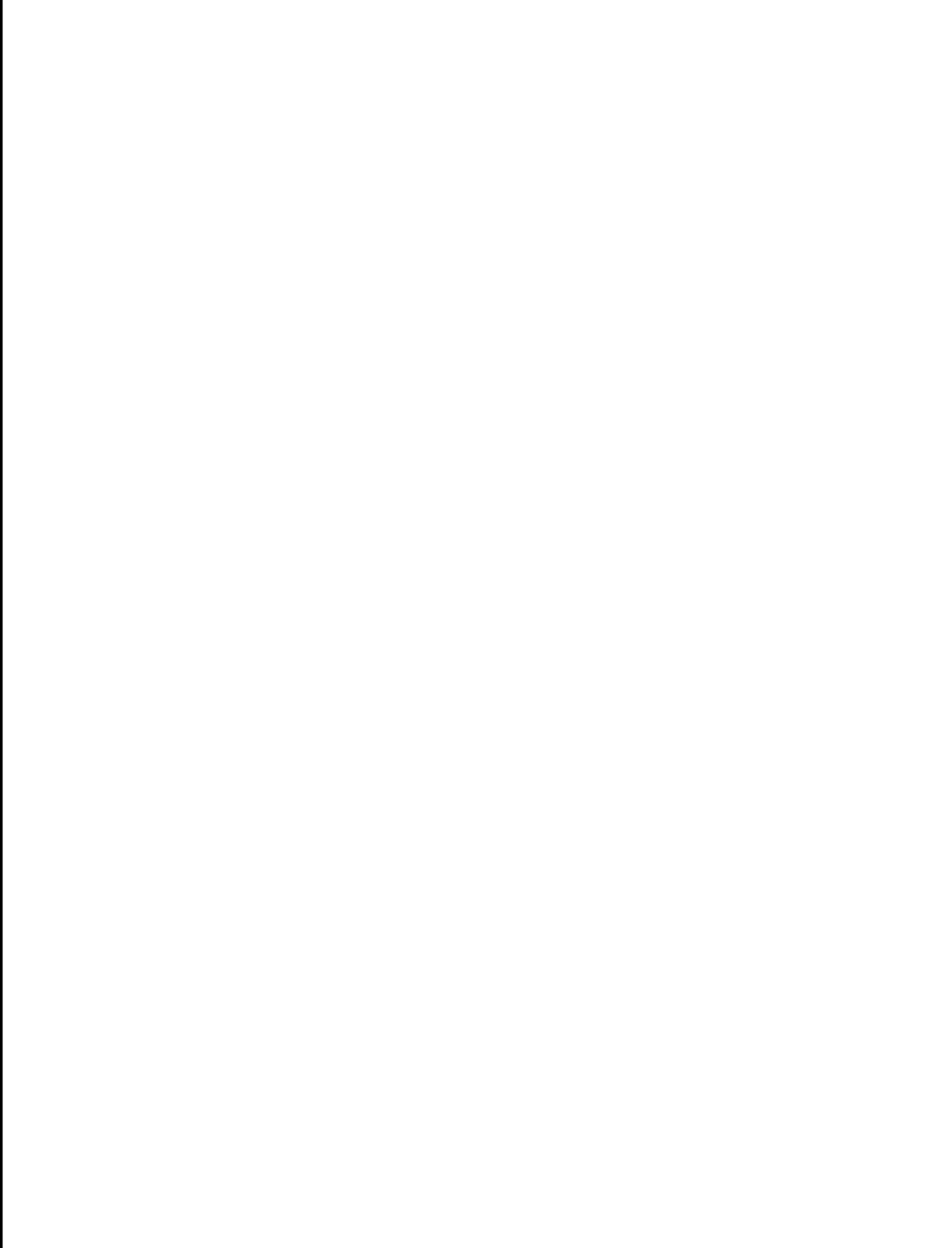
Variiegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Water bars. A hump or small, dikelike surface drainage structure, properly used only in closing retired roads to traffic, on fire lines, and on abandoned skid trails.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such 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 oven-dry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.



Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION
(Recorded in the period 1961-90 at Kirksville, Missouri)

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have--		Average number of growing degree days*	Average	2 years in 10 will have--		Average number of days with 0.10 inch or more	Average snowfall
				Maximum temperature higher than--	Minimum temperature lower than--			Less than--	More than--		
° F	° F	° F	° F	° F	Units	In	In	In		In	
January-----	32.8	14.4	23.6	61	-17	12	1.14	0.28	2.06	2	6.2
February-----	38.0	18.8	28.4	67	-12	27	.90	.44	1.36	2	4.8
March-----	50.7	30.0	40.3	80	4	150	2.65	1.42	3.72	5	4.1
April-----	64.3	41.7	53.0	86	20	388	3.20	1.60	4.60	6	1.1
May-----	73.6	51.3	62.5	89	33	697	4.36	2.50	6.02	7	.0
June-----	82.2	60.5	71.3	95	43	938	4.20	1.78	6.25	6	.0
July-----	87.1	65.1	76.1	99	49	1,040	3.80	1.53	5.72	5	.0
August-----	84.6	62.4	73.5	99	46	999	3.70	1.34	5.66	5	.0
September----	77.0	54.8	65.9	93	34	749	4.27	1.86	6.32	6	.0
October-----	66.1	44.0	55.1	87	24	456	3.19	1.36	4.94	5	.2
November-----	51.1	32.2	41.7	75	7	144	2.09	.69	3.51	3	2.0
December-----	36.6	19.6	28.1	65	-12	26	1.75	.78	2.68	3	4.8
Yearly:											
Average----	62.0	41.2	51.6	---	---	---	---	---	---	---	---
Extreme----	---	---	---	101	-18	---	---	---	---	---	---
Total-----	---	---	---	---	---	5,626	35.25	26.75	41.79	55	23.2

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (40 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL
(Recorded in the period 1961-90 at Kirksville, Missouri)

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	Apr. 16	Apr. 20	May 5
2 years in 10 later than--	Apr. 12	Apr. 16	Apr. 29
5 years in 10 later than--	Apr. 3	Apr. 10	Apr. 20
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 24	Oct. 8	Sept. 26
2 years in 10 earlier than--	Oct. 28	Oct. 13	Oct. 1
5 years in 10 earlier than--	Nov. 6	Oct. 24	Oct. 10

TABLE 3.--GROWING SEASON
(Recorded in the period 1961-90 at Kirksville, Missouri)

Probability	Daily minimum temperature during growing season		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	Days	Days	Days
9 years in 10	180	175	152
8 years in 10	187	180	159
5 years in 10	201	191	172
2 years in 10	215	202	185
1 year in 10	222	208	192

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
14C2	Armstrong loam, 5 to 9 percent slopes, eroded-----	67,800	18.6
14D2	Armstrong clay loam, 9 to 14 percent slopes, eroded-----	22,100	6.1
16C	Bevier silty clay loam, 3 to 8 percent slopes-----	4,900	1.3
17E2	Purdin clay loam, 14 to 20 percent slopes, eroded-----	7,600	2.1
17F2	Purdin clay loam, 20 to 35 percent slopes, eroded-----	7,200	2.0
19E	Vanmeter loam, 9 to 20 percent slopes-----	2,700	0.7
19F	Vanmeter silty clay loam, 20 to 40 percent slopes-----	9,700	2.7
22B	Adco silt loam, 1 to 3 percent slopes-----	21,800	6.0
23D2	Gorin-Winnegan complex, 5 to 14 percent slopes, eroded-----	22,200	6.1
24D2	Gara loam, 9 to 14 percent slopes, eroded-----	11,400	3.1
24E2	Gara fine sandy loam, 14 to 20 percent slopes, eroded-----	31,300	8.6
24F2	Gara fine sandy loam, 20 to 35 percent slopes, eroded-----	11,900	3.3
26B2	Leonard silty clay loam, 2 to 6 percent slopes, eroded-----	13,700	3.7
28E2	Winnegan loam, 14 to 20 percent slopes, eroded-----	11,000	3.0
28F	Winnegan loam, 20 to 35 percent slopes-----	53,100	14.5
31	Putnam silt loam-----	2,000	0.5
40	Arbela silty clay loam, occasionally flooded-----	3,500	1.0
43	Chariton silt loam-----	230	0.1
44B	Gifford silty clay loam, 2 to 5 percent slopes-----	570	0.2
44C2	Gifford silty clay loam, 5 to 9 percent slopes, eroded-----	2,000	0.5
46	Vesser silt loam, occasionally flooded-----	16,500	4.5
47	Zook silty clay loam, occasionally flooded, overwash-----	8,366	2.3
49	Dockery and Tice silt loams, occasionally flooded-----	16,500	4.5
54B	Vigar loam, 2 to 5 percent slopes, rarely flooded-----	6,700	1.8
55B	Vigar-Zook-Excello complex, 0 to 5 percent slopes-----	2,500	0.7
56	Wabash silty clay loam, occasionally flooded, overwash-----	1,700	0.5
57	Floris loam, frequently flooded-----	3,400	0.9
69	Floris silt loam, occasionally flooded-----	240	0.1
71C	Plainfield loamy sand, 2 to 9 percent slopes-----	280	0.1
71F	Plainfield loamy sand, 20 to 40 percent slopes-----	250	0.1
	Water areas more than 40 acres in size-----	1,312	0.4
	Total-----	364,448	100.0

TABLE 5.--PRIME FARMLAND

(Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name)

Map symbol	Soil name
16C	Bevier silty clay loam, 3 to 8 percent slopes
22B	Adco silt loam, 1 to 3 percent slopes
26B2	Leonard silty clay loam, 2 to 6 percent slopes, eroded (where drained)
31	Putnam silt loam (where drained)
40	Arbela silty clay loam, occasionally flooded (where drained)
43	Chariton silt loam (where drained)
44B	Gifford silty clay loam, 2 to 5 percent slopes (where drained)
46	Vesser silt loam, occasionally flooded (where drained)
47	Zook silty clay loam, occasionally flooded, overwash (where drained)
49	Dockery and Tice silt loams, occasionally flooded
54B	Vigar loam, 2 to 5 percent slopes, rarely flooded
55B	Vigar-Zook-Excello complex, 0 to 5 percent slopes (where drained)
56	Wabash silty clay loam, occasionally flooded, overwash (where drained)
57	Floris loam, frequently flooded (where protected from flooding or not frequently flooded during the growing season)
69	Floris silt loam, occasionally flooded

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE

(Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Land capability	Corn	Grain sorghum	Soybeans	Winter wheat	Alfalfa hay	Timothy- red clover hay	Tall fescue
		Bu	Bu	Bu	Bu	Tons	Tons	AUM*
14C2----- Armstrong	IIIe	92	73	31	37	3.7	3.1	6.2
14D2----- Armstrong	IVe	86	69	29	34	3.2	2.7	5.4
16C----- Bevier	IIIe	95	76	31	40	4.0	3.3	6.6
17E2----- Purdin	VIe	---	---	---	---	3.1	2.6	5.1
17F2----- Purdin	VIe	---	---	---	---	---	---	4.5
19E----- Vanmeter	VIe	---	---	---	---	---	1.9	3.8
19F----- Vanmeter	VIIe	---	---	---	---	---	---	3.6
22B----- Adco	IIe	95	76	32	35	3.5	3.5	6.5
23D2**: Gorin-----	IIIe	86	68	29	34	3.4	2.9	5.8
Winnegan-----	IVe	75	59	25	30	3.0	2.5	5.0
24D2----- Gara	IVe	102	81	34	41	3.8	3.2	5.4
24E2----- Gara	VIe	---	---	---	---	3.3	2.8	5.1
24F2----- Gara	VIe	---	---	---	---	---	---	3.0
26B2----- Leonard	IIIe	90	71	30	33	---	3.1	4.5
28E2----- Winnegan	VIe	---	---	---	---	3.0	2.3	3.5
28F----- Winnegan	VIIe	---	---	---	---	---	---	3.0
31----- Putnam	IIw	105	80	33	40	---	3.6	5.4
40----- Arbela	IIw	112	88	37	45	---	4.0	6.0
43----- Chariton	IIw	107	85	36	43	---	3.5	5.3

See footnotes at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Grain sorghum	Soybeans	Winter wheat	Alfalfa hay	Timothy- red clover hay	Tall fescue
		Bu	Bu	Bu	Bu	Tons	Tons	AUM*
44B----- Gifford	IIe	92	75	31	39	3.5	3.1	4.7
44C2----- Gifford	IIIe	80	63	28	33	3.1	2.6	3.9
46----- Vesser	IIw	120	94	40	48	---	4.0	6.0
47----- Zook	IIw	126	96	38	43	---	3.6	5.4
49**: Dockery-----	IIw	128	105	44	53	---	4.5	6.6
Tice-----	IIw	130	110	46	60	---	4.7	7.0
54B----- Vigar	IIe	127	101	44	52	4.8	4.3	6.5
55B**: Vigar-----	IIe	107	87	38	45	4.8	4.3	6.0
Zook-----	IIw	115	85	38	45	---	3.8	5.8
Excello-----	IIw	107	84	35	43	---	3.7	5.6
56----- Wabash	IIIw	100	84	32	41	---	3.6	5.4
57----- Floris	IIIw	73	65	24	30	---	2.4	3.6
69----- Floris	IIw	90	79	32	36	---	3.0	4.5
71C----- Plainfield	IVs	50	40	18	30	2.9	2.4	3.6
71F----- Plainfield	VIIe	---	---	---	---	---	---	---

* Animal unit month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY

(Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available)

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Wind-throw hazard	Common trees	Site index	Volume*	
14C2, 14D2----- Armstrong	3C	Slight	Slight	Moderate	Slight	White oak----- Northern red oak---- Black oak-----	55 65 61	38 48 44	Eastern white pine, black oak, red oak.
16C----- Bevier	3C	Slight	Slight	Severe	Slight	White oak-----	55	38	White oak, eastern white pine.
17E2, 17F2----- Purdin	3R	Moderate	Moderate	Slight	Slight	White oak----- Post oak----- Black oak-----	60 --- ---	43 --- ---	White oak, white ash, black oak, northern red oak.
19E----- Vanmeter	2C	Moderate	Moderate	Severe	Severe	White oak-----	45	30	Eastern white pine, black oak, eastern redcedar.
19F----- Vanmeter	2R	Severe	Severe	Severe	Severe	White oak-----	45	30	Eastern white pine, black oak, eastern redcedar.
23D2**: Gorin-----	3C	Slight	Slight	Moderate	Slight	White oak----- Black oak----- Northern red oak----	53 61 62	36 44 45	White oak, northern red oak, black oak.
Winnegan-----	3A	Slight	Slight	Slight	Slight	White oak----- Post oak----- Blackjack oak----- Black oak-----	57 --- --- ---	40 --- --- ---	White oak, black oak, northern red oak.
24D2----- Gara	3A	Slight	Slight	Slight	Slight	White oak----- Northern red oak---- Black oak-----	56 57 59	39 40 41	Black oak, white oak, northern red oak.
24E2, 24F2----- Gara	3R	Moderate	Moderate	Slight	Slight	White oak----- Northern red oak---- Black oak-----	56 57 59	39 40 41	Black oak, white oak, northern red oak.
28E2, 28F----- Winnegan	3R	Moderate	Moderate	Slight	Slight	White oak----- Post oak----- Black oak-----	57 --- ---	40 --- ---	White oak, black oak, white ash, northern red oak.

See footnotes at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Wind-throw hazard	Common trees	Site index	Volume*	
49**: Dockery-----	4A	Slight	Slight	Slight	Slight	Pin oak-----	76	58	Pin oak, pecan, eastern cottonwood, green ash.
Tice-----	4A	Slight	Slight	Slight	Slight	Pin oak-----	76	58	Pin oak, pecan, eastern cottonwood, green ash.
56----- Wabash	4W	Slight	Severe	Moderate	Moderate	Pin oak-----	75	57	Pin oak, pecan, eastern cottonwood.
57----- Floris	3W	Slight	Moderate	Slight	Slight	White oak----- Eastern cottonwood--	63 105	46 141	White oak, eastern cottonwood, eastern white pine, red pine, Scotch pine.
69----- Floris	3A	Slight	Slight	Slight	Slight	White oak----- Eastern cottonwood--	63 105	46 141	White oak, eastern cottonwood, eastern white pine, red pine, Scotch pine.
71C----- Plainfield	2S	Slight	Slight	Moderate	Slight	Black oak----- White oak----- Northern red oak----	45 43 ---	30 28 ---	Black oak, eastern redcedar.
71F----- Plainfield	2R	Moderate	Moderate	Moderate	Slight	Black oak----- White oak----- Northern red oak----	45 43 ---	30 28 ---	Black oak, eastern redcedar.

* Volume is the yield in cubic feet per acre per year calculated at the age of culmination of mean annual increment for fully stocked natural stands.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
14C2, 14D2----- Armstrong	---	Eastern redcedar, Washington hawthorn, Amur privet, arrowwood, American cranberrybush, gray dogwood.	Austrian pine, green ash, bur oak.	Eastern white pine, pin oak.	---
16C----- Bevier	---	American cranberrybush, gray dogwood, Amur privet, arrowwood, Washington hawthorn, eastern redcedar.	Austrian pine, green ash, bur oak.	Eastern white pine, pin oak.	---
17E2, 17F2----- Purdin	Fragrant sumac----	Washington hawthorn, Amur maple, gray dogwood.	Hackberry, eastern redcedar, Norway spruce.	Honeylocust, pin oak, Austrian pine.	---
19E, 19F. Vanmeter					
22B----- Adco	---	American cranberrybush, gray dogwood, Amur privet, arrowwood, Washington hawthorn, eastern redcedar.	Austrian pine, green ash, bur oak.	Eastern white pine, pin oak.	---
23D2*: Gorin-----	Fragrant sumac----	Washington hawthorn, Amur maple.	Hackberry, eastern redcedar, Norway spruce.	Pin oak, Austrian pine, honeylocust.	---
Winnegan-----	---	American cranberrybush, gray dogwood, Amur privet, arrowwood, Washington hawthorn, eastern redcedar.	Austrian pine, green ash, bur oak.	Pin oak, eastern white pine.	---
24D2, 24E2, 24F2-- Gara	---	Gray dogwood, American cranberrybush, Amur privet, silky dogwood.	Northern whitecedar, white fir, Washington hawthorn, blue spruce.	Austrian pine, Norway spruce.	Eastern white pine, pin oak.

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
26B2----- Leonard	Fragrant sumac----	Amur maple-----	Hackberry, eastern redcedar, Norway spruce.	Pin oak, Austrian pine, honeylocust.	---
28E2, 28F----- Winnegan	---	American cranberrybush, gray dogwood, Amur privet, arrowwood, Washington hawthorn, eastern redcedar.	Austrian pine, green ash, bur oak.	Pin oak, eastern white pine.	---
31----- Putnam	---	American cranberrybush, gray dogwood, Amur privet, silky dogwood.	Norway spruce, Austrian pine, northern whitecedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
40----- Arbela	---	American plum, silky dogwood, gray dogwood.	Nannyberry viburnum, Washington hawthorn, white fir.	Green ash, eastern white pine, Norway spruce, sweetgum.	Pin oak.
43----- Chariton	---	Amur privet, gray dogwood, American cranberrybush, silky dogwood.	Norway spruce, Austrian pine, northern whitecedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
44B, 44C2----- Gifford	---	Gray dogwood, Amur privet, eastern redcedar, arrowwood, Washington hawthorn, American cranberrybush.	Green ash, Austrian pine, bur oak.	Pin oak, eastern white pine.	---
46----- Vesser	---	Amur privet, gray dogwood, American cranberrybush, silky dogwood.	Norway spruce, Austrian pine, northern whitecedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
47----- Zook	---	Silky dogwood, gray dogwood, American cranberrybush, Amur privet.	Norway spruce, northern whitecedar, Austrian pine, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
49*: Dockery-----	---	Silky dogwood, gray dogwood, American cranberrybush, Amur privet.	Washington hawthorn, northern whitecedar, blue spruce, white fir, Austrian pine.	Norway spruce----	Eastern white pine, pin oak.
Tice-----	---	Silky dogwood, Amur privet, American cranberrybush, gray dogwood.	Austrian pine, white fir, blue spruce, northern whitecedar, Washington hawthorn.	Norway spruce----	Eastern white pine, pin oak.
54B----- Vigar	---	Amur privet, gray dogwood, American cranberrybush, silky dogwood.	Austrian pine, white fir, blue spruce, northern whitecedar, Washington hawthorn.	Norway spruce----	Eastern white pine, pin oak.
55B*: Vigar-----	---	Amur privet, gray dogwood, American cranberrybush, silky dogwood.	Austrian pine, white fir, blue spruce, northern whitecedar, Washington hawthorn.	Norway spruce----	Eastern white pine, pin oak.
Zook-----	---	Silky dogwood, gray dogwood, American cranberrybush, Amur privet.	Norway spruce, northern whitecedar, Austrian pine, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
Excello-----	---	American cranberrybush, silky dogwood, gray dogwood, Amur privet.	Austrian pine, northern whitecedar, Norway spruce, Washington hawthorn, eastern redcedar, white fir.	Eastern white pine	Pin oak.
56----- Wabash	---	Gray dogwood, silky dogwood, Amur privet, American cranberrybush.	Norway spruce, Austrian pine, northern whitecedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
57, 69----- Floris	---	Amur privet, gray dogwood, American cranberrybush, silky dogwood.	Norway spruce, Austrian pine, northern whitecedar, blue spruce, white fir, Washington hawthorn.	---	Pin oak, eastern white pine.
71C, 71F----- Plainfield	Siberian peashrub	Eastern redcedar, radiant crabapple, Washington hawthorn, autumn- olive, gray dogwood, lilac.	Red pine, Austrian pine, jack pine.	Eastern white pine	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe")

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
14C2----- Armstrong	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness.
14D2----- Armstrong	Severe: wetness.	Moderate: slope, wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness, slope.
16C----- Bevier	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: slope.	Severe: erodes easily.	Slight.
17E2----- Purdin	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
17F2----- Purdin	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
19E----- Vanmeter	Severe: percs slowly.	Severe: percs slowly.	Severe: slope, percs slowly.	Severe: erodes easily.	Moderate: slope, depth to rock.
19F----- Vanmeter	Severe: slope, percs slowly.	Severe: slope, percs slowly.	Severe: slope, percs slowly.	Severe: slope, erodes easily.	Severe: slope.
22B----- Adco	Severe: percs slowly.	Severe: percs slowly.	Severe: percs slowly.	Slight-----	Slight.
23D2*: Gorin-----	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: slope.	Severe: erodes easily.	Slight.
Winnegan-----	Moderate: slope, wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Severe: slope.	Slight-----	Moderate: slope.
24D2----- Gara	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight-----	Moderate: slope.
24E2----- Gara	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
24F2----- Gara	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
26B2----- Leonard	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
28E2----- Winnegan	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
28F----- Winnegan	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
31----- Putnam	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.
40----- Arbela	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
43----- Chariton	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
44B----- Gifford	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, erodes easily.	Severe: wetness.
44C2----- Gifford	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: slope, wetness, percs slowly.	Severe: wetness, erodes easily.	Severe: wetness.
46----- Vesser	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
47----- Zook	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
49*: Dockery-----	Severe: flooding.	Moderate: wetness.	Moderate: wetness, flooding.	Slight-----	Moderate: flooding.
Tice-----	Severe: flooding.	Moderate: wetness.	Moderate: wetness, flooding.	Moderate: wetness.	Moderate: wetness, flooding.
54B----- Vigar	Severe: flooding.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Slight-----	Slight.
55B*: Vigar-----	Severe: flooding.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Slight-----	Slight.
Zook-----	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Excello-----	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
56----- Wabash	Severe: flooding, wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.
57----- Floris	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
69----- Floris	Severe: flooding.	Slight-----	Moderate: flooding.	Slight-----	Moderate: flooding.
71C----- Plainfield	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Moderate: droughty.
71F----- Plainfield	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor")

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hardwood trees	Conif- erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
14C2, 14D2----- Armstrong	Fair	Good	Good	Good	Fair	Very poor.	Very poor.	Good	Good	Very poor.
16C----- Bevier	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
17E2----- Purdin	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
17F2----- Purdin	Very poor.	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
19E, 19F----- Vanmeter	Very poor.	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
22B----- Adco	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
23D2*: Gorin----- Winnegan-----	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
24D2----- Gara	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Poor.
24E2----- Gara	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
24F2----- Gara	Very poor.	Fair	Good	Fair	Fair	Very poor.	Very poor.	Good	Fair	Very poor.
26B2----- Leonard	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
28E2----- Winnegan	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
28F----- Winnegan	Very poor.	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
31----- Putnam	Fair	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair.
40----- Arbela	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
43----- Chariton	Fair	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair.
44B, 44C2----- Gifford	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hardwood trees	Conif- erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
46----- Vesser	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
47----- Zook	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
49*; Dockery-----	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Tice-----	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
54B----- Vigar	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
55B*; Vigar-----	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Zook-----	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
Excello-----	Fair	Good	Good	Fair	Fair	Good	Fair	Good	Fair	Fair.
56----- Wabash	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
57, 69----- Floris	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
71C----- Plainfield	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
71F----- Plainfield	Very poor.	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
14C2----- Armstrong	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength.	Moderate: wetness.
14D2----- Armstrong	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell, slope.	Severe: shrink-swell, low strength.	Moderate: wetness, slope.
16C----- Bevier	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength, frost action.	Slight.
17E2, 17F2----- Purdin	Severe: wetness, slope.	Severe: shrink-swell, slope.	Severe: wetness, slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength, slope.	Severe: slope.
19E----- Vanmeter	Moderate: depth to rock, too clayey, slope.	Severe: shrink-swell.	Moderate: depth to rock, slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength.	Moderate: slope, depth to rock.
19F----- Vanmeter	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength, slope.	Severe: slope.
22B----- Adco	Moderate: too clayey, wetness.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength, frost action.	Slight.
23D2*: Gorin-----	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength, frost action.	Slight.
Winnegan-----	Severe: wetness.	Severe: shrink-swell.	Severe: wetness.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength.	Moderate: slope.
24D2----- Gara	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
24E2, 24F2----- Gara	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
26B2----- Leonard	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness.
28E2, 28F----- Winnegan	Severe: wetness, slope.	Severe: shrink-swell, slope.	Severe: wetness, slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength, slope.	Severe: slope.
31----- Putnam	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness.
40----- Arbela	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.	Severe: wetness.
43----- Chariton	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, wetness, frost action.	Severe: wetness.
44B, 44C2----- Gifford	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness.
46----- Vesser	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, flooding, frost action.	Moderate: wetness, flooding.
47----- Zook	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness.
49*: Dockery-----	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: low strength, flooding, frost action.	Moderate: flooding.
Tice-----	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: low strength, flooding, frost action.	Moderate: wetness, flooding.
54B----- Vigar	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: low strength, frost action.	Slight.
55B*: Vigar-----	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: low strength, frost action.	Slight.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
55B*: Zook-----	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness.
Excello-----	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, flooding, frost action.	Moderate: wetness, flooding.
56----- Wabash	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness.
57----- Floris	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
69----- Floris	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
71C----- Plainfield	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight-----	Moderate: droughty.
71F----- Plainfield	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "fair," and other terms. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
14C2, 14D2----- Armstrong	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
16C----- Bevier	Severe: wetness, percs slowly.	Moderate: slope.	Moderate: wetness, too clayey.	Moderate: wetness.	Poor: hard to pack.
17E2, 17F2----- Purdin	Severe: wetness, percs slowly, slope.	Severe: slope.	Severe: slope, too clayey.	Severe: slope.	Poor: too clayey, slope.
19E----- Vanmeter	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
19F----- Vanmeter	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: depth to rock, slope.
22B----- Adco	Severe: wetness, percs slowly.	Moderate: slope.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
23D2*: Gorin-----	Severe: wetness, percs slowly.	Severe: wetness.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
Winnegan-----	Severe: wetness, percs slowly.	Severe: slope.	Moderate: wetness, slope, too clayey.	Moderate: wetness, slope.	Fair: too clayey, slope, wetness.
24D2----- Gara	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
24E2, 24F2----- Gara	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
26B2----- Leonard	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
28E2, 28F----- Winnegan	Severe: wetness, percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
31----- Putnam	Severe: wetness, percs slowly.	Slight-----	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
40----- Arbela	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
43----- Chariton	Severe: wetness, percs slowly.	Slight-----	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
44B----- Gifford	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
44C2----- Gifford	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
46----- Vesser	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
47----- Zook	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
49*: Dockery-----	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: too clayey, wetness.
Tice-----	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: hard to pack.
54B----- Vigar	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
55B*: Vigar-----	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
Zook-----	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
Excello-----	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
56----- Wabash	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
57, 69----- Floris	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, seepage, wetness.	Fair: too clayey, wetness.
71C----- Plainfield	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
71F----- Plainfield	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
14C2, 14D2----- Armstrong	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
16C----- Bevier	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
17E2----- Purdin	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, slope.
17F2----- Purdin	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, slope.
19E----- Vanmeter	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
19F----- Vanmeter	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, slope.
22B----- Adco	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
23D2*: Gorin-----	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Winnegan-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
24D2----- Gara	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
24E2----- Gara	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
24F2----- Gara	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
26B2----- Leonard	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
28E2----- Winnegan	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, slope.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
28F----- Winnegan	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, slope.
31----- Putnam	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
40----- Arbela	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
43----- Chariton	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
44B, 44C2----- Gifford	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
46----- Vesser	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
47----- Zook	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
49*: Dockery-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Tice-----	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
54B----- Vigar	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
55B*: Vigar-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Zook-----	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Excello-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
56----- Wabash	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
57, 69----- Floris	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
71C----- Plainfield	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy.
71F----- Plainfield	Poor: slope.	Probable-----	Improbable: too sandy.	Poor: too sandy, slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
14C2----- Armstrong	Moderate: slope.	Severe: hard to pack.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Wetness, percs slowly.	Wetness, percs slowly.
14D2----- Armstrong	Severe: slope.	Severe: hard to pack.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Slope, wetness, percs slowly.	Wetness, slope, percs slowly.
16C----- Bevier	Moderate: slope.	Moderate: hard to pack, wetness.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Erodes easily, wetness.	Erodes easily, percs slowly.
17E2, 17F2----- Purdin	Severe: slope.	Moderate: wetness.	Percs slowly, slope.	Slope, wetness, percs slowly.	Slope, wetness, percs slowly.	Slope, percs slowly.
19E, 19F----- Vanmeter	Severe: slope.	Slight-----	Deep to water	Slope, percs slowly, depth to rock.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
22B----- Adco	Slight-----	Severe: hard to pack.	Percs slowly, frost action.	Wetness, percs slowly.	Erodes easily, wetness, percs slowly.	Erodes easily, percs slowly.
23D2*: Gorin-----	Moderate: slope.	Moderate: thin layer, hard to pack, wetness.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Erodes easily, wetness.	Erodes easily, percs slowly.
Winnegan-----	Severe: slope.	Moderate: wetness.	Percs slowly, slope.	Slope, wetness, percs slowly.	Slope, wetness.	Slope, percs slowly.
24D2, 24E2, 24F2-- Gara	Severe: slope.	Slight-----	Deep to water	Slope, rooting depth.	Slope-----	Slope, rooting depth.
26B2----- Leonard	Moderate: slope.	Severe: wetness.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Erodes easily, wetness.	Wetness, erodes easily.
28E2, 28F----- Winnegan	Severe: slope.	Moderate: wetness.	Percs slowly, slope.	Slope, wetness, percs slowly.	Slope, wetness.	Slope, percs slowly.
31----- Putnam	Slight-----	Severe: wetness.	Percs slowly---	Wetness, percs slowly, erodes easily.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
40----- Arbela	Moderate: seepage.	Severe: wetness.	Flooding, frost action.	Wetness, flooding.	Erodes easily, wetness.	Wetness, erodes easily.
43----- Chariton	Moderate: seepage.	Severe: hard to pack, wetness.	Percs slowly, frost action.	Wetness, percs slowly, erodes easily.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
44B, 44C2----- Gifford	Moderate: slope.	Severe: wetness.	Percs slowly, slope.	Slope, wetness, percs slowly.	Erodes easily, wetness.	Wetness, erodes easily.
46----- Vesser	Moderate: seepage.	Severe: wetness.	Flooding, frost action.	Wetness, flooding.	Erodes easily, wetness.	Wetness, erodes easily.
47----- Zook	Slight-----	Severe: hard to pack, wetness.	Percs slowly, flooding, frost action.	Wetness, percs slowly.	Wetness, percs slowly.	Wetness, percs slowly.
49*: Dockery-----	Moderate: seepage.	Moderate: piping, wetness.	Flooding, frost action.	Wetness, erodes easily.	Erodes easily, wetness.	Erodes easily.
Tice-----	Moderate: seepage.	Severe: wetness.	Flooding, frost action.	Wetness-----	Wetness-----	Favorable.
54B----- Vigar	Moderate: slope.	Moderate: wetness.	Frost action, slope.	Slope, wetness.	Wetness-----	Favorable.
55B*: Vigar-----	Moderate: slope.	Moderate: wetness.	Frost action, slope.	Slope, wetness.	Wetness-----	Favorable.
Zook-----	Moderate: slope.	Severe: hard to pack, wetness.	Percs slowly, frost action.	Slope, wetness, percs slowly.	Wetness, percs slowly.	Wetness, percs slowly.
Excello-----	Moderate: seepage.	Severe: wetness.	Flooding, frost action.	Wetness, flooding.	Wetness-----	Wetness.
56----- Wabash	Slight-----	Severe: hard to pack, wetness.	Percs slowly, flooding.	Wetness-----	Wetness, percs slowly.	Wetness, percs slowly.
57, 69----- Floris	Severe: seepage.	Severe: piping.	Deep to water	Flooding-----	Erodes easily	Erodes easily.
71C----- Plainfield	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
71F----- Plainfield	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments 3-10 inches	Percentage passing sieve number--				Liquid limit Pct	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
14C2----- Armstrong	0-6	Loam-----	CL, CL-ML	A-6, A-4	0-5	90-100	80-95	75-90	55-80	20-30	5-15
	6-47	Clay loam, clay, silty clay loam.	CL, CH, ML, MH	A-7	0-5	90-100	80-95	70-90	55-80	45-70	20-35
	47-60	Clay loam-----	CL	A-6	0-5	90-100	80-95	70-90	55-80	30-40	15-20
14D2----- Armstrong	0-5	Clay loam-----	CL	A-6, A-7	0-5	90-100	80-95	75-90	55-80	35-45	15-25
	5-40	Clay loam, clay, silty clay loam.	CL, CH, ML, MH	A-7	0-5	90-100	80-95	70-90	55-80	45-70	20-35
	40-60	Clay loam-----	CL	A-6	0-5	90-100	80-95	70-90	55-80	30-40	15-20
16C----- Bevier	0-7	Silty clay loam	CL	A-7	0	100	100	95-100	85-95	42-48	22-27
	7-22	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	85-95	55-65	30-40
	22-37	Silty clay loam	CL, CH	A-7	0	100	100	95-100	85-95	43-56	20-33
	37-60	Silt loam, loam, clay loam.	CL, CH	A-6, A-7	0	95-100	95-100	80-100	55-85	36-56	17-33
17E2----- Purdin	0-6	Clay loam-----	CL	A-6	0	95-100	95-100	70-85	60-75	30-40	11-20
	6-11	Clay loam-----	CL	A-6, A-7	0	95-100	95-100	80-95	60-75	35-45	15-25
	11-27	Clay loam, clay	CL	A-6, A-7	0	95-100	95-100	85-95	65-85	35-50	15-25
	27-48	Clay loam, clay	CL	A-7	0	95-100	95-100	85-95	65-85	40-50	15-25
17F2----- Purdin	48-60	Clay loam, loam	CL	A-6	0	95-100	95-100	80-95	60-80	30-40	11-20
	0-6	Clay loam-----	CL	A-6	0	95-100	95-100	70-85	60-75	30-40	11-20
	6-27	Clay loam, clay	CL	A-6, A-7	0	95-100	95-100	85-95	65-85	35-50	15-25
	27-46	Clay loam, clay	CL	A-7	0	95-100	95-100	85-95	65-85	40-50	15-25
19E----- Vanmeter	46-60	Clay loam, loam	CL	A-6	0	95-100	95-100	80-95	60-80	30-40	11-20
	0-6	Loam-----	CL, CL-ML	A-4, A-6	0-5	95-100	75-100	70-100	65-100	25-40	5-15
	6-32	Silty clay, clay	CH, CL	A-7	0-5	95-100	75-100	70-100	65-100	40-65	24-40
	32-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
19F----- Vanmeter	0-4	Silty clay loam	ML, MH	A-7	0-5	95-100	75-100	70-100	65-100	40-55	11-25
	4-39	Silty clay, clay	CH, CL	A-7	0-5	95-100	75-100	70-100	65-100	40-65	24-40
	39-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
22B----- Adco	0-6	Silt loam-----	CL	A-6, A-7	0	100	100	100	95-100	30-45	13-25
	6-13	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	100	95-100	30-45	13-25
	13-18	Silty clay-----	CH	A-7	0	100	100	100	95-100	66-76	41-49
	18-50	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	100	90-100	43-66	22-41
	50-60	Silt loam, silty clay loam, clay loam.	CL	A-6, A-7	0	100	100	95-100	75-100	31-51	13-29
23D2*: Gorin-----	0-6	Silt loam-----	CL, CL-ML	A-4, A-6	0	100	100	95-100	85-100	25-40	5-18
	6-13	Silty clay loam, silty clay.	CL	A-6, A-7	0	100	100	95-100	90-100	35-50	15-30
	13-33	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	90-100	50-65	30-40
	33-49	Loam, silt loam	CL	A-4, A-6	0	100	95-100	85-100	65-90	25-35	8-15
	49-60	Clay, clay loam	CH, CL	A-7	0	95-100	95-100	90-100	70-95	45-70	30-45

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments 3-10 inches Pct	Percentage passing sieve number--				Liquid limit Pct	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
23D2*: Winnegan-----	0-5	Silt loam-----	CL-ML, CL	A-4, A-6	0	95-100	95-100	80-90	60-80	20-30	5-15
	5-12	Loam, clay loam	CL-ML, CL	A-4, A-6	0	95-100	95-100	80-90	60-80	20-30	5-15
	12-39	Clay loam, clay	CL	A-7	0	95-100	95-100	85-95	65-85	40-50	20-30
	39-50	Clay loam, clay	CL	A-7	0	95-100	95-100	85-95	65-85	40-50	20-30
	50-60	Clay loam, loam	CL	A-6	0	95-100	95-100	85-95	60-80	25-40	10-20
24D2----- Gara	0-6	Loam-----	CL	A-6, A-7	0	90-95	85-95	70-85	55-75	35-45	15-25
	6-36	Clay loam, loam	CL	A-6	0-5	90-95	85-95	70-85	55-75	30-40	15-25
	36-60	Clay loam, loam	CL	A-6	0-5	90-95	85-95	70-85	55-75	30-40	15-25
24E2, 24F2----- Gara	0-5	Fine sandy loam	SM, SC, SC-SM	A-2, A-4	0	100	100	80-95	30-50	15-30	NP-10
	5-30	Clay loam, loam	CL	A-6	0-5	90-95	85-95	70-85	55-75	30-40	15-25
	30-60	Clay loam, loam	CL	A-6	0-5	90-95	85-95	70-85	55-75	30-40	15-25
26B2----- Leonard	0-6	Silty clay loam	CL	A-6, A-7	0	100	95-100	90-100	85-100	30-45	15-25
	6-14	Silty clay loam, silty clay.	CL	A-6, A-7	0	100	95-100	90-100	85-100	35-50	20-30
	14-42	Silty clay, clay, silty clay loam.	CH	A-7	0	100	95-100	85-100	80-100	55-70	30-40
	42-60	Silty clay, clay loam, silty clay loam.	CL, CH	A-7	0	95-100	95-100	90-100	75-90	45-60	25-35
28E2, 28F----- Winnegan	0-4	Loam-----	CL-ML, CL	A-4, A-6	0	95-100	95-100	80-90	60-80	20-30	5-15
	4-26	Clay loam, clay	CL	A-7	0	95-100	95-100	85-95	65-85	40-50	20-30
	26-36	Clay loam, clay	CL	A-7	0	95-100	95-100	85-95	65-85	40-50	20-30
	36-60	Clay loam, loam	CL	A-6	0	95-100	95-100	85-95	60-80	25-40	10-20
31----- Putnam	0-8	Silt loam-----	CL, ML	A-6, A-4	0	100	100	90-100	85-100	30-40	5-15
	8-15	Silt loam-----	CL, ML	A-4, A-6	0	100	100	90-100	85-100	30-40	5-15
	15-20	Silty clay, clay	CH	A-7	0	100	100	95-100	90-100	60-70	35-45
	20-47	Silty clay loam, silty clay.	CH	A-7	0	100	100	95-100	90-100	50-65	25-40
	47-60	Silty clay loam	CL	A-7	0	100	100	95-100	90-100	40-50	20-30
40----- Arbela	0-10	Silty clay loam	CL	A-6	0	100	100	95-100	90-100	30-40	10-20
	10-20	Silt loam, silty clay loam.	CL-ML, CL	A-4, A-6	0	100	100	95-100	90-100	25-35	5-15
	20-54	Silty clay loam, silty clay.	CL	A-6, A-7	0	100	100	95-100	90-100	35-50	20-30
	54-60	Silty clay loam, clay loam.	CL	A-6	0	100	100	90-100	70-95	30-40	15-25
43----- Chariton	0-9	Silt loam-----	CL-ML, CL	A-4, A-6	0	100	100	90-100	70-90	25-35	5-15
	9-16	Silt loam-----	CL-ML	A-4, A-6	0	100	100	90-100	70-90	25-35	5-15
	16-37	Silty clay-----	CH	A-7	0	100	100	95-100	90-95	55-75	40-50
	37-48	Silty clay loam	CL, CH	A-7	0	100	100	95-100	85-95	45-55	25-35
	48-60	Sandy clay loam, fine sandy loam, clay loam.	CL, SC, CL-ML, SC-SM	A-6, A-4	0	100	100	80-95	40-70	20-35	5-20
44B----- Gifford	0-8	Silty clay loam	CL	A-6	0	100	100	90-100	85-95	30-40	10-20
	8-11	Silty clay loam	CL	A-6	0	100	100	90-100	85-95	30-40	10-20
	11-19	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	95-100	50-65	30-40
	19-60	Silty clay loam, clay loam.	CL	A-6, A-7	0	100	100	85-100	75-90	35-45	20-25

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
44C2----- Gifford	0-4	Silty clay loam	CL	A-6	0	100	100	90-100	85-95	30-40	10-20
	4-60	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	95-100	50-65	30-40
46----- Vesser	0-18	Silt loam-----	CL	A-6	0	100	100	98-100	95-100	30-40	10-20
	18-41	Silt loam-----	CL	A-6	0	100	100	98-100	95-100	30-40	10-20
	41-60	Silty clay loam	CL	A-7	0	100	100	98-100	95-100	40-50	15-25
47----- Zook	0-31	Silty clay loam	CH, CL	A-7	0	100	100	95-100	95-100	45-65	20-35
	31-60	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	95-100	60-85	35-55
49*: Dockery-----	0-8	Silt loam-----	CL-ML, CL	A-4, A-6	0	100	100	90-100	85-100	25-35	5-15
	8-55	Silt loam, silty clay loam.	CL	A-4, A-6	0	100	100	90-100	85-95	25-40	8-20
	55-60	Stratified sandy loam to silt loam.	CL-ML, CL, SC	A-4, A-6	0	100	100	65-95	35-85	25-35	5-12
Tice-----	0-20	Silt loam-----	CL	A-6, A-7	0	100	100	90-100	80-95	30-45	10-20
	20-30	Silty clay loam, silt loam.	CL, CH	A-7	0	100	100	95-100	85-95	40-55	15-30
	30-60	Stratified silty clay loam to loam.	CL-ML, CL	A-4, A-6, A-7	0	100	100	60-95	55-80	25-45	5-20
54B----- Vigar	0-19	Loam-----	CL-ML, CL	A-4, A-6	0	95-100	90-100	85-95	60-75	20-30	5-15
	19-60	Clay loam, silty clay loam, loam.	CL	A-6	0	95-100	90-100	70-95	60-90	30-40	15-25
55B*: Vigar-----	0-19	Loam-----	CL-ML, CL	A-4, A-6	0	95-100	90-100	85-95	60-75	20-30	5-15
	19-60	Clay loam, silty clay loam, loam.	CL	A-6	0	95-100	90-100	70-95	60-90	30-40	15-25
Zook-----	0-10	Silty clay loam	CH, CL	A-7	0	100	100	95-100	95-100	45-65	20-35
	10-60	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	95-100	60-85	35-55
Excello-----	0-13	Loam-----	CL	A-6	0	100	100	85-100	60-90	30-40	11-20
	13-47	Loam, clay loam, sandy clay loam.	CL	A-6, A-7	0	100	100	80-100	50-95	30-50	11-30
	47-60	Loam, clay loam, sandy clay loam.	CL	A-6, A-7	0	100	100	80-100	50-80	30-50	11-30
56----- Wabash	0-10	Silty clay loam	CL, CH	A-6, A-7	0	100	100	100	95-100	35-55	15-35
	10-60	Silty clay, clay	CH	A-7	0	100	100	100	95-100	52-78	30-55
57----- Floris	0-12	Loam-----	CL, ML, CL-ML	A-4	0	100	95-100	90-100	50-75	<30	3-10
	12-24	Fine sandy loam, sandy loam.	SM, SC, SC-SM	A-2-4, A-4	0	100	95-100	65-95	20-45	<30	NP-10
	24-60	Loam, silt loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	100	100	95-100	70-100	25-35	5-15
69----- Floris	0-32	Silt loam-----	CL, ML, CL-ML	A-4	0	100	95-100	90-100	50-75	<30	3-10
	32-43	Fine sandy loam, sandy loam.	SM, SC, SC-SM	A-2-4, A-4	0	100	95-100	65-95	20-45	<30	NP-10
	43-60	Loam, silt loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	100	100	95-100	70-100	25-35	5-15

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	<u>In</u>				<u>Pct</u>					<u>Pct</u>	
71C, 71F----- Plainfield	0-2	Loamy sand-----	SM, SP-SM	A-2, A-4, A-1	0	75-100	75-100	40-90	12-40	---	NP
	2-28	Sand-----	SP, SM, SP-SM	A-3, A-1, A-2	0	75-100	75-100	40-70	1-15	---	NP
	28-60	Sand, fine sand	SP, SM, SP-SM	A-3, A-1, A-2	0	75-100	75-100	40-90	1-15	---	NP

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
14C2----- Armstrong	0-6	22-27	1.45-1.50	0.6-2.0	0.20-0.22	5.6-7.3	Moderate-----	0.32	3	6	2-3
	6-47	36-60	1.45-1.55	0.06-0.2	0.11-0.16	4.5-6.5	High-----	0.32			
	47-60	30-36	1.55-1.70	0.2-0.6	0.14-0.16	5.1-7.8	Moderate-----	0.32			
14D2----- Armstrong	0-5	27-40	1.45-1.50	0.2-0.6	0.18-0.20	5.6-7.3	Moderate-----	0.32	3	4	2-3
	5-40	36-60	1.45-1.55	0.06-0.2	0.11-0.16	4.5-6.5	High-----	0.32			
	40-60	30-36	1.55-1.70	0.2-0.6	0.14-0.16	5.1-7.8	Moderate-----	0.32			
16C----- Bevier	0-7	27-32	1.30-1.50	0.2-0.6	0.20-0.23	5.6-7.3	Moderate-----	0.37	3	7	2-4
	7-22	35-52	1.30-1.50	0.06-0.2	0.11-0.20	5.1-7.3	High-----	0.28			
	22-37	27-40	1.30-1.50	0.2-0.6	0.18-0.20	5.1-7.3	High-----	0.32			
	37-60	20-40	1.30-1.50	0.2-0.6	0.14-0.18	5.1-7.3	High-----	0.32			
17E2----- Purdin	0-6	27-35	1.20-1.40	0.2-0.6	0.16-0.18	4.5-7.3	Moderate-----	0.32	3-2	6	1-2
	6-11	30-40	1.35-1.55	0.2-0.6	0.12-0.16	4.5-6.5	Moderate-----	0.32			
	11-27	35-45	1.35-1.55	0.06-0.2	0.10-0.16	4.5-7.3	High-----	0.32			
	27-48	35-45	1.35-1.55	0.06-0.2	0.10-0.16	7.4-8.4	High-----	0.32			
	48-60	24-35	1.40-1.60	0.2-0.6	0.12-0.17	7.4-8.4	Moderate-----	0.32			
17F2----- Purdin	0-6	27-35	1.20-1.40	0.2-0.6	0.16-0.18	4.5-7.3	Moderate-----	0.32	3-2	6	1-2
	6-27	35-45	1.35-1.55	0.06-0.2	0.10-0.16	4.5-7.3	High-----	0.32			
	27-46	35-45	1.35-1.55	0.06-0.2	0.10-0.16	7.4-8.4	High-----	0.32			
	46-60	24-35	1.40-1.60	0.2-0.6	0.12-0.17	7.4-8.4	Moderate-----	0.32			
19E----- Vanmeter	0-6	18-27	1.30-1.40	0.2-0.6	0.18-0.20	6.1-8.4	Low-----	0.37	3	4L	1-2
	6-32	40-60	1.50-1.60	<0.06	0.12-0.14	6.1-8.4	High-----	0.32			
	32-60	---	---	<0.06	---	---	-----	---			
19F----- Vanmeter	0-4	27-35	1.30-1.40	0.2-0.6	0.14-0.16	6.1-8.4	Moderate-----	0.43	2	4L	1-2
	4-39	40-60	1.50-1.60	<0.06	0.12-0.14	6.1-8.4	High-----	0.32			
	39-60	---	---	<0.06	---	---	-----	---			
22B----- Adco	0-6	15-27	1.20-1.40	0.6-2.0	0.20-0.24	4.5-7.3	Low-----	0.32	3	6	2-4
	6-13	15-30	1.20-1.40	0.6-2.0	0.16-0.20	4.5-6.5	Low-----	0.32			
	13-18	50-60	1.20-1.40	<0.06	0.09-0.11	5.1-6.5	High-----	0.43			
	18-50	32-50	1.25-1.45	0.06-0.2	0.12-0.18	5.1-7.3	High-----	0.43			
	50-60	15-35	1.30-1.50	0.06-0.2	0.14-0.18	5.6-7.3	Moderate-----	0.43			
23D2*: Gorin	0-6	12-27	1.30-1.50	0.6-2.0	0.22-0.24	5.1-7.3	Moderate-----	0.43	3	6	.5-1
	6-13	27-42	1.30-1.45	0.06-0.6	0.18-0.20	4.5-6.5	Moderate-----	0.32			
	13-33	35-60	1.30-1.40	0.06-0.2	0.11-0.16	4.5-6.0	High-----	0.32			
	33-49	20-27	1.30-1.45	0.2-0.6	0.17-0.20	4.5-6.5	Moderate-----	0.32			
	49-60	35-60	1.30-1.40	<0.06	0.10-0.12	4.5-6.5	High-----	0.32			
Winnegan-----	0-5	18-27	1.20-1.40	0.6-2.0	0.20-0.24	4.5-7.3	Low-----	0.32	3	6	.5-1
	5-12	20-30	1.25-1.45	0.2-0.6	0.15-0.19	4.5-6.5	Moderate-----	0.32			
	12-39	35-45	1.35-1.55	0.06-0.2	0.09-0.15	4.5-6.5	High-----	0.32			
	39-50	35-45	1.35-1.55	0.06-0.2	0.09-0.15	7.4-8.4	High-----	0.32			
	50-60	20-35	1.40-1.60	0.2-0.6	0.09-0.15	7.4-8.4	Moderate-----	0.32			
24D2----- Gara	0-6	22-27	1.50-1.55	0.2-0.6	0.16-0.18	5.6-7.3	Moderate-----	0.32	5	6	2-3
	6-36	25-38	1.55-1.75	0.2-0.6	0.16-0.18	4.5-6.5	Moderate-----	0.32			
	36-60	24-38	1.65-1.75	0.2-0.6	0.16-0.18	5.6-8.4	Moderate-----	0.37			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
24E2, 24F2----- Gara	0-5	12-18	1.50-1.55	2.0-6.0	0.12-0.15	5.6-7.3	Low-----	0.20	5	6	1-2
	5-30	25-38	1.55-1.75	0.2-0.6	0.16-0.18	4.5-6.5	Moderate----	0.32			
	30-60	24-38	1.65-1.75	0.2-0.6	0.16-0.18	5.6-8.4	Moderate----	0.37			
26B2----- Leonard	0-6	27-35	1.20-1.40	0.2-0.6	0.22-0.24	6.1-7.3	Moderate----	0.37	3	7	1-2
	6-14	35-45	1.30-1.45	0.06-0.2	0.11-0.13	4.5-6.5	High-----	0.37			
	14-42	35-50	1.20-1.35	0.06-0.2	0.10-0.12	4.5-6.5	High-----	0.37			
	42-60	32-50	1.25-1.40	0.06-0.2	0.11-0.14	5.1-7.8	High-----	0.37			
28E2, 28F----- Winnegan	0-4	18-27	1.20-1.40	0.6-2.0	0.20-0.24	4.5-7.3	Low-----	0.32	3	6	.5-2
	4-26	35-45	1.35-1.55	0.06-0.2	0.09-0.15	4.5-6.5	High-----	0.32			
	26-36	35-45	1.35-1.55	0.06-0.2	0.09-0.15	7.4-8.4	High-----	0.32			
	36-60	20-35	1.40-1.60	0.2-0.6	0.09-0.15	7.4-8.4	Moderate----	0.32			
31----- Putnam	0-8	12-27	1.30-1.45	0.6-2.0	0.22-0.24	4.5-7.3	Low-----	0.43	3	6	2-3
	8-15	12-27	1.30-1.50	0.6-2.0	0.20-0.22	4.5-6.5	Low-----	0.43			
	15-20	48-60	1.20-1.40	<0.06	0.09-0.11	3.6-5.5	High-----	0.28			
	20-47	35-48	1.25-1.45	0.06-0.2	0.12-0.16	3.6-5.5	High-----	0.37			
	47-60	27-35	1.30-1.50	0.06-0.2	0.14-0.18	5.1-6.5	Moderate----	0.43			
40----- Arbela	0-10	27-30	1.30-1.50	0.6-2.0	0.20-0.22	5.6-7.3	Low-----	0.32	5	7	2-4
	10-20	18-30	1.35-1.55	0.6-2.0	0.20-0.22	5.1-6.5	Low-----	0.43			
	20-54	35-45	1.30-1.40	0.2-0.6	0.18-0.20	4.5-6.0	Moderate----	0.43			
	54-60	27-36	1.30-1.40	0.2-0.6	0.16-0.20	5.6-6.5	Moderate----	0.43			
43----- Chariton	0-9	18-27	1.35-1.50	0.6-2.0	0.22-0.24	5.1-7.3	Low-----	0.37	3	6	2-4
	9-16	15-24	1.35-1.50	0.6-2.0	0.20-0.22	5.1-6.5	Low-----	0.37			
	16-37	48-60	1.35-1.45	0.06-0.2	0.11-0.13	5.1-7.3	High-----	0.28			
	37-48	32-40	1.35-1.45	0.2-0.6	0.18-0.20	6.1-7.8	Moderate----	0.43			
	48-60	15-35	1.40-1.55	0.6-2.0	0.15-0.18	6.1-7.8	Moderate----	0.32			
44B----- Gifford	0-8	27-35	1.30-1.45	0.6-2.0	0.22-0.24	5.1-7.3	Low-----	0.43	3	7	1-2
	8-11	27-35	1.30-1.45	0.2-0.6	0.18-0.20	5.1-6.5	Low-----	0.43			
	11-19	35-50	1.30-1.45	<0.06	0.11-0.14	5.1-7.3	High-----	0.32			
	19-60	25-35	1.35-1.50	0.06-0.2	0.18-0.20	5.6-7.3	Moderate----	0.43			
44C2----- Gifford	0-4	27-35	1.30-1.45	0.6-2.0	0.22-0.24	5.1-7.3	Low-----	0.43	3	7	1-2
	4-60	35-50	1.30-1.45	<0.06	0.11-0.14	5.1-7.3	High-----	0.32			
46----- Vesser	0-18	20-27	1.30-1.35	0.6-2.0	0.20-0.24	5.6-7.3	Moderate----	0.28	5	6	2-3
	18-41	18-22	1.35-1.40	0.6-2.0	0.18-0.22	5.1-6.0	Moderate----	0.43			
	41-60	30-35	1.40-1.45	0.6-2.0	0.17-0.21	5.1-6.5	Moderate----	0.43			
47----- Zook	0-31	35-40	1.30-1.35	0.2-0.6	0.21-0.23	5.6-7.3	High-----	0.28	5	4	4-6
	31-60	35-45	1.30-1.45	0.06-0.2	0.11-0.13	5.6-7.3	High-----	0.28			
49*: Dockery-----	0-8	15-27	1.35-1.45	0.6-2.0	0.22-0.24	5.6-7.3	Low-----	0.37	5	6	2-4
	8-55	18-30	1.35-1.45	0.6-2.0	0.20-0.24	5.6-7.8	Moderate----	0.37			
	55-60	15-27	1.35-1.45	0.6-2.0	0.12-0.20	5.6-7.3	Low-----	0.37			
Tice-----	0-20	22-27	1.25-1.45	0.6-2.0	0.21-0.24	6.1-7.8	Moderate----	0.32	5	6	2-3
	20-30	24-35	1.30-1.50	0.6-2.0	0.18-0.20	5.6-7.8	Moderate----	0.32			
	30-60	15-30	1.40-1.60	0.6-2.0	0.11-0.18	5.6-7.8	Moderate----	0.32			
54B----- Vigar	0-19	15-27	1.25-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low-----	0.24	5	5	2-4
	19-60	24-35	1.20-1.40	0.2-0.6	0.14-0.16	5.6-7.3	Moderate----	0.32			
55B*: Vigar-----	0-19	15-27	1.25-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low-----	0.24	5	5	2-4
	19-60	24-35	1.20-1.40	0.2-0.6	0.14-0.16	5.6-7.3	Moderate----	0.32			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth		Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodi- bility group	Organic matter Pct
	In	Pct							K	T		
55B*: Zook-----	0-10	35-40	1.30-1.35	0.2-0.6	0.21-0.23	5.6-7.3	High-----	0.28	5	4	4-6	
	10-60	35-45	1.30-1.45	0.06-0.2	0.11-0.13	5.6-7.3	High-----	0.28				
Excello-----	0-13	18-27	1.35-1.45	0.6-2.0	0.22-0.24	6.1-7.3	Moderate----	0.28	5	6	2-4	
	13-47	18-35	1.40-1.60	0.6-2.0	0.15-0.19	6.1-7.3	Moderate----	0.28				
	47-60	18-35	1.50-1.65	0.6-2.0	0.14-0.19	6.1-7.3	Moderate----	0.28				
56----- Wabash	0-10	27-35	1.35-1.50	0.06-0.2	0.21-0.24	5.1-7.3	High-----	0.28	5	7	2-4	
	10-60	40-60	1.20-1.45	<0.06	0.08-0.12	5.1-7.8	Very high----	0.28				
57----- Floris	0-12	10-18	1.25-1.30	2.0-6.0	0.20-0.22	6.1-7.3	Low-----	0.32	5	5	1-2	
	12-24	5-18	1.25-1.35	2.0-6.0	0.13-0.18	6.1-7.3	Low-----	0.20				
	24-60	18-38	1.25-1.35	0.6-2.0	0.20-0.23	6.1-7.3	Moderate----	0.43				
69----- Floris	0-32	10-18	1.25-1.30	2.0-6.0	0.20-0.22	6.1-7.3	Low-----	0.32	5	5	1-2	
	32-43	5-18	1.25-1.35	2.0-6.0	0.13-0.18	6.1-7.3	Low-----	0.20				
	43-60	18-38	1.25-1.35	0.6-2.0	0.20-0.23	6.1-7.3	Moderate----	0.43				
71C, 71F----- Plainfield	0-2	3-7	1.50-1.65	2.0-6.0	0.09-0.12	4.5-7.3	Low-----	0.17	5	2	.5-1	
	2-28	0-4	1.50-1.65	6.0-20	0.04-0.07	4.5-7.3	Low-----	0.17				
	28-60	0-4	1.50-1.70	6.0-20	0.04-0.07	4.5-6.5	Low-----	0.17				

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--SOIL AND WATER FEATURES

("Flooding," "water table," and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
14C2, 14D2----- Armstrong	C	None-----	---	---	1.0-3.0	Perched	Nov-May	>60	---	High-----	High-----	Moderate.
16C----- Bevier	C	None-----	---	---	2.0-4.0	Perched	Nov-Apr	>60	---	High-----	High-----	Moderate.
17E2, 17F2----- Purdin	C	None-----	---	---	2.0-3.5	Perched	Nov-Apr	>60	---	Moderate	High-----	High.
19E, 19F----- Vanmeter	C	None-----	---	---	>6.0	---	---	20-40	Soft	Moderate	High-----	Low.
22B----- Adco	D	None-----	---	---	2.0-4.0	Perched	Nov-May	>60	---	High-----	High-----	Moderate.
23D2*: Gorin-----	C	None-----	---	---	2.0-4.0	Perched	Nov-Apr	>60	---	High-----	High-----	Moderate.
Winnegan-----	C	None-----	---	---	2.0-3.5	Perched	Nov-Apr	>60	---	Moderate	High-----	High.
24D2, 24E2, 24F2-- Gara	C	None-----	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
26B2----- Leonard	D	None-----	---	---	0.5-2.0	Perched	Nov-May	>60	---	High-----	High-----	Moderate.
28E2, 28F----- Winnegan	C	None-----	---	---	2.0-3.5	Perched	Nov-Apr	>60	---	Moderate	High-----	High.
31----- Putnam	D	None-----	---	---	0.5-1.5	Perched	Nov-May	>60	---	Moderate	High-----	High.
40----- Arbela	C	Occasional	Brief-----	Nov-Apr	0-1.5	Apparent	Nov-May	>60	---	High-----	High-----	Moderate.
43----- Chariton	C	None-----	---	---	0-1.5	Perched	Nov-May	>60	---	High-----	High-----	Moderate.
44B, 44C2----- Gifford	D	None-----	---	---	0.5-2.0	Perched	Nov-Apr	>60	---	Moderate	High-----	Moderate.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
46----- Vesser	C	Occasional	Brief-----	Nov-Apr	1.0-3.0	Apparent	Nov-Jun	>60	---	High-----	High-----	Moderate.
47----- Zook	C	Occasional	Brief-----	Nov-May	0.-2.0	Apparent	Nov-Jun	>60	---	High-----	High-----	Moderate.
49*: Dockery-----	C	Occasional	Brief-----	Nov-May	2.0-3.0	Apparent	Nov-Apr	>60	---	High-----	Moderate	Low.
Tice-----	B	Occasional	Very brief	Nov-May	1.5-3.0	Apparent	Nov-Apr	>60	---	High-----	High-----	Low.
54B----- Vigar	C	Rare-----	---	---	2.0-3.0	Apparent	Nov-Apr	>60	---	High-----	High-----	Moderate.
55B*: Vigar-----	C	Rare-----	---	---	2.0-3.0	Apparent	Nov-Apr	>60	---	High-----	High-----	Moderate.
Zook-----	C	Rare-----	---	---	0.-2.0	Apparent	Nov-Jun	>60	---	High-----	High-----	Moderate.
Excello-----	B/D	Occasional	Brief-----	Nov-May	1.0-3.0	Apparent	Nov-May	>60	---	High-----	High-----	Low.
56----- Wabash	D	Occasional	Brief-----	Nov-May	0-1.0	Apparent	Nov-May	>60	---	Moderate	High-----	Moderate.
57----- Floris	B	Frequent---	Very brief to brief.	Nov-May	3.0-5.0	Apparent	Nov-May	>60	---	Moderate	Low-----	Moderate.
69----- Floris	B	Occasional	Very brief to brief.	Nov-May	3.0-5.0	Apparent	Nov-May	>60	---	Moderate	Low-----	Moderate.
71C, 71F----- Plainfield	A	None-----	---	---	>6.0	---	---	>60	---	Low-----	Low-----	High.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Adco-----	Fine, montmorillonitic, mesic Vertic Albaqualfs
Arbela-----	Fine, montmorillonitic, mesic Argiaquic Argialbolls
Armstrong-----	Fine, montmorillonitic, mesic Aquertic Hapludalfs
Bevier-----	Fine, montmorillonitic, mesic Vertic Epiaqualfs
Chariton-----	Fine, montmorillonitic, mesic Vertic Albaqualfs
Dockery-----	Fine-silty, mixed, nonacid, mesic Aquic Udifluvents
Excello-----	Fine-loamy, mixed, mesic Cumulic Endoaquolls
Floris-----	Coarse-loamy, mixed, nonacid, mesic Typic Udifluvents
Gara-----	Fine-loamy, mixed, mesic Mollic Hapludalfs
Gifford-----	Fine, montmorillonitic, mesic Vertic Epiaqualfs
Gorin-----	Fine, montmorillonitic, mesic Aquertic Hapludalfs
Leonard-----	Fine, montmorillonitic, mesic, sloping Vertic Epiaqualfs
Plainfield-----	Mixed, mesic Typic Udipsamments
Purdin-----	Fine, mixed, mesic Oxyaquic Hapludalfs
Putnam-----	Fine, montmorillonitic, mesic Vertic Albaqualfs
Tice-----	Fine-silty, mixed, mesic Fluvaquentic Hapludolls
Vanmeter-----	Fine, illitic, mesic Typic Eutrochrepts
Vesser-----	Fine-silty, mixed, mesic Argiaquic Argialbolls
Vigar-----	Fine-loamy, mixed, mesic Aquic Argiudolls
Wabash-----	Fine, montmorillonitic, mesic Vertic Endoaquolls
Winnegan-----	Fine, mixed, mesic Oxyaquic Hapludalfs
Zook-----	Fine, montmorillonitic, mesic Vertic Endoaquolls

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