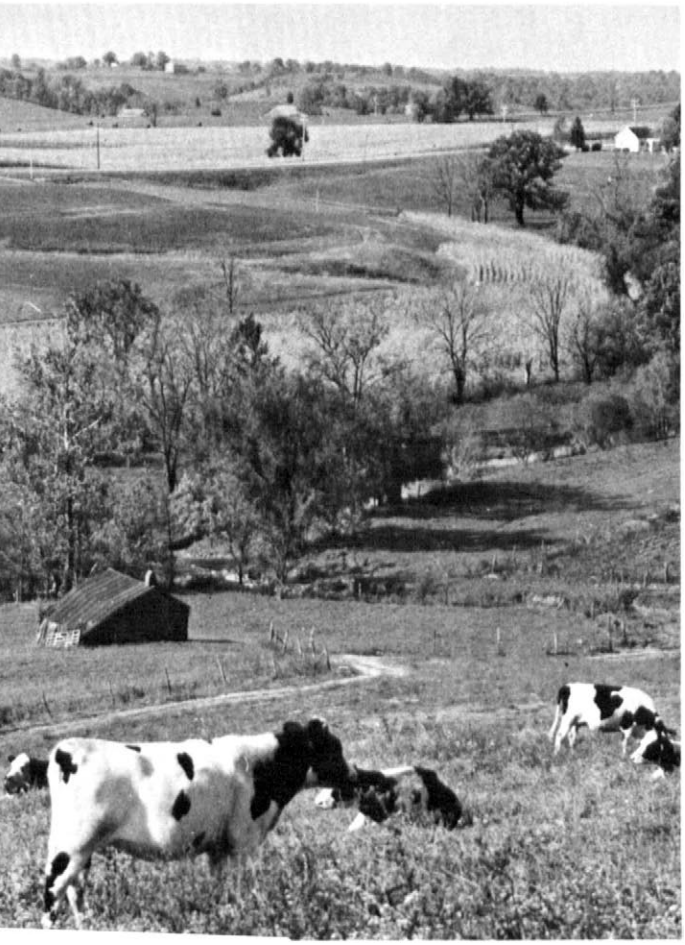


soil survey of

GRANT and PENDLETON COUNTIES, KENTUCKY

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

in cooperation with

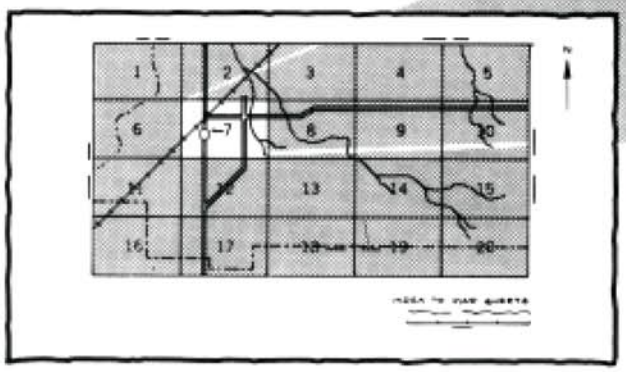
KENTUCKY DEPARTMENT FOR NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION

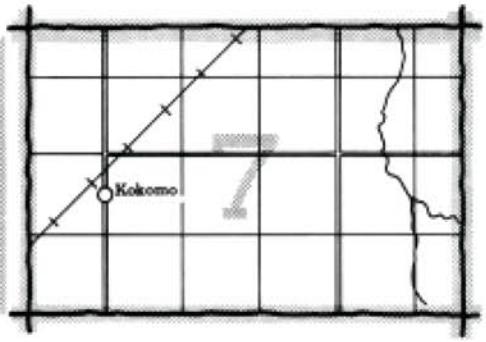
and

KENTUCKY AGRICULTURAL EXPERIMENT STATION

HOW TO USE

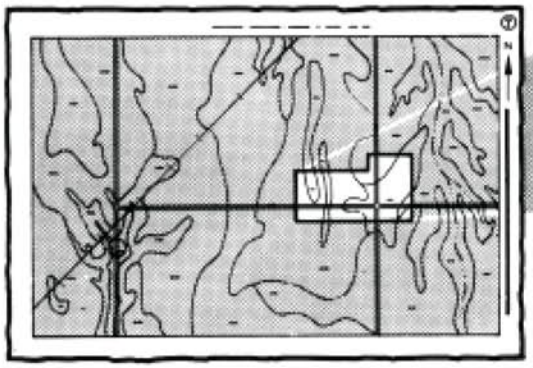
1. Locate your area of interest on the "Index to Map Sheets"

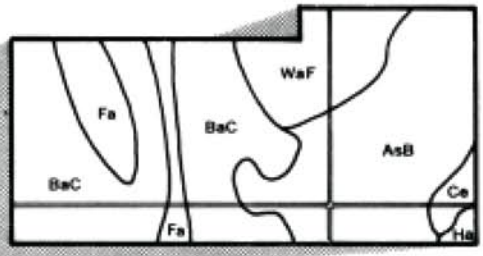




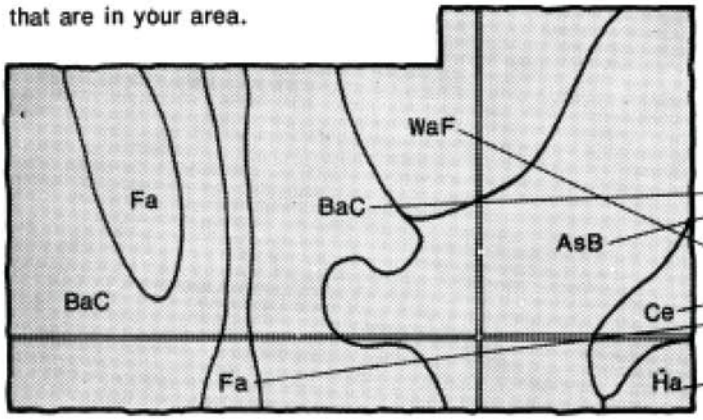
2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.





4. List the map unit symbols that are in your area.

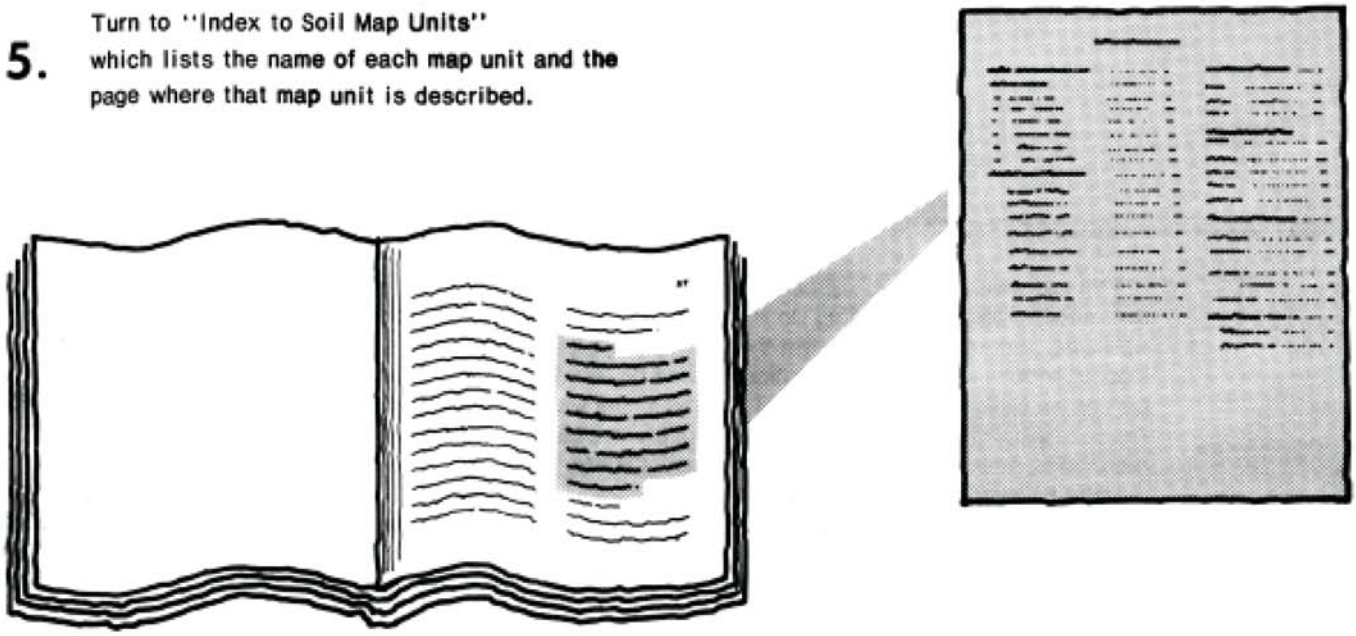


Symbols

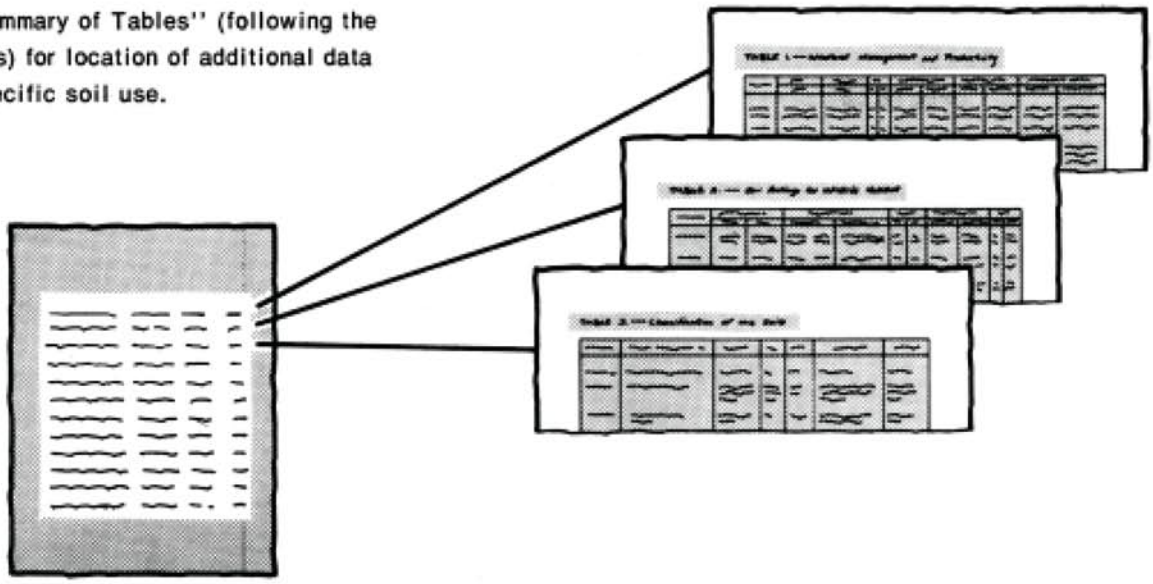
AsB
BaC
Ce
Fa
Ha
WaF

THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

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 Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was performed in the period 1973-77. Soil names and descriptions were approved in 1978. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1978. This survey was made cooperatively by the Soil Conservation Service, the Kentucky Department for Natural Resources and Environmental Protection, and the Kentucky Agricultural Experiment Station. It is part of the technical assistance furnished to the Grant and Pendleton Counties Conservation Districts.

Cover: Crop production and livestock raising are major uses of rural land in the survey area.

Contents

Issued February 1980

Index to map units

Summary of tables

Summary of tables—Continued

Foreword

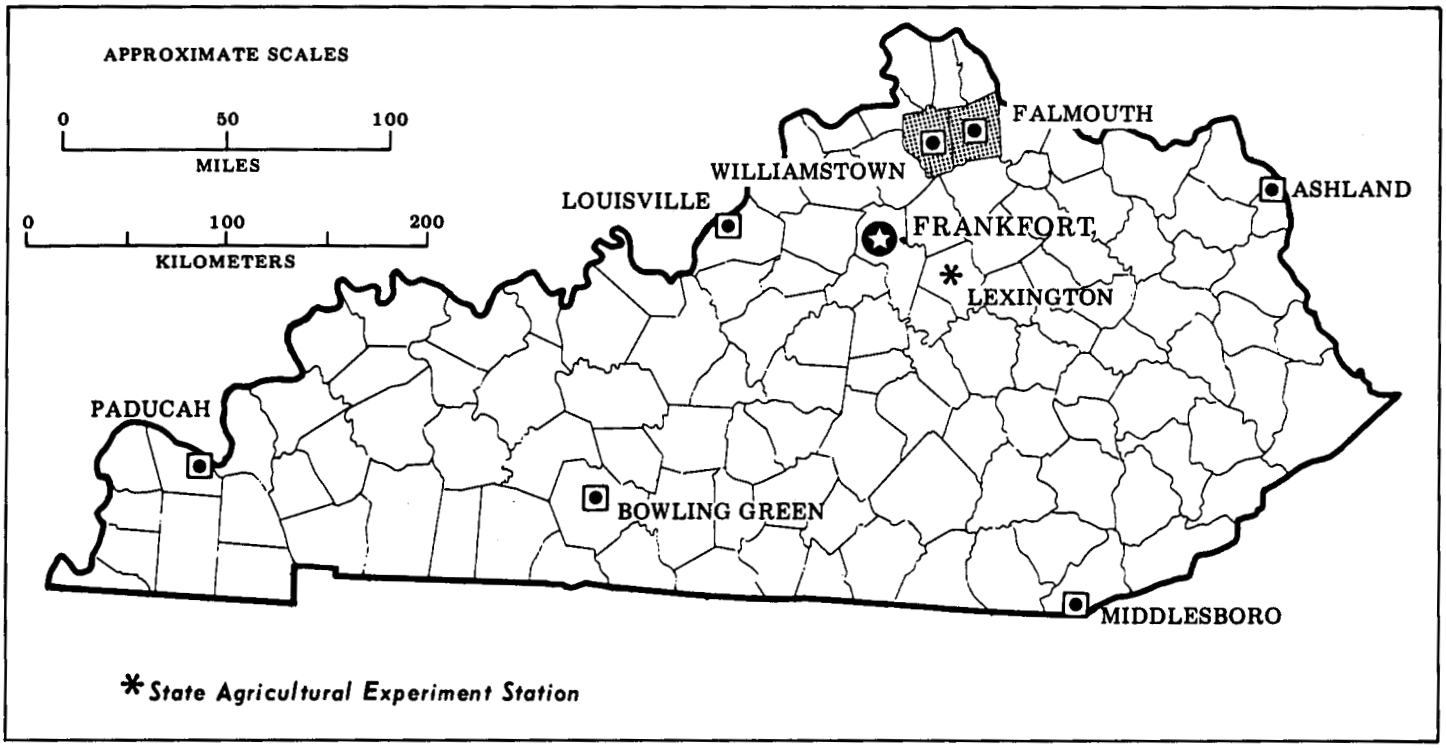
This soil survey contains information that can be used in land-planning programs in Grant and Pendleton Counties. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, 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 insure 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 to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as 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 Soil Conservation Service or the Cooperative Extension Service.

Glen E. Murray
State Conservationist
Soil Conservation Service



Location of Grant and Pendleton Counties in Kentucky.

SOIL SURVEY OF GRANT AND PENDLETON COUNTIES, KENTUCKY

By Ronnie B. Froedge and Billy C. Weisenburger, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service,
in cooperation with
Kentucky Department for Natural Resources and Environmental Protection,
and Kentucky Agricultural Experiment Station

GRANT AND PENDLETON COUNTIES are in the northern part of Kentucky. Williamstown is the county seat of Grant County and has a population of 2,063. Falmouth is the county seat of Pendleton County and has a population of 2,593. Grant County has a total land area of 159,170 acres, or 248.7 square miles, and Pendleton County has 178,620 acres, or 279.1 square miles.

The climate in Grant and Pendleton Counties is humid-temperate. Summer is hot, and winter is moderately cold. Rainfall is fairly heavy and well distributed throughout the year. Snowfall occurs nearly every winter, but the snow cover generally lasts only a few days.

Throughout the survey area, the topography is dominantly steep. It mainly consists of long, narrow ridges and narrow valleys between the ridges. Some gently sloping broad ridges, however, are in the north-central part of Grant County. Generally, the soils are deep on the broader ridges and moderately deep to shallow on the narrow ridges and side slopes. Eagle Creek, Licking River, and South Fork Licking River are the main stream valley systems in the survey area. Eagle Creek is in the western part of Grant County and extends in a north-south direction. The Licking River flows from the southeastern corner of Pendleton County to Falmouth, then runs north through the center of the county. South Fork Licking River flows from the southwestern corner of Pendleton County and merges with the Licking River at Falmouth. Elevation in the survey area ranges from about 560 feet on the South Fork Licking River bottom land north of Morgan (*6*), to about 960 feet at Williamstown (*7*).

General nature of the survey area

This section gives general information concerning the survey area. It discusses climate; history and settlement; farming; natural resources; recreation; and geology, physiography, relief, and drainage.

Climate

Prepared by the National Climatic Center, Asheville, North Carolina.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Williamstown, Kentucky, in the period 1951 to 1974. 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 33 degrees F, and the average daily minimum temperature is 24 degrees. The lowest temperature on record, which occurred at Williamstown on January 24, 1963, is -21 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, 1954, is 104 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 (50 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.

Of the total annual precipitation, 23 inches, or 55 percent, usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 19 inches. The heaviest 1-day rainfall during the period of record was 4.57 inches at Williamstown on September 1, 1965. Thunderstorms occur on about 45 days each year, and most occur in summer.

Average seasonal snowfall is 18 inches. The greatest snow depth at any one time during the period of record was 14 inches. On an average of 10 days, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 65 percent

of the time possible in summer and 40 percent in winter. The prevailing wind is from the southwest. Average windspeed is highest, 12 miles per hour, in March.

History and settlement

In 1820 Grant County was formed from 250 square miles of Pendleton County, making it the 67th county in the state. The origin of the name of the county is not generally agreed upon by historians. Williamstown became the county seat and was named after William Arnold, a settler who donated the land for building the city. In 1820 the population of Grant County was 1,805 (*3*). In 1970 the population was 9,999 (*13*).

The 28th county organized in Kentucky was Pendleton County. In 1798 Pendleton County was formed from Bracken and Campbell Counties. Pendleton County was named for Edmund Pendleton of Virginia, a member of the House of Burgesses. Falmouth, the county seat, was established in 1793 and named after Falmouth, Virginia, from where most of the settlers came. The population of Pendleton County was 6,775 in 1850, and it reached a high of 16,700 in 1880 (*3*). In 1970, the population was 9,949 in Pendleton County (*13*).

Farming

Farming is the major economic activity in Grant and Pendleton Counties. The 1974 census of agriculture reported 1,031 farms in Grant County. The average farm was 124 acres. Pendleton County had 974 farms, and the average farm was 132 acres. In Grant County 80.6 percent of the land, or 128,344 acres, was in farmland, and 71.8 percent, or 128,164 acres, in Pendleton County was in farmland (*14*).

Some of the diversified farming in Grant and Pendleton Counties is dairy, hay, cattle, sheep, hogs, tobacco, poultry, and grain. Tobacco, corn, and hay are the major crops. The acreage and yields from the major crops harvested in Grant and Pendleton Counties in 1976 are as follows: In Grant County 2,480 acres of burley tobacco produced 6,324,000 pounds; 3,500 acres of corn, of which 2,600 acres was used for grain, produced 218,400 bushels; and 12,000 acres of hay (all kinds) produced 21,900 tons. In Pendleton County 2,410 acres of burley tobacco produced 5,736,000 pounds; 4,800 acres of corn, of which 3,600 acres was used for grain, produced 360,200 bushels; and 14,400 acres of hay (all kinds) produced 25,700 tons (*5*).

Natural resources

The main natural resources in the survey area are soil, water, trees, and limestone.

The soil is the most important natural resource in the survey area; farm production depends directly or indirectly on this resource.

Water is necessary for agriculture and for other economic activities. The largest surface water supplies are available from the Ohio River, Licking River, and South Fork Licking River in Pendleton County, and from Eagle Creek in Grant County. Along these major streams and tributaries, ground water is easily accessible. Away from these drainage areas, most drilled wells 100 feet deep do not produce enough water for a dependable domestic supply of about 100 gallons a day (*8, 9*). Williamstown Lake, Corinth Lake, Boltz Lake, and Bullock Pen Lake are man-made reservoirs in Grant County and are used for local water supplies.

The most abundant trees in the survey area are red oaks, white oaks, hickory, ash, beech, black walnut, eastern redcedar, yellow-poplar, hard maple, and soft maple. Approximately 88,000 acres of forest land is in the two counties.

Limestone, a sedimentary rock composed predominantly of calcite, is found in large quantities in Grant and Pendleton Counties. Limestone is mined near the Ohio River and used in the metallurgical industry. The limestone deposits in the Butler community are mined for agricultural lime and for construction purposes, such as roads, buildings, and riprap.

Recreation

Grant and Pendleton Counties offer various outdoor facilities to the public.

Kincaid Lake State Park in Pendleton County provides facilities for camping, hiking, swimming, water skiing, and fishing.

Boltz Lake, Corinth Lake, and Bullock Pen Lake in Grant County are used for fishing. Water sports such as skiing, swimming, and fishing are provided by Williamstown Lake, near Williamstown.

Excellent stream fishing is along Eagle Creek in Grant County and along the Licking and South Fork Licking Rivers in Pendleton County.

The Curtis Gates Lloyd Wildlife Area, south of Crittenden on U.S. Highway 25, is the only wildlife preserve in the survey area. It has an archery range and has various trails for hiking.

Geology, physiography, relief, and drainage

The soils in the survey area are underlain by limestone, shale, and siltstone—sedimentary rocks of the Ordovician geologic age (*7*).

The survey area is in parts of the Hills of the Bluegrass and Outer Bluegrass physiographic regions. The north-central and northeastern parts of Grant County are in the Outer Bluegrass region. The remaining land in the survey area is in the Hills of the Bluegrass region. In Grant and Pendleton Counties the Hills of the Bluegrass region is geologically lower than the Outer Bluegrass region.

The Outer Bluegrass region is underlain by interbedded limestone, calcareous shale, and siltstone of the

Fairview Formation (fig. 1). This upland region has long, broad, undulating to rolling ridgetops and short, hilly side slopes. It is dissected by lateral drains and steep walled, V-shaped valleys.

The Hills of the Bluegrass region is underlain by interbedded calcareous shale, limestone, and siltstone of the Kope Formation (fig. 2). This upland region has long, winding, narrow, rolling to hilly ridges and steep walled, V-shaped valleys. Short ridges extend laterally from the main ridges. The region is strongly dissected by small streams and lateral drains.

The topography ranges from nearly level to steep. The highest point in the survey area is 960 feet, which is 400 feet higher than the lowest valley floor.

Eagle Creek, Licking River, South Fork Licking River, and the Ohio River drain the entire survey area. The chain of ridges running north and south along Interstate 75 in Grant County is a natural boundary between Eagle Creek watershed and the Licking River watershed. The Eagle Creek watershed drains all of Grant County except the area east of Interstate 75, which drains into the South Fork Licking River and Licking River. The northeastern tip of Pendleton County drains east into the Ohio River. The remaining part of Pendleton County drains into the South Fork Licking River and the Licking River.

How this survey was made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; and the kinds of rock. They dug many holes to study soil profiles.

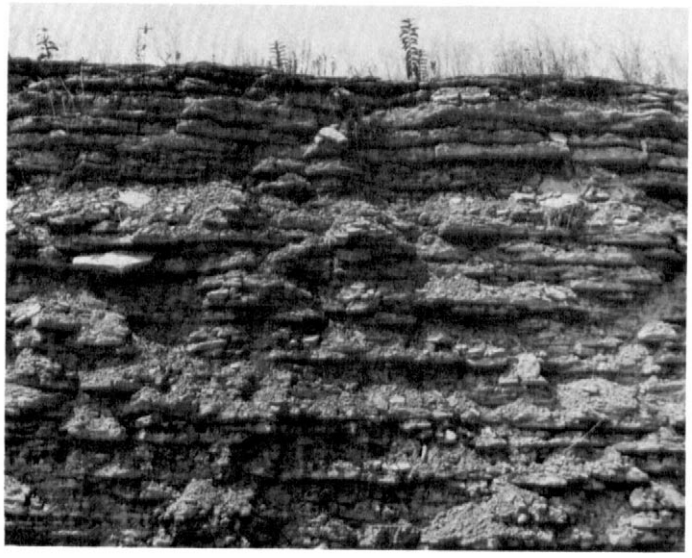


Figure 1.—Thin, interbedded limestone, shale, and siltstone of the Fairview Formation underlie Lowell and Nicholson soils.

Figure 2.—Calcareous, interbedded shale, limestone, and siltstone of the Kope Formation underlie Eden and Heitt soils.

A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General soil map for broad land use planning" and "Soil maps for detailed planning."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined management are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed

information then needs to be organized so that it can be used by farmers, rangeland and woodland managers, engineers, planners, developers and builders, home buyers, and others.

General soil map for broad land use planning

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in 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 map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

1. Eden

Moderately deep, sloping to steep, well drained soils that have a clayey subsoil; on ridgetops and hillsides

This unit (fig. 3) is on highly dissected uplands that have narrow ridgetops and narrow flood plains (fig. 4).

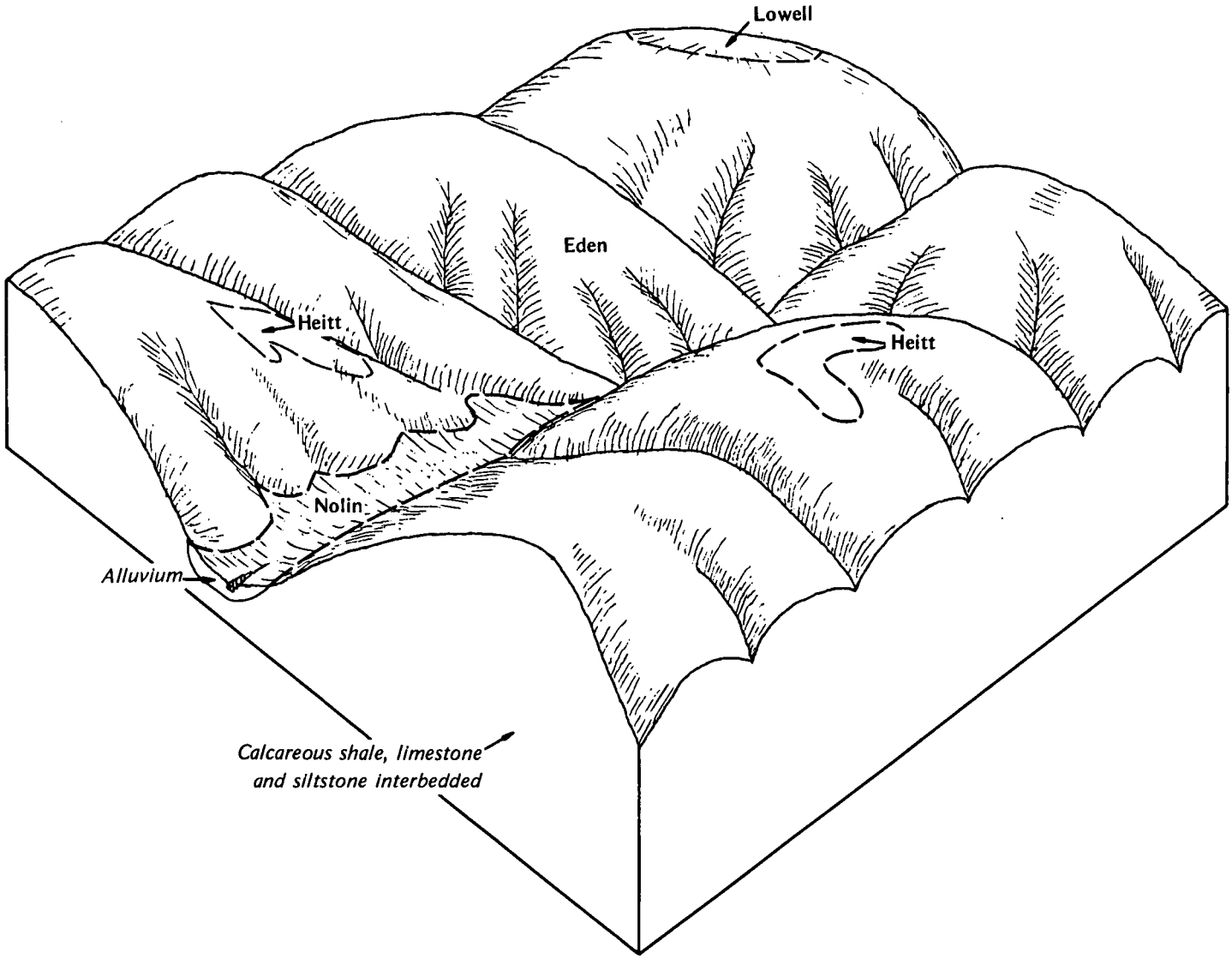


Figure 3.—Relationship of soil to topography and underlying material in the Eden unit.

Figure 4.—Typical scene of Eden Hills.

The unit makes up about 75 percent of Grant County and 88 percent of Pendleton County. In Grant County, it is about 91 percent Eden soils and 9 percent soils of minor extent. In Pendleton County, it is about 78 percent Eden soils and 22 percent soils of minor extent.

The Eden soils formed in the residuum from calcareous shale and thin-bedded limestone and siltstone. The sloping Eden soils are on ridgetops, and the moderately steep and steep Eden soils are on hillsides. Eden soils are moderately deep, well drained, and slowly permeable. They have a loamy or clayey surface layer and a clayey subsoil.

Of minor extent in this unit are the well drained Heitt and Lowell soils on narrow ridges, the moderately well drained Licking soils on stream terraces, the well drained Nolin soils on narrow flood plains, and the shallow Cynthiana soils on hillsides.

About two-thirds of the acreage of this unit is used for hay and pasture, and one-third is wooded or covered with brush. A small acreage is used for cultivated crops, mainly garden crops and tobacco. The steepness of slope and clayey subsoil are the main limitations to farming and most other uses.

The soils in this unit have poor potential for cultivated crops, hay, and most specialty crops. The steepness of slope, poor workability, and droughtiness are the main limitations to farming. These soils have fair potential for pasture and for woodland. Potential is poor for residential and other urban developments. The steepness of slope, moderate depth to bedrock, slow permeability, moderate shrink-swell potential and low strength are limitations and are difficult to overcome. Potential is poor for intensive recreation. Potential is fair for developing woodland wildlife and openland wildlife habitats.

2. Lowell-Nicholson

Deep, gently sloping to moderately steep, well drained and moderately well drained soils that have a clayey and loamy subsoil; on ridgetops and hillsides

This unit (fig. 5) is on long, broad ridges, mainly in the north-central part of Grant County and the northeastern part of Pendleton County.

The unit makes up about 21 percent of Grant County and about 1 percent of Pendleton County. In Grant County, it is about 54 percent Lowell soils, 32 percent

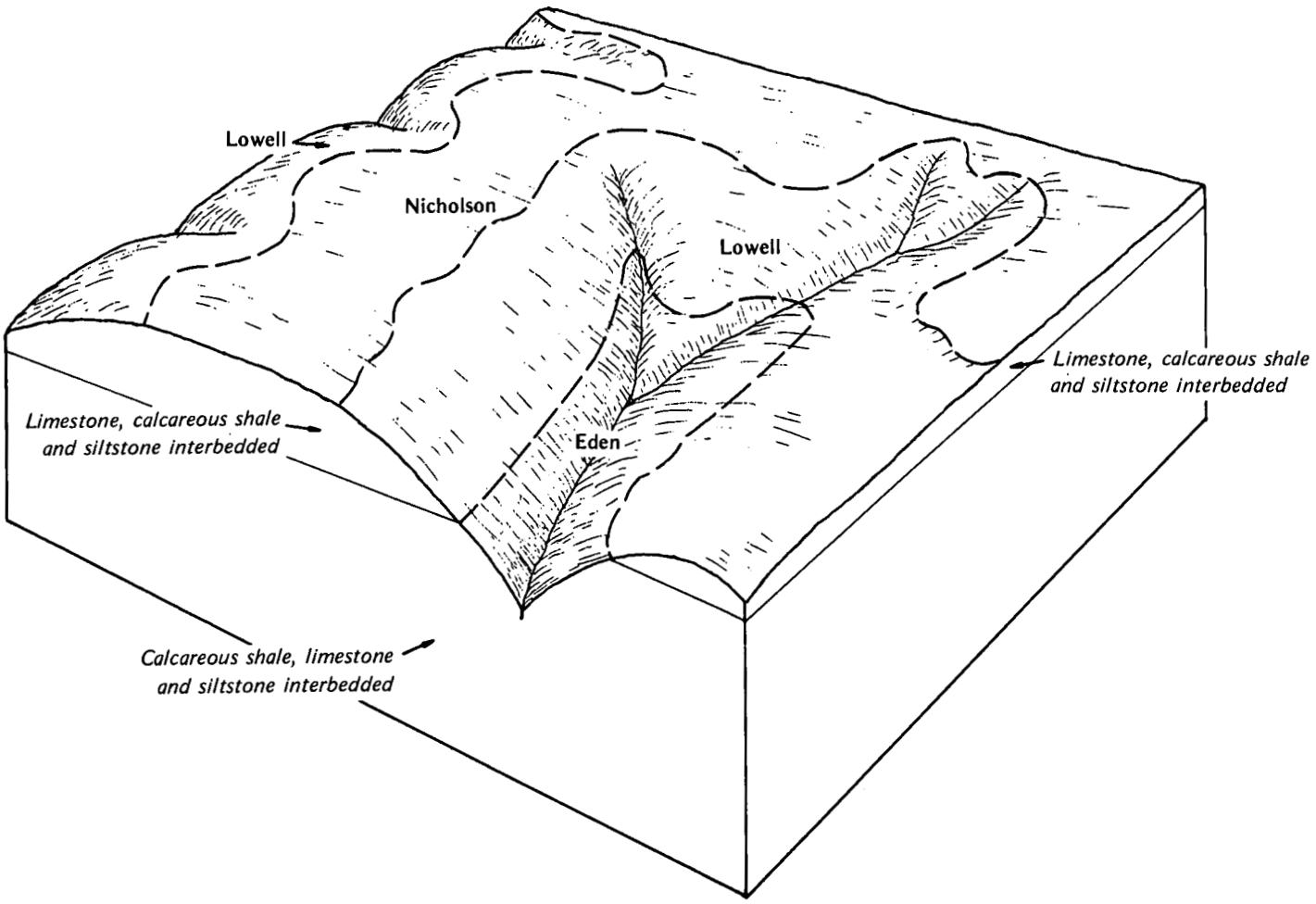


Figure 5.—Relationship of soils to topography and underlying material in the Lowell-Nicholson unit.

Nicholson soils, and 14 percent soils of minor extent. In Pendleton County, it is about 57 percent Lowell soils, 33 percent Nicholson soils, and 10 percent soils of minor extent.

The Lowell soils formed in residuum from limestone; siltstone; and thin-bedded, calcareous shale. In most places, the Lowell soils are at a slightly lower elevation than the Nicholson soils. The sloping Lowell soils are on ridgetops, and the moderately steep Lowell soils are on hillsides. Lowell soils are deep and well drained. Permeability is moderately slow. They have a surface layer of silt loam and a clayey subsoil.

The Nicholson soils formed in a mantle of loess and the underlying residuum of limestone and siltstone interbedded with thin layers of calcareous shale. These soils are gently sloping to sloping and are on fairly broad ridges. The Nicholson soils are deep, are moderately well drained, and have a slowly permeable fragipan. They have a surface layer of silt loam. The upper part of the subsoil is loamy, the middle part is a fragipan, and the lower part is clayey.

Of minor extent in this unit is the well drained, steep Eden soil. It is on the lower part of hillsides.

Areas of this unit are used mainly for crops and pasture. Most of the acreage is in grassland. The broader ridges are used for cultivated crops, mainly corn and tobacco. The steepness of slope and clayey subsoil of the Lowell soils and the slowly permeable fragipan of the Nicholson soils are the main limitations to farming and most other uses.

The soils in this unit have fair potential for cultivated crops and most specialty crops. If the soils are cultivated, erosion is the main management concern and erosion control practices are needed. These soils have good potential for pasture, hay crops, and woodland. Potential is fair for intensive recreation and for residential and other urban developments. The steepness of slope, moderate shrink-swell potential, low strength, and slow permeability are limitations and are difficult to overcome.

3. Nolin-Licking-Otwell

Deep, nearly level to moderately steep, well drained and

moderately well drained soils that have a loamy or clayey subsoil; on flood plains and stream terraces

This unit is on flood plains and stream terraces along Eagle Creek in Grant County.

The unit makes up about 4 percent of Grant County and is not in Pendleton County. It is about 40 percent Nolin soils, 20 percent Licking soils, 16 percent Otwell soils, and 24 percent soils of minor extent.

The Nolin soils formed in recent alluvial material. These soils are nearly level and are on flood plains. The Nolin soils are deep, moderately well drained, and slowly permeable. They have a surface layer of silt loam and a loamy subsoil.

The Licking soils formed in lacustrine sediment. These soils are gently sloping to moderately steep and are on stream terraces. The Licking soils are deep, moderately well drained, and slowly permeable. They have a surface layer of silt loam and a clayey subsoil.

The Otwell soils formed in lacustrine sediment or in old, mixed alluvial deposits. These soils are nearly level to sloping and are on stream terraces. The Otwell soils are deep, are moderately well drained, and have a slowly permeable fragipan. They have a surface layer of silt loam and a clayey subsoil.

Of minor extent in this unit are the somewhat poorly drained Newark soils on flood plains, the somewhat poorly drained McGary soils and the well drained Elk soils on stream terraces, and the well drained Woolper soils on toe slopes and stream terraces.

Most areas of this unit are cleared and used for farming. Much of the acreage is used for cultivated crops. The steeper areas are used for pasture and hay. The steepness of slope, flooding, and slow permeability are the main limitations to farming and most other uses.

The soils in this unit have good potential for cultivated crops and most specialty crops. If the soils are cultivated, erosion is the main management concern and erosion control practices are needed. These soils have good potential for pasture, hay crops, and woodland. Potential is fair for intensive recreation. Potential is poor for residential and other urban developments. The steepness of slope, seasonal high water table, and flooding are limitations and are difficult to overcome.

4. Otwell-Licking-Elk

Deep, nearly level to moderately steep, well drained and moderately well drained soils that have a loamy or clayey subsoil; on stream terraces

This unit (fig. 6) is on stream terraces, mainly along the Licking River and forks of the Licking River in Pendleton County.

The unit makes up about 11 percent of Pendleton County and is not in Grant County. It is about 27 percent Otwell soils, 21 percent Licking soils, 20 percent Elk soils, and 32 percent soils of minor extent.

The Otwell soils formed in lacustrine sediment or in old, mixed alluvial deposits. These soils are nearly level to sloping. The Otwell soils are deep, are moderately well drained, and have a slowly permeable fragipan. They have a surface layer of silt loam and a loamy subsoil.

The Licking soils formed in lacustrine sediment. These soils are gently sloping to moderately steep. The Licking soils are deep, moderately well drained, and slowly permeable. They have a surface layer of silt loam and a clayey subsoil.

The Elk soils formed in mixed alluvium. These soils are nearly level to sloping. The Elk soils are deep, well drained, and moderately permeable. They have a surface layer of silt loam and a loamy subsoil.

Of minor extent in this unit are the well drained Nolin soils and somewhat poorly drained Newark soils on flood plains and the well drained Woolper soils on toe slopes and stream terraces. Also of minor extent are the somewhat poorly drained McGary soils and the poorly drained Zipp and Robertsville soils on stream terraces.

Most areas of this soil have been cleared and are used mainly for cultivated crops and pasture. Steepness of slope, slow permeability, and flooding are the main limitations for farming and most other uses.

The soils in this unit have good potential for cultivated crops, specialty crops, pasture or hay crops, and woodland. When these soils are cultivated, erosion is the main management concern and erosion control practices are needed. These soils have fair potential for intensive recreation uses. The potential for residential and other urban developments is fair in parts that do not flood. The slow permeability in the fragipan of Otwell soils, steepness of slope, and slow permeability in the clayey subsoil of Licking soils are the main limitations.

Broad land use considerations

Grant and Pendleton Counties are mainly rural, but small towns or communities are throughout the counties. In general, the soils that have good potential for cultivated crops also have good potential for urban development. Farmers, environmentalists, urban planners, construction engineers, the general public, and others are faced with the important question: How should the soils be used to satisfy the diverse needs of the people? To ensure that productive soils will always be available for farming, present and future needs must be determined, options must be weighed, and intelligent choices must be made. The general soil map is most helpful in planning future broad land use patterns.

The soils on flood plains and stream terraces in map units 3 and 4 are the most productive and valuable for cultivated crops. The soils in map units 3 and 4 have good potential for cultivated crops, and the soils in map unit 2 have fair potential. The Lowell soils in unit 2 and the Licking soils in units 3 and 4 have an erosion hazard so severe that they should be used mainly for pasture or hay. The soils in map unit 1 have little value for cultivated crops because of the steepness of slope, erosion

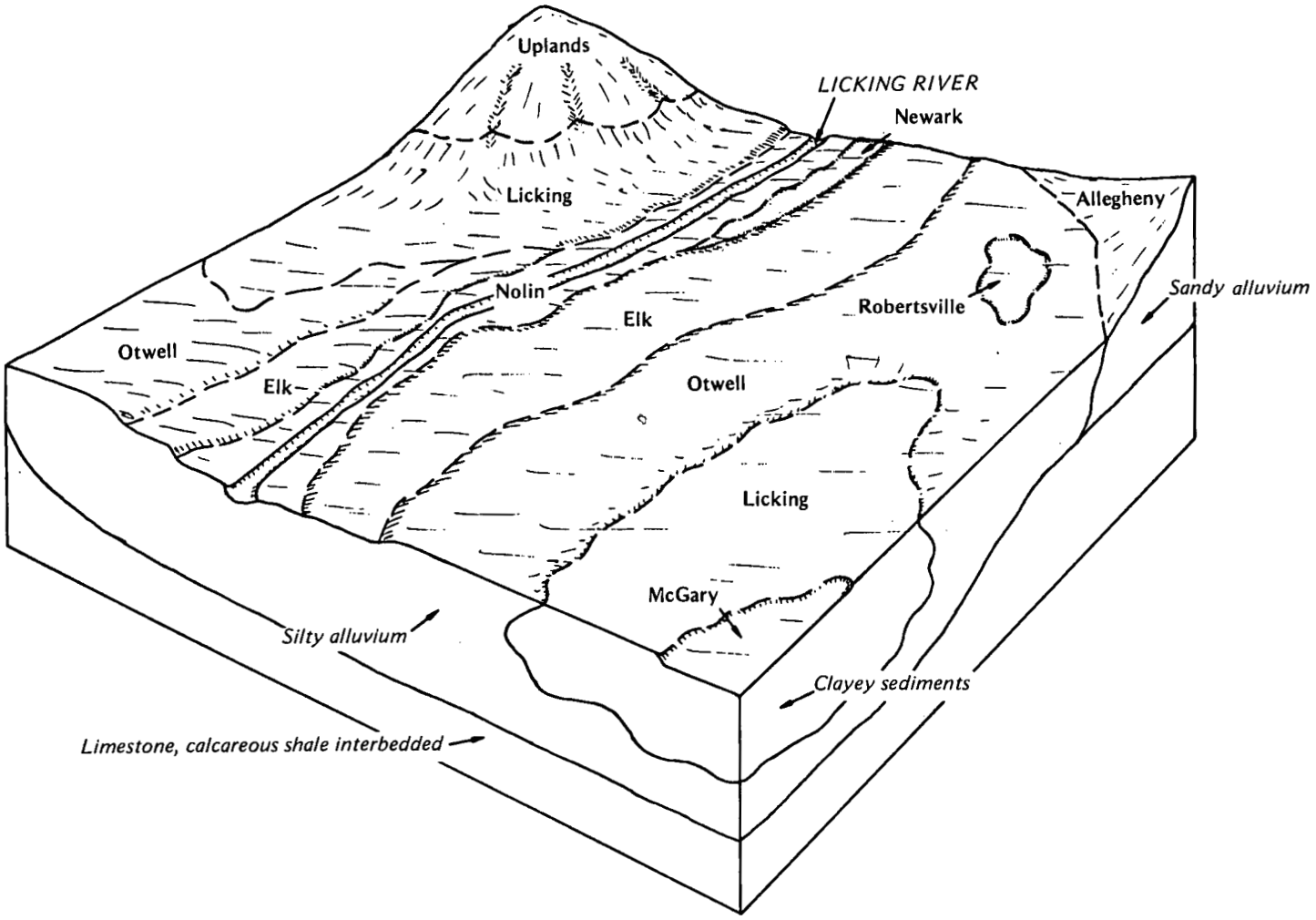


Figure 6.—Relationship of soils to topography and underlying material in the Otwell-Licking-Elk unit.

hazard, flagstones on the surface, poor workability, and droughtiness. The less sloping soils in map units 2, 3, and 4 have good potential for vegetables and many other specialty crops.

The soils in map unit 2 have better potential than most other units for urban uses. The steepness of slope, moderate shrink-swell potential, perched water table, and slow permeability are the main limitations. The soils in map units 3 and 4 have poor potential, mainly because of the hazard of flooding. The clayey soils in map unit 1 have poor potential for urban uses because of the steepness of slope, moderate depth to rock, and moderate shrink-swell potential.

Soils throughout Grant and Pendleton Counties can be used for various types of recreation. The soils in map unit 1 are suitable for nature studies and as wilderness, but they have poor potential for intensive recreation uses, mainly because of the steepness of slope. The clayey Eden soils in map unit 1 are underlain by shale and are suitable for water impoundments. In map units 2, 3, and 4, the less sloping soils have good to fair potential for intensive recreation uses. The steepness of slope, clayey subsoil, and slow permeability limit use in most areas.

The soils in map units 2, 3, and 4 have good potential for woodland. In map unit 1, the potential is fair. The main concerns in management of woodland in map unit 2 are equipment limitations and the erosion hazard. The main concerns in management of the soils in map units 1, 3, and 4 are equipment limitations, the erosion hazard, seedling mortality, and plant competition. The soils in map unit 1 are more severely limited because of the steepness of slope and moderate depth to rock.

Most of the soils in map units 2, 3, and 4 have been cleared and have good potential as habitat for openland wildlife. The soils in map unit 1 have fair potential as habitat for openland and woodland wildlife. The supply of food and cover is plentiful.

Soil maps for detailed planning

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 "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, a brief description of the soil profile, and a listing of the principal hazards and limitations to be considered in planning management.

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 underlying material, 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 underlying material. They also can differ in slope, stoniness, salinity, 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, Licking silt loam, 2 to 6 percent slopes, is one of several phases in the Licking series.

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

A *soil complex* consists of two or more soils 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. Elk-Newark complex is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these 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.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits-Dumps complex is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

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.

Descriptions of the map units on the detailed soil maps are given in the following pages.

AlB—Allegheny loam, 2 to 6 percent slopes. This gently sloping soil is deep and well drained. It is on stream terraces and foot slopes. Slopes are smooth and convex. Areas are 20 to 100 acres.

Typically, the surface layer is brown loam about 7 inches thick. The subsoil extends to a depth of 52 inches. The upper 35 inches of the subsoil is strong brown clay loam, and the lower 10 inches is strong brown loam. The underlying material to a depth of 65 inches is strong brown sandy loam.

This Allegheny soil has a deep root zone. Permeability is moderate, surface runoff is medium, and available water capacity is high. Organic matter content and natural fertility are low. The soil is very strongly acid or extremely acid throughout, except in areas that have been limed. This soil has good tilth and can be worked throughout a wide range of soil moisture. Some areas of this soil are subject to flooding, if the floodwater is exceptionally high.

Included with this soil in mapping are a few areas of soils that have more silt in the upper part of the subsoil and less clay in the lower part than this Allegheny soil. Also included are areas that are subject to flooding. The included soils make up 20 to 30 percent of this map unit.

Much of the acreage of this soil is used for hay or pasture. Some areas are used for burley tobacco and corn. This soil has good potential for cultivated crops commonly grown in the area, such as corn, tobacco, and small grain. Flooding on this soil is generally not a hazard to cultivated crops. The hazard of erosion is moderate if this soil is cultivated. Contour farming, minimum tillage, contour stripcropping, including grasses and legumes in the cropping system, returning crop residue to the soil, no-tillage, and grassed waterways help to reduce runoff and control erosion. Incorporating crop residue in the plow layer helps to maintain organic matter content.

This soil has good potential for pasture and hay. Kentucky bluegrass, tall fescue, orchardgrass, red clover, alfalfa, Ladino clover, and annual lespedeza are better suited to this soil than most other hay and pasture plants.

Potential is good for upland oaks, eastern white pine, yellow-poplar, and black walnut. Woodland management concerns are slight. The main concern is plant competition when establishing seedlings.

Potential is good for urban uses. Limitations are slight, except in low areas where flooding may occur in places. The low strength is a limitation if this soil is used for roadfill.

This soil is in capability subclass IIe and woodland group 2o.

AlC—Allegheny loam, 6 to 12 percent slopes. This sloping soil is deep and well drained. It is on stream terraces, foot slopes, and low ridges. Slopes are smooth and convex. Areas are 10 to 50 acres.

Typically, the surface layer is brown loam about 7 inches thick. The subsoil extends to a depth of 52 inches. The upper 35 inches of the subsoil is strong brown clay loam, and the lower 10 inches is strong brown loam. The underlying material to a depth of 65 inches is strong brown sandy loam.

This Allegheny soil has a deep root zone. Permeability is moderate, surface runoff is medium, and available water capacity is high. Organic matter content and natural fertility are low. This soil is very strongly acid or extremely acid throughout, except in areas that have been limed. This soil has good tilth and can be worked throughout a wide range of soil moisture. Some areas of this soil are subject to flooding.

Included with this soil in mapping are areas of soils that have more silt in the upper part of the subsoil and less clay in the lower part than this Allegheny soil. Also included are areas that are subject to flooding. The included soils make up 10 to 20 percent of this map unit.

Much of the acreage of this soil is used for hay or pasture, but many areas are used for burley tobacco and corn. This soil has good potential for hay and pasture. Kentucky bluegrass, orchardgrass, tall fescue, alfalfa, red clover, Ladino clover, and annual lespedeza are better suited to this soil than most other hay and pasture plants. This soil has fair potential for cultivated crops commonly grown in the area. Flooding on this soil is generally not a hazard to cultivated crops. The hazard of erosion is severe if this soil is cultivated. Contour farming, minimum tillage, contour stripcropping, including grasses and legumes in the cropping system, returning crop residue to the soil, no-tillage, and grassed waterways help to reduce runoff and control erosion. Incorporating crop residue in the plow layer helps to maintain organic matter content.

Potential is good for upland oaks, eastern white pine, yellow-poplar, and black walnut. Woodland management concerns are slight. The main concern is plant competition when establishing seedlings.

Potential is fair for urban uses. The steepness of slope is the main limitation. Some low areas are subject to flooding.

This soil is in capability subclass IIIe and woodland group 2o.

AlD—Allegheny loam, 12 to 20 percent slopes. This moderately steep soil is deep and well drained. It is on low ridges, foot slopes, and stream terraces. Slopes are smooth and convex. Areas are 10 to 30 acres.

Typically, the surface layer is brown loam about 7 inches thick. The subsoil extends to a depth of 52 inches. The upper 35 inches of the subsoil is strong brown clay loam, and the lower 10 inches is strong brown loam. The underlying material to a depth of 65 inches is strong brown sandy loam.

This Allegheny soil has a deep root zone. Permeability is moderate, surface runoff is medium, and available water capacity is high. Organic matter content and natural fertility are low. This soil is very strongly acid or extremely acid throughout, except in areas that have been limed. This soil has good tilth and can be worked throughout a wide range of soil moisture. Some areas of this soil are subject to flooding.

Included with this soil in mapping are small areas of Elk and Licking soils and areas of soils that are similar to this Allegheny soil but have a thin layer of gravelly clayey alluvium. Also included are areas that are subject to flooding. The included soils make up 20 to 30 percent of this map unit.

Most areas of this soil are in pasture. Some areas are in scrub trees or are covered with brush. This soil has good potential for pasture or hay. Kentucky bluegrass, tall fescue, orchardgrass, red clover, alfalfa, Ladino clover, and annual lespedeza are better suited to this soil than most other hay and pasture plants. This soil has poor potential for cultivated crops. Flooding on this soil is generally not a hazard to cultivated crops. The hazard of erosion is very severe if this soil is cultivated. The soil can be cultivated occasionally if erosion control practices are used. Contour farming, minimum tillage, contour stripcropping, including grasses and legumes in the cropping system, returning crop residue to the soil, no-tillage, and grassed waterways help to reduce runoff and control erosion. Incorporating crop residue in the plow layer helps to maintain organic matter content. Preparing a seedbed is difficult because of the moderately steep slopes and equipment limitations.

Potential is good for upland oaks, eastern white pine, yellow-poplar, and black walnut. The main concerns in management of woodland are equipment limitations, because of steepness of slope; control of undesirable plants; and the erosion hazard.

Potential is poor or fair for most urban uses. The steepness of slope is the main limitation. In low areas, flooding may occur in places. The low strength is a limitation if this soil is used for roadfill.

This soil is in capability subclass IVe and woodland group 2r.

ChD—Cynthiana silty clay loam, very rocky, 6 to 20 percent slopes. This moderately steep soil is shallow and well drained to somewhat excessively drained. It is on low ridges in the southern part of Pendleton County. Slopes are smooth and convex. Areas are 20 to 40 acres.

Typically, the surface layer is dark grayish brown silty clay loam about 4 inches thick. The subsoil is light olive brown flaggy silty clay about 14 inches thick. Limestone bedrock is at a depth of about 18 inches.

This Cynthiana soil has a shallow root zone. Permeability is moderately slow, surface runoff is rapid, and available water capacity is low. Organic matter content is moderate, and natural fertility is medium. The surface

layer is slightly acid or neutral, and the subsoil is slightly acid to mildly alkaline. Shrink-swell potential is moderate, and strength is low. Depth to limestone bedrock is 10 to 20 inches.

Included with this soil in mapping are small areas of soils that are similar to this Cynthiana soil but have bedrock at a depth of more than 20 inches or less than 6 to 10 inches. Also included are small areas of Eden soils and limestone outcrop. The included soils make up about 20 to 30 percent of this map unit, and limestone outcrop makes up about 5 percent.

Many areas of this soil are used for hay or pasture. Some areas are wooded or covered with brush. This soil has fair potential for hay and cultivated crops. Tall fescue, Kentucky bluegrass, and sericea lespedeza are better suited to this soil than most other pasture plants. Establishing a stand of grass is difficult because of the moderately steep slopes, outcrops, and droughtiness. The hazard of erosion is very severe if the plant cover is removed.

Potential is fair for Virginia pine and eastern redcedar. The main concerns in management of woodland are equipment limitations, because of the steepness of slope; the erosion hazard; and seedling mortality.

Potential is poor for most urban uses. The moderately steep slopes and shallow depth to bedrock are the main limitations. The low strength is a limitation if this soil is used for roadfill.

This soil is in capability subclass VIs and woodland group 4d.

CyF—Cynthiana-Rock outcrop complex, 20 to 50 percent slopes. This complex consists of shallow, well drained and somewhat excessively drained, steep, clayey soils and Rock outcrop. The soils and Rock outcrop are so intermingled that to separate them in mapping was not practical. This complex is on low hillsides near major streams. Areas are 20 to 150 acres (fig. 7). This complex is 40 to 50 percent Cynthiana soils and 25 to 30 percent Rock outcrop.

Typically, the Cynthiana soil has a surface layer of dark grayish brown silty clay loam about 4 inches thick. The subsoil is light olive brown flaggy silty clay about 14 inches thick. Limestone bedrock is at a depth of about 18 inches.

The Cynthiana soil has a shallow root zone. Permeability is moderately slow. Surface runoff is rapid or very rapid, and available water capacity is low. Organic matter content is moderate, and natural fertility is medium. The surface layer is slightly acid or neutral, and the subsoil is slightly acid to mildly alkaline. Shrink-swell potential is moderate, and strength is low. Depth to limestone bedrock is 10 to 20 inches.

The Rock outcrop consists of exposures of bare limestone bedrock.

Included with this complex in mapping are a few large areas of soils that are similar to the Cynthiana soils but have slopes of more than 50 percent. Also included are

50 percent slopes. This unit commonly is below Eden soils.

areas of Eden soils and small areas of soils that have bedrock at a depth of more than 20 inches or less than 10 inches. The included soils make up about 15 to 25 percent of this map unit.

Most areas of this complex are wooded or covered with brush. Some areas are used for pasture. This complex has poor potential for crops, hay, or pasture. Tall fescue, Kentucky bluegrass, and sericea lespedeza are better suited to this complex than most other pasture plants. Establishing a stand of grass is difficult because of the steep and very steep slopes, Rock outcrop, and droughtiness.

Potential is fair for Virginia pine and eastern redcedar. The main concerns in management of woodland are equipment limitations, erosion hazard, and seedling mortality. The steepness of slope limits the use of equipment.

Potential is poor for most urban uses because of the shallow depth to rock, Rock outcrop, and steep slope.

This complex is in capability subclass VIIs. Cynthiana soil is in woodland group 4d; Rock outcrop is not assigned to a woodland group.

EdD—Eden silty clay loam, 6 to 20 percent slopes. This sloping to moderately steep soil is moderately deep, well drained, and has a clayey, flaggy subsoil. It is on narrow ridges and the upper part of hillsides above areas of steep Eden and Cynthiana soils. Slopes are smooth and convex. Areas are 30 to 200 acres (fig. 8).

Figure 8.—Eden silty clay loam, 6 to 20 percent slopes. The sparse grass in the foreground is growing on the clayey subsoil. Loamy topsoil is provided to help obtain a lush, beautiful lawn.

Typically, the surface layer is brown silty clay loam about 6 inches thick. The subsoil is yellowish brown and light olive brown silty clay that extends to a depth of 30 inches. The underlying material to a depth of 38 inches is soft, partly weathered shale and siltstone that have thin layers of limestone.

This Eden soil has a moderately deep root zone. The penetration of roots is impeded by the coarse fragments in the clayey subsoil. Surface runoff is rapid, permeability is slow, and available water capacity is moderate to low. Organic matter content is low. This soil is medium acid to moderately alkaline above the underlying material. Many areas of this soil are medium to high in potash and low to medium in phosphate, but the soil is generally low in nitrogen. Shrink-swell potential is moderate, and strength is low. Depth to unweathered, soft shale is 20 to 40 inches.

Included with this soil in mapping are small areas of soils that have a surface layer of silt loam, small areas of soils that have a surface layer of silty clay, and small areas of flaggy soils. Also included are long, narrow areas of soils that have slopes of less than 6 percent; small areas of soils that are similar to Eden soils but have unweathered shale at a depth of less than 20 inches or more than 40 inches; and small areas of Heitt soils. The included soils make up about 15 to 25 percent of this map unit.

Most areas of this soil are used for hay or pasture. Small areas are used for burley tobacco, and some areas are wooded. This soil has poor potential for cultivated crops. The hazard of erosion is very severe if the soil is cultivated. The soil can be cultivated occasionally if erosion control practices are used. Contour farming, minimum tillage, contour stripcropping, including grasses and legumes in the cropping system, returning crop residue to the soil, and grassed waterways help to reduce runoff and control erosion. Incorporating crop residue in the plow layer helps to maintain organic matter content. Preparing a seedbed is difficult because of the moderately steep slopes and equipment limitations. This soil has fair or good potential for hay and pasture. Tall fescue, Kentucky bluegrass, and annual lespedeza are better suited to this soil than most other pasture plants. Establishing a stand of grass is difficult because of the moderately fine textured surface layer, moderately steep slopes, and very severe hazard of erosion.

Potential is fair for Virginia pine, Scotch pine, Austrian pine, and eastern redcedar. The main concerns in management of woodland are equipment limitations, the erosion hazard, seedling mortality, and plant competition. The steepness of slope limits the use of equipment.

Potential is poor for urban uses. The moderately steep slope; the tendency of this soil to erode and form slides and slips; the soft, unweathered clay shale at a depth of 20 to 40 inches; and slow permeability are the main limitations. The low strength is a limitation if this soil is used for roadfill.

This soil is in capability subclass IVe and woodland group 3c.

EfE3—Eden flaggy silty clay, 20 to 30 percent slopes, severely eroded. This steep soil is moderately deep, well drained, and somewhat droughty. It is on hillsides. A large part of the original surface layer has been removed by erosion, and the present plow layer is mainly material from the original subsoil. Most areas are highly dissected by shallow gullies. Slopes are long and smooth. Areas are several hundred acres in size (fig 9).

Typically, the surface layer is flaggy silty clay about 6 inches thick. The subsoil is yellowish brown and light olive brown flaggy silty clay that extends to a depth of 30 inches. The underlying material to a depth of 38 inches is soft, partly weathered shale and siltstone that have thin layers of limestone.

This Eden soil has a moderately deep root zone. The penetration of roots is impeded by coarse fragments in the clayey subsoil. Surface runoff is rapid, permeability is slow, and available water capacity is moderate or low. Organic matter content is low. This soil is medium acid to moderately alkaline above the underlying material. Many areas of this soil are medium to high in potassium and low to medium in phosphorus, but the soil is generally low in nitrogen. Shrink-swell potential is moderate, and strength is low. Depth to unweathered, soft shale is 20 to 40 inches.

Included with this soil in mapping are small areas of soils that have a surface layer of silty clay loam, small areas of soils that have more than 35 percent flagstones on the surface, and very small slip or creep areas that are more acid and deeper to unweathered shale than this Eden soil. Also included are small areas of soils that are similar to this Eden soil but have bedrock at a depth

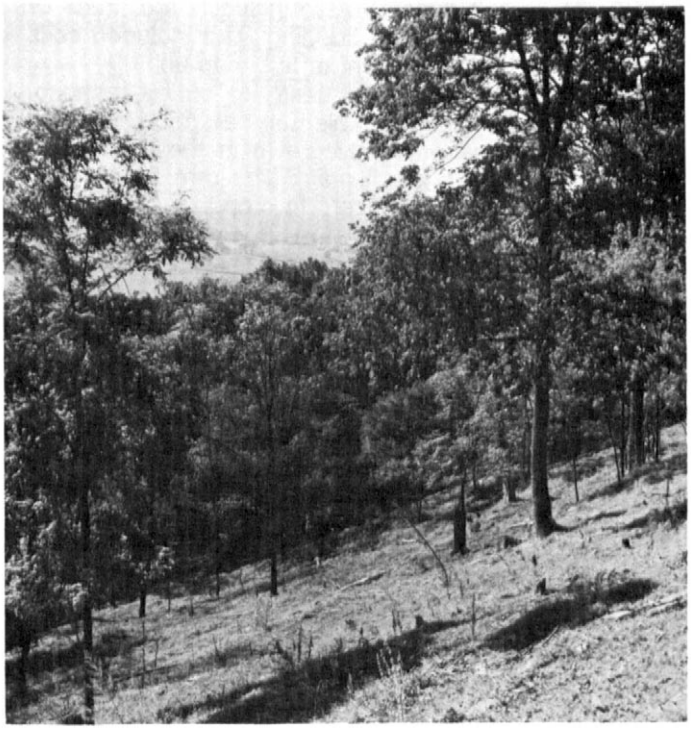


Figure 9.—Typical wooded area of Eden flaggy silty clay, 20 to 30 percent slopes, severely eroded.

of less than 20 inches. The included soils make up about 15 to 25 percent of this map unit.

Some areas of this soil are in tall fescue pasture, but many areas have reverted to redcedar, deciduous trees, and brush. This soil has poor potential for cultivated crops or hay because of the steepness of slope and the very severe erosion hazard if the plant cover is removed. It has poor or fair potential for pasture. Establishing a stand of grass is difficult because of the steep slopes, very severe hazard of erosion, flagstones on the surface, clayey surface layer, and shallow gullies. Tall fescue, Kentucky bluegrass, and annual lespedeza are better suited to this soil than most other pasture plants.

Potential is fair for Virginia pine, Scotch pine, Austrian pine, and eastern redcedar. The main concern in management of woodland are the equipment limitations, erosion hazard, and seedling mortality. The steepness of slope limits the use of most equipment.

Potential is poor for urban uses. The steepness of slope; the tendency of this soil to erode and form slips and slides; the soft, unweathered shale at a depth of 20 to 40 inches; and slow permeability are the main limitations. The low strength is a limitation if this soil is used for roadfill.

This soil is in capability subclass VIIe and woodland group 4c.

EkB—Elk silt loam, 2 to 6 percent slopes. This gently sloping soil is deep and well drained. It is on high stream terraces in scattered areas along the major streams. Slopes are smooth and convex. Areas are 5 to 50 acres.

Typically, the surface layer is brown silt loam about 8 inches thick. The subsoil extends to a depth of 42 inches. The upper 7 inches of the subsoil is brown silt loam, and the lower 27 inches is brown and strong brown silty clay loam. The underlying material to a depth of 65 inches is yellowish brown silty clay loam.

This Elk soil has a deep root zone. Permeability is moderate, surface runoff is medium, and available water capacity is high. Organic matter content is moderate, and natural fertility is medium. This soil is strongly acid or medium acid, except in areas that have been limed. This soil has good tilth and can be worked throughout a wide range of soil moisture. Some areas of this soil are subject to flooding, if the floodwater is exceptionally high.

Included with this soil in mapping are small narrow areas of Elk soils that have slopes of less than 2 percent. Also included are areas that are subject to flooding. The included soils make up 5 to 10 percent of this map unit.

Most areas of this soil are used for burley tobacco, corn, and hay crops. This soil has good potential for cultivated crops commonly grown in the area, such as corn, tobacco, and small grain. Flooding on this soil is generally not a hazard to cultivated crops. The hazard of erosion is moderate if this soil is cultivated. Contour farming, minimum tillage, contour stripcropping, including grasses and legumes in the cropping system, returning crop residue to the soil, no-tillage, and grassed waterways help to reduce runoff and control erosion. This soil has good potential for pasture and hay. Kentucky bluegrass, tall fescue, orchardgrass, red clover, alfalfa, Ladino clover, and annual lespedeza are better suited to this soil than most other hay and pasture plants.

Potential is good for upland oaks, eastern white pine, loblolly pine, yellow-poplar, and black walnut. The main concern in management of woodland is plant competition.

Potential is good for most urban uses, except in low areas where flooding may occur in places. The low strength is a limitation if this soil is used for roadfill.

This soil is in capability subclass IIe and woodland group 2o.

EkC—Elk silt loam, 6 to 12 percent slopes. This sloping soil is deep and well drained. It is on stream terraces in scattered areas along the major streams. Slopes are short and smooth. Areas are 5 to 20 acres.

Typically, the surface layer is brown silt loam about 8 inches thick. The subsoil extends to a depth of 42 inches. The upper 7 inches of the subsoil is brown silt loam, and the lower 27 inches is brown and strong brown silty clay loam. The underlying material to a depth of 65 inches is yellowish brown silty clay loam.

This Elk soil has a deep root zone. Permeability is

moderate, surface runoff is medium, and available water capacity is high. Organic matter content is moderate, and natural fertility is medium. The soil is strongly acid or medium acid, except in areas that have been limed. This soil has good tilth and can be worked throughout a wide range of soil moisture.

Included with this soil in mapping are small areas of Elk soils that have slopes of more than 12 percent and a few small areas of eroded soils. Also included are areas that are subject to flooding. The included soils make up about 5 to 10 percent of this map unit.

Most areas of this soil are used for hay or pasture, but many areas are used for burley tobacco and corn. This soil has good potential for hay and pasture. Kentucky bluegrass, orchardgrass, tall fescue, alfalfa, red clover, Ladino clover, and annual lespedeza are better suited to this soil than most other hay and pasture plants. This soil has fair potential for cultivated crops commonly grown in the area. Flooding on this soil is generally not a hazard to crops. The hazard of erosion is severe if this soil is cultivated. Contour farming, minimum tillage, contour stripcropping, including grasses and legumes in the cropping system, returning crop residue to the soil, no-tillage, and grassed waterways help to reduce runoff and control erosion.

Potential is good for eastern white pine, loblolly pine, upland oaks, yellow-poplar, and black walnut. The main concern in management of woodland is plant competition.

Potential is fair for urban uses. The steepness of slope is the main limitation, but in low areas flooding may occur in places. The low strength is a limitation if this soil is used for roadfill.

This soil is in capability subclass IIIe and woodland group 2o.

ElA—Elk silt loam, rarely flooded, 0 to 2 percent slopes. This nearly level soil is deep and well drained. It is on low stream terraces in scattered areas along the major streams. Slopes are smooth and slightly convex. Areas are 5 to 100 acres or more.

Typically, the surface layer is brown silt loam about 8 inches thick. The subsoil extends to a depth of 42 inches. The upper 7 inches of the subsoil is brown silt loam, and the lower 27 inches is brown and strong brown silty clay loam. The underlying material to a depth of 65 inches is yellowish brown silty clay loam.

This Elk soil has a deep root zone. Permeability is moderate, surface runoff is slow, and available water capacity is high. Organic matter content is moderate, and natural fertility is medium. The soil is strongly acid or medium acid, except in areas that have been limed. This soil has good tilth and can be worked throughout a wide range of soil moisture. Areas of this soil are subject to rare flooding.

Included with this soil in mapping are small areas of Elk soils that have slopes of more than 2 percent and small areas of soils that are similar to this Elk soil but are moderately well drained. Also included are areas of soils that are not subject to flooding. The included soils make up about 5 to 10 percent of this map unit.

Most areas of this soil are used for burley tobacco, corn, or hay crops (fig. 10). This soil has good potential for cultivated crops commonly grown in the area, such as corn, tobacco, and small grain. The rare flooding on this soil is generally not a hazard to crops.

The hazard of erosion is slight if this soil is cultivated. Continuous cultivation is suitable if the organic matter content, tilth, and fertility are maintained. This soil has good potential for hay and pasture. Kentucky bluegrass, orchardgrass, tall fescue, alfalfa, red clover, Ladino clover, and annual lespedeza are better suited to this soil than most other hay and pasture plants.

Potential is good for eastern white pine, loblolly pine, upland oaks, yellow-poplar, and black walnut. The main concern in management of woodland is plant competition.

Potential is poor for most urban uses because of rare flooding. The low strength is a limitation if this soil is used for roadfill.

This soil is in capability class I and woodland group 2o.

ElB—Elk silt loam, rarely flooded, 2 to 6 percent slopes. This gently sloping soil is deep and well drained. It is on low stream terraces in scattered areas along the major streams. Slopes are smooth and convex. Areas are 5 to 50 acres.

Typically, the surface layer is brown silt loam about 8 inches thick. The subsoil extends to a depth of 42 inches. The upper 7 inches of the subsoil is brown silt loam, and the lower 27 inches is brown and strong brown silty clay loam. The underlying material to a depth of 65 inches is yellowish brown silty clay loam.

This Elk soil has a deep root zone. Permeability is moderate, surface runoff is medium, and available water capacity is high. Organic matter content is moderate, and natural fertility is medium. The soil is strongly acid or medium acid, except in areas that have been limed. This soil has good tilth and can be worked throughout a wide range of soil moisture. Areas of this soil are subject to rare flooding.

Included with this soil in mapping are small, narrow areas of Elk soils that have slopes of less than 2 percent. The included soils make up about 5 to 10 percent of this map unit.

Most areas of this soil are used for burley tobacco, corn, and hay crops. This soil has good potential for cultivated crops commonly grown in the area, such as corn, tobacco, and small grain. The rare flooding on this soil is generally not a hazard to cultivated crops. The hazard of erosion is moderate if this soil is cultivated. Contour farming, minimum tillage, contour stripcropping, including grasses and legumes in the cropping system, returning crop residue to the soil, no-tillage, and grassed waterways help reduce runoff and control erosion. This

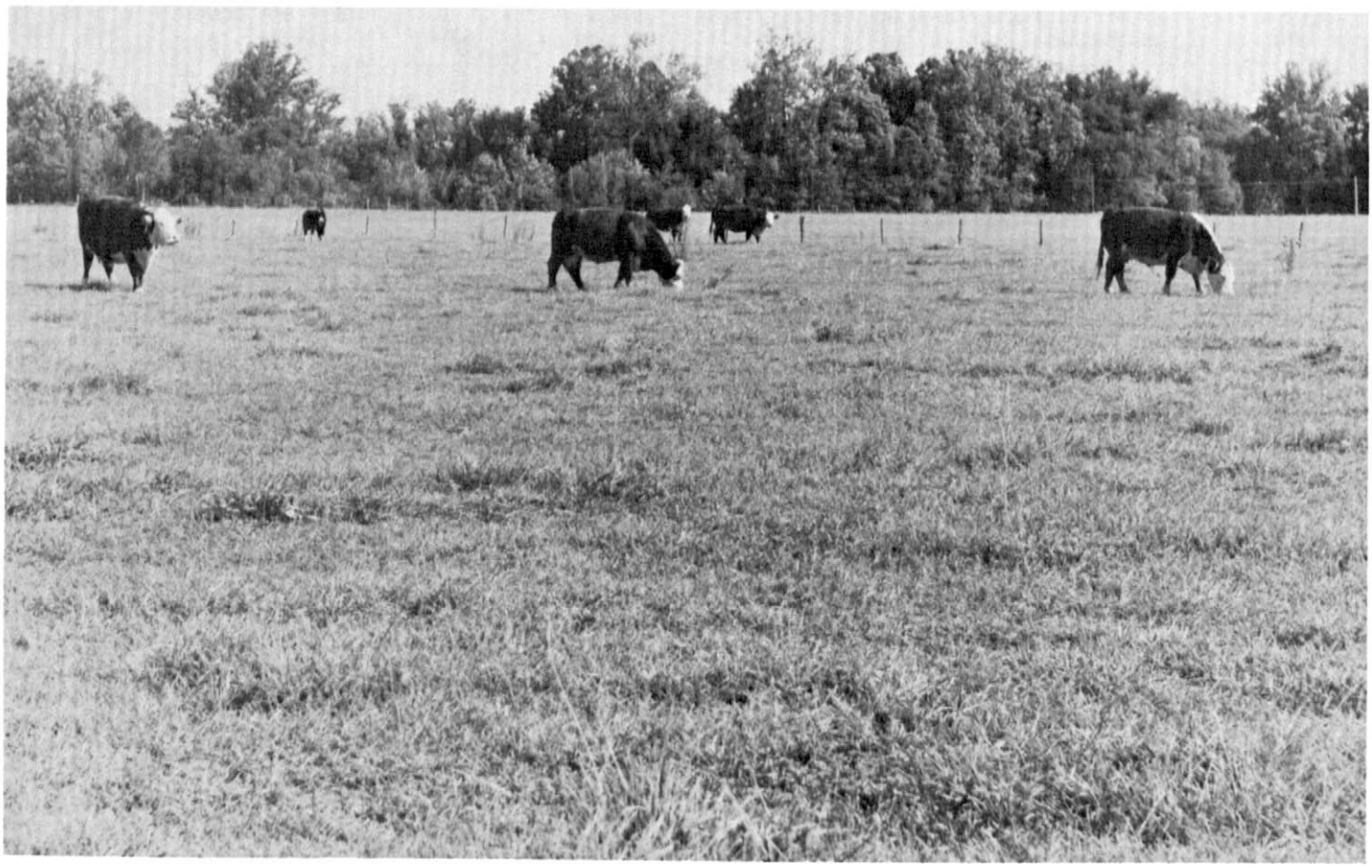


Figure 10.—Hereford cattle grazing tall fescue pasture on Elk silt loam, rarely flooded, 0 to 2 percent slopes.

soil has good potential for pasture and hay. Kentucky bluegrass, tall fescue, orchardgrass, red clover, alfalfa, Ladino clover, and annual lespedeza are better suited to this soil than most other hay and pasture plants.

Potential is good for eastern white pine, loblolly pine, upland oaks, yellow-poplar, and black walnut. The main concern in management of woodland is plant competition.

Potential is poor for most urban uses because of rare flooding. The low strength is a limitation if this soil is used for roadfill.

This soil is in capability subclass IIe and woodland group 2o.

ElC—Elk silt loam, rarely flooded, 6 to 12 percent slopes. This sloping soil is deep and well drained. It is on low stream terraces in scattered areas along the major streams. Slopes are short and smooth. Areas are 5 to 20 acres.

Typically, the surface layer is brown silt loam about 8 inches thick. The subsoil extends to a depth of 42 inches. The upper 7 inches of the subsoil is brown silt loam, and the lower 27 inches is brown and strong brown silty clay loam. The underlying material to a depth of 65 inches is yellowish brown silty clay loam.

This Elk soil has a deep root zone. Permeability is moderate, surface runoff is medium, and available water capacity is high. Organic matter content is moderate, and natural fertility is medium. The soil is strongly acid or medium acid, except in areas that have been limed. This soil has good tilth and can be worked throughout a wide range of soil moisture. Areas of this soil are subject to rare flooding.

Included with this soil in mapping are small areas of Elk soils that have slopes of more than 12 percent and a few small areas of eroded soils. The included soils make up about 5 to 10 percent of this map unit.

Much of the acreage of this soil is used for hay or pasture, but many areas are used for burley tobacco and corn. This soil has good potential for hay and pasture. Kentucky bluegrass, orchardgrass, tall fescue, alfalfa, red clover, Ladino clover, and annual lespedeza are better suited to this soil than most other pasture and hay plants. This soil has fair potential for cultivated crops commonly grown in the area. The rare flooding on this soil is generally not a hazard to cultivated crops. The

hazard of erosion is severe if this soil is cultivated. Contour farming, minimum tillage, contour stripcropping, including grasses and legumes in the cropping system, returning crop residue to the soil, no-tillage, and grassed waterways help to reduce runoff and control erosion.

Potential is good for eastern white pine, loblolly pine, upland oaks, yellow-poplar, and black walnut. The main concern in management of woodland is plant competition.

Potential is poor for most urban uses because of the rare flooding and steepness of slope. The low strength is a limitation if this soil is used for roadfill.

This soil is in capability subclass IIIe and woodland group 2o.

En—Elk-Newark complex. This complex is along the Licking River and South Fork Licking River in Pendleton County. It consists of somewhat poorly drained Newark soils on narrow flood plains between well drained, deep Elk soils on narrow stream terraces. Areas of these soils are so intermingled that to separate them in mapping was not practical. This complex is 35 to 65 percent Elk soils and 15 to 35 percent Newark soils. Slope is 20 to 45 percent in the Elk soils and 0 to 2 in the Newark soils. Areas of this complex are about 120 to 400 feet wide and about 5 to 50 acres.

Typically, the Elk soil has a surface layer of brown silt loam about 8 inches thick. The subsoil extends to a depth of 42 inches. The upper 7 inches of the subsoil is brown silt loam, and the lower 27 inches is brown and strong brown silty clay loam. The underlying material to a depth of 65 inches is yellowish brown silty clay loam.

This Elk soil has a deep root zone. Permeability is moderate, surface runoff is rapid, and available water capacity is high. Organic matter content is moderate, and natural fertility is medium. The soil is strongly acid to medium acid.

Typically, the Newark soil has a surface layer of brown silt loam about 7 inches thick. The subsoil extends to a depth of 40 inches. The upper 7 inches of the subsoil is yellowish brown silt loam and has light brownish gray mottles, and the lower 26 inches is light brownish gray silt loam. The underlying material extends to a depth of 65 inches. The upper 20 inches is gray silt loam, and the lower 5 inches is gray silty clay loam.

This Newark soil has a deep root zone. Permeability is moderate, surface runoff is very slow, and available water capacity is high. A seasonal high water table is at a depth of 6 to 18 inches. Organic matter content is low, and natural fertility is medium. The soil is slightly acid to mildly alkaline. The plow layer is easy to till. The Newark soils are subject to frequent flooding.

Included with this complex in mapping are areas of Otwell, Licking, Allegheny, and Nolin soils. Also included are areas of soils that are similar to Newark soils but are poorly drained, areas of steep riverbank, and areas of Eden and Cynthiana soils. The included soils make up 20 to 40 percent of this map unit.

Most areas of this complex are covered with native hardwoods and brush or are used for pasture. The soils in this complex have poor potential for cultivated crops, hay, and urban uses. They have fair potential for pasture. The steep slopes, wetness, and flooding are the main limitations.

Potential is good for yellow-poplar, eastern white pine, loblolly pine, black walnut, sweetgum, and American sycamore. The main concerns in management of woodland are equipment limitations, the erosion hazard, and plant competition. Steepness of slope and wetness limit the use of equipment. This complex is suitable as woodland wildlife habitat.

This complex is in capability class VII. Elk soil is in woodland group 2r; Newark soil is in woodland group 1w.

HeC—Heitt silt loam, 6 to 12 percent slopes. This sloping, clayey soil is deep and well drained. It mainly is on long, narrow ridges near major streams. A few shallow gullies are in some areas. Slopes are short, smooth, and convex. Areas are 5 to 20 acres.

Typically, the surface layer is brown silt loam about 6 inches thick. The subsoil extends to a depth of 38 inches. The upper 5 inches of the subsoil is strong brown silty clay that has yellowish red variegations, the next 19 inches is yellowish red and strong brown clay that has pale brown and light olive brown mottles, and the lower 8 inches is light olive brown silty clay that has yellowish brown and light brownish gray mottles. The underlying material to a depth of 56 inches is soft, clay shale that has thin layers of limestone.

This Heitt soil has a deep root zone, but roots are restricted by the clayey subsoil. Permeability is moderately slow, surface runoff is medium, and available water capacity is high. Organic matter content is low, and natural fertility is medium. The surface layer is strongly acid, except in areas that have been limed. The upper part of the subsoil is strongly acid or medium acid, and the lower part is strongly acid to mildly alkaline. The plow layer is easy to cultivate except in small, eroded areas where the subsoil is exposed. Shrink-swell potential is moderate, and strength is low. Depth to rock is 40 to 60 inches.

Included with this soil in mapping are a few small areas of Eden soils, some small areas of eroded soils, and narrow areas of soils that have slopes of less than 6 percent. The included soils make up about 7 to 12 percent of this map unit.

Much of the acreage of this soil is used for hay or pasture, but many areas are used for burley tobacco and corn (fig. 11). This soil has good potential for hay and pasture. Kentucky bluegrass, orchardgrass, tall fescue, alfalfa, red clover, Ladino clover, and annual lespedeza are better suited to this soil than most other hay and pasture plants. This soil has fair potential for cultivated crops; however, the hazard of erosion is severe in cultivated areas. Contour farming, minimum tillage, contour stripcropping, including grasses and legumes in the crop-

Figure 11.—Heitt silt loam, 6 to 12 percent slopes. In the foreground, remnants of a tobacco crop are mixed in with a cover crop of winter wheat. In the background, corn is harvested in shocks.

ping system, returning crop residue to the soil, no-tillage, and grassed waterways help to reduce runoff and control erosion.

Potential is fair for eastern white pine, shortleaf pine, Virginia pine, and eastern redcedar. The main concerns in management of woodland are plant competition and equipment limitations.

Potential is fair for most urban uses. The steepness of slope, tendency of the clayey subsoil to shrink and swell, and moderately slow permeability are the main limitations. The low strength is a limitation if this soil is used for roadfill.

This soil is in capability subclass IIIe and woodland group 3c.

LcB—Licking silt loam, 2 to 6 percent slopes. This gently sloping, clayey soil is deep and moderately well drained. It is on stream terraces and on foot slopes at the base of steep hills. Slopes are smooth and convex. Areas are 5 acres to more than 50 acres.

Typically, the surface layer is brown silt loam about 6 inches thick. The subsoil extends to a depth of more than 65 inches. The upper 12 inches of the subsoil is yellowish brown silty clay loam, and the lower part is yellowish brown silty clay. The subsoil has light brownish gray mottles.

This Licking soil has a deep root zone, but roots are restricted by the clayey subsoil. Permeability is slow, surface runoff is medium, and available water capacity is high. A seasonal high water table is at a depth of 18 to 36 inches after heavy rains. Organic matter content is low, and natural fertility is medium. The soil is very strongly acid or medium acid in the upper layers, except in areas that have been limed. The lower part of the subsoil is medium acid to mildly alkaline. The plow layer is easy to till. Shrink-swell potential is moderate, and strength is low. Some areas of this soil are subject to flooding, if the floodwater is exceptionally high.

Included with this soil in mapping are small areas of soils that are similar to this Licking soil but are somewhat poorly drained or well drained. Also included are small areas of Nolin and Otwell soils and areas of soils

that are subject to flooding. The included soils make up about 5 to 10 percent of this map unit.

Areas of this soil are used for burley tobacco, corn, hay, and pasture (fig. 12). This soil has good potential for cultivated crops commonly grown in the area, such as corn, tobacco, and small grain. Flooding on this soil is generally not a hazard to cultivated crops. The hazard of erosion is moderate in cultivated areas of this soil. Contour farming, minimum tillage, contour stripcropping, including grasses and legumes in the cropping system, returning crop residue to the soil, no-tillage, and grassed waterways help to reduce runoff and control erosion. In places, the seasonal high water table causes damage to crops. This soil has good potential for pasture and hay. Kentucky bluegrass, tall fescue, orchardgrass, red clover, alfalfa, Ladino clover, and annual lespedeza are better suited to this soil than most other hay and pasture plants. Alfalfa may be short-lived because the root zone is saturated with water part of the year.

Potential is good for upland oaks, eastern white pine, and yellow-poplar. The main concern in management of woodland is plant competition.

Potential is poor for most urban uses. The seasonal high water table, low strength, and slow permeability are the main limitations. In low areas, flooding may occur in places. The low strength is a limitation if this soil is used for roadfill.

This soil is in capability subclass IIe and woodland group 2o.

LcC—Licking silt loam, 6 to 12 percent slopes. This sloping, clayey soil is deep and moderately well drained. It is on stream terraces and on foot slopes at the base of steep hills. Slopes mainly are short, smooth, and concave. Areas are 5 to 50 acres.

Typically, the surface layer is brown silt loam about 6 inches thick. The subsoil extends to a depth of more than 65 inches. The upper 12 inches of the subsoil is yellowish brown silty clay loam, and the lower part is yellowish brown silty clay. The subsoil is mottled with light brownish gray.

Figure 12.—Timothy hay is mowed on Licking silt loam, 2 to 6 percent slopes.

This soil has a deep root zone, but roots are restricted by the clayey subsoil. Permeability is slow, surface runoff is medium to rapid, and available water capacity is high. A seasonal high water table is at a depth of 18 to 36 inches after heavy rains. Organic matter content is low, and natural fertility is medium. The soil is very strongly acid to medium acid in the upper layers, except in areas that have been limed. The lower part of the subsoil is medium acid to mildly alkaline. The plow layer is easy to till except in small, eroded spots. Shrink-swell potential is moderate, and strength is low. Some areas of this soil are subject to flooding, if the floodwater is exceptionally high.

Included with this soil in mapping are narrow areas that have slopes of less than 6 percent, small areas of soils that are similar to this Licking soil but the surface layer is very dark grayish brown silty clay loam, and small areas of Nolin, Newark, Otwell, and Eden soils. Also included are areas of this soil that are flooded. The included soils make up 10 to 20 percent of this map unit.

Most areas of this soil are used for hay or pasture, but many areas are used for burley tobacco and corn. This soil has good potential for hay and pasture. Kentucky bluegrass, orchardgrass, tall fescue, alfalfa, red clover, Ladino clover, and annual lespedeza are better suited to this soil than most other hay and pasture plants. Alfalfa may be short-lived because the root zone is saturated with water part of the year. This soil has fair potential for cultivated crops commonly grown in the area. Flooding on this soil is generally not a hazard to cultivated crops. The hazard of erosion is severe in cultivated areas of this soil. Contour farming, minimum tillage, contour strip-cropping, including grasses and legumes in the cropping system, returning crop residue to the soil, no-tillage, and grassed waterways help to reduce runoff and control erosion.

Potential is good for eastern white pine, upland oaks, and yellow-poplar. The main concern in management of woodland is plant competition.

Potential is poor for most urban uses. The steepness of slope, seasonal high water table, low strength, and slow permeability are the main limitations. In low areas, flooding may occur in places, and slips may occur on hillsides above this soil. The low strength is a limitation if this soil is used for roadfill.

This soil is in capability subclass IIIe and woodland group 2o.

LcD—Licking silt loam, 12 to 20 percent slopes. This moderately steep, clayey soil is deep and moderately well drained. It is on stream terraces and on foot slopes at the base of steep hills. Slopes are smooth and concave. Areas are 5 to 50 acres.

Typically, the surface layer is brown silt loam about 6 inches thick. The subsoil extends to a depth of more than 65 inches. The upper 12 inches of the subsoil is yellowish brown silty clay loam, and the lower part is yellowish brown silty clay. The subsoil has light brownish gray mottles.

This Licking soil has a deep root zone, but roots are restricted by the clayey subsoil. Permeability is slow, surface runoff is rapid, and available water capacity is high. A seasonal high water table is at a depth of 18 to 36 inches after heavy rains. Organic matter content is low, and natural fertility is medium. The soil is medium acid or very strongly acid in the upper layers, except in areas that have been limed. The lower part of the subsoil is medium acid to mildly alkaline. The plow layer is easy to till except in small, eroded spots. Shrink-swell potential is moderate, and strength is low. Some areas of this soil are subject to flooding, if the floodwater is exceptionally high.

Included with this soil in mapping are small areas of soils that are similar to this Licking soil, but the surface layer is silty clay loam or silty clay. Also included are a few areas that are well drained; small areas of Nolin, Elk, Otwell, and Eden soils; and areas that are subject to flooding. The included soils make up about 15 to 25 percent of this map unit.

Most areas of this soil are used for pasture or hay. Some areas are used for tobacco, and some are wooded. This soil has good potential for pasture and hay. Kentucky bluegrass, tall fescue, orchardgrass, red clover, alfalfa, Ladino clover, and annual lespedeza are better suited to this soil than most other hay and pasture plants. Alfalfa may be short-lived because the root zone is saturated with water part of the year. This soil has poor potential for cultivated crops. Flooding on this soil is generally not a hazard to crops; however, the hazard of erosion is very severe in cultivated areas. The soil can be cultivated occasionally if erosion control practices are used. Contour farming, minimum tillage, contour strip-cropping, including grasses and legumes in the cropping system, returning crop residue to the soil, no-tillage, and grassed waterways help to reduce runoff and control erosion. Incorporating crop residue in the plow layer helps to maintain the organic matter content. Preparing a seedbed is difficult because of the moderately steep slopes and equipment limitations.

Potential is good for eastern white pine, upland oaks, and yellow-poplar. The main concerns in management of woodland are equipment limitations, the erosion hazard, and plant competition. The steep slopes limit the use of equipment.

Potential is poor for most urban uses. The moderately steep slopes, seasonal high water table, low strength, and slow permeability are the main limitations. In low areas, flooding may occur in places, and slips may occur on hillsides above this soil. The low strength is a limitation if this soil is used for roadfill.

This soil is in capability subclass IVe and woodland group 2r.

LoC—Lowell silt loam, 6 to 12 percent slopes. This sloping, clayey soil is deep and well drained. It is on narrow ridges above steeper areas of Eden soils. Slopes are short, smooth, and convex. Areas are 5 to 60 acres.

Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsoil extends to a depth of 56 inches. The upper 10 inches of the subsoil is brown silty clay loam, the next 9 inches is brown silty clay, the next 15 inches is yellowish brown clay, and the lower 14 inches is light olive brown clay. The underlying material is gray and brown silty clay. Limestone bedrock is at a depth of about 60 inches.

This Lowell soil has a deep root zone, but roots are restricted by the clayey subsoil. Permeability is moderately slow, surface runoff is medium to rapid, and available water capacity is high. Organic matter content is low, and natural fertility is medium. The soil is strongly acid or medium acid in the upper layers, except in areas that have been limed. The lower part of the subsoil is slightly acid to mildly alkaline. The plow layer is easy to till except in small, eroded spots. Shrink-swell potential is moderate, and strength is low.

Included with this soil in mapping are small areas of soils that are similar to this Lowell soil but have bedrock at a depth of less than 40 inches, a few areas of soils that are moderately well drained, and small areas of soils that have a fragipan less than 7 inches thick. Also included are small areas of soils that have less clay in the subsoil than this Lowell soil, small areas of eroded soils that have a surface layer of silty clay loam, and long, narrow areas of soils that have slopes of less than 6 percent. The included soils make up about 5 to 15 percent of this map unit.

Much of the acreage of this soil is used for hay or pasture. Many areas are used for burley tobacco and corn. This soil has good potential for hay and pasture. Kentucky bluegrass, orchardgrass, tall fescue, alfalfa, red clover, Ladino clover, and annual lespedeza are better suited to this soil than most other hay and pasture plants. This soil has fair potential for cultivated crops commonly grown in the area; however, the hazard of erosion is severe in cultivated areas. Contour farming, minimum tillage, contour stripcropping, including grasses and legumes in the cropping system, returning crop residue to the soil, no-tillage, and grassed waterways help to reduce runoff and control erosion.

Potential is good for eastern white pine, shortleaf pine, loblolly pine, yellow-poplar, and Virginia pine. The main concern in management of woodland is plant competition.

Potential is fair for most urban uses. The steepness of slope, low strength, and moderately slow permeability are the main limitations. The low strength is a limitation if this soil is used for roadfill.

This soil is in capability subclass IIIe and woodland group 2c.

LoD—Lowell silt loam, 12 to 20 percent slopes. This moderately steep, clayey soil is deep and well drained. It is on the upper part of hillsides below areas of Nicholson soils. Slopes are long, smooth, and convex. Areas are 20 to 200 acres.

Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsoil extends to a depth of 56 inches. The upper 10 inches of the subsoil is brown silty clay loam, the next 9 inches is brown silty clay, the next 15 inches is yellowish brown clay, and the lower 14 inches is light olive brown clay. The underlying material is gray and brown silty clay. Limestone bedrock is at a depth of about 60 inches.

This Lowell soil has a deep root zone, but roots are restricted by the clayey subsoil. Permeability is moderately slow, surface runoff is rapid, and available water capacity is high. Organic matter content is low and natural fertility is medium. The soil is strongly acid or medium acid in the upper layers, except in areas that have been limed. The lower part of the subsoil is slightly acid to mildly alkaline. The plow layer is easy to till except in small, eroded spots. Shrink-swell potential is moderate, and strength is low.

Included with this soil in mapping are some small areas of soils that are similar to this Lowell soil but have bedrock at a depth of less than 40 inches and very small areas of Nicholson and Eden soils. The included soils make up about 10 to 20 percent of this map unit.

Most areas of this soil are used for pasture or hay. Some areas are used for tobacco, and a few areas are wooded. This soil has good potential for pasture and hay. Kentucky bluegrass, tall fescue, orchardgrass, red clover, alfalfa, Ladino clover, and annual lespedeza are better suited to this soil than most other hay and pasture plants. This soil has poor potential for cultivated crops. The hazard of erosion is very severe in cultivated areas of this soil. The soil can be cultivated occasionally if erosion control practices are used. Contour farming, minimum tillage, contour stripcropping, including grasses and legumes in the cropping system, returning crop residue to the soil, no-tillage, and grassed waterways help to reduce runoff and control erosion. Incorporating crop residue in the plow layer helps to maintain the organic matter content. Preparing a seedbed is difficult because of the moderately steep slopes and equipment limitations.

Potential is good for yellow-poplar, eastern white pine, shortleaf pine, loblolly pine, and Virginia pine. The main concerns in management of woodland are equipment limitations, the erosion hazard, and plant competition. The steep slopes limit the use of equipment.

Potential is poor for most urban uses. The moderately steep slopes, low strength, and moderately slow permeability are the main limitations. The low strength is a limitation if the soil is used for roadfill.

This soil is in capability subclass IVe and woodland group 2c.

Mc—McGary silt loam. This nearly level, clayey soil is deep and somewhat poorly drained. It is on stream terraces along Eagle Creek, Licking River, and South Fork Licking River. Slopes are smooth and slightly concave. Slope is 0 to 2 percent. Areas are 20 to 100 acres.

Typically, the surface layer is brown silt loam about 7 inches thick. The subsoil extends to a depth of 40 inches. The upper 12 inches of the subsoil is yellowish brown silty clay loam, the next 12 inches is light brownish gray clay, and the lower 9 inches is gray silty clay. The underlying material to a depth of 65 inches is gray and light olive brown silty clay.

This McGary soil has a deep root zone, but roots are restricted by the clayey subsoil. Permeability is slow, surface runoff is slow or very slow, and available water capacity is high. A seasonal high water table is at a depth of 12 to 36 inches after heavy rains. Organic matter content is low, and natural fertility is medium. The soil is medium acid or slightly acid in the surface layer and subsoil, except in areas that have been limed. This soil has good tilth and can be worked throughout a wide range of soil moisture. Shrink-swell potential is high, and strength is low. Some areas of this soil are subject to flooding, if the floodwater is exceptionally high.

Included with this soil in mapping are small areas of Otwell soils, small areas of soils that are similar to this McGary soil but are poorly drained, small areas of soils that have slopes of more than 2 percent, and areas of soils that are not so clayey in the subsoil as this McGary soil. Also included are areas that are subject to flooding. The included soils make up about 10 to 20 percent of this map unit.

Most areas of this soil are used for hay or pasture. Some areas are used for corn and soybeans. This soil has fair potential for most cultivated crops commonly grown in the area. Flooding on this soil is generally not a hazard to cultivated crops, and the hazard of erosion is slight. Tobacco generally is not grown because of wetness. This soil can be continually cultivated if it is effectively drained and the organic matter content, tilth, and fertility are maintained. Open ditch drainage in combination with grassed waterways or tile drainage systems can be used to remove excess water. This soil has fair potential for hay because of wetness, and it has good potential for pasture. Tall fescue, alsike clover, and annual lespedeza are better suited to this soil than most other hay and pasture plants because they are water tolerant.

Potential is fair for white ash, sweetgum, eastern white pine, American sycamore, yellow-poplar, and pin oak. The main concerns in management of woodland are equipment limitations and plant competition. Wetness is a limitation to the use of equipment.

Potential is poor for most urban uses. The seasonal high water table, low strength, high shrink-swell potential, and slow permeability are the main limitations. In low areas, flooding may occur in places. The low strength is a limitation if this soil is used for roadfill.

This soil is in capability subclass IIw and woodland group 3w.

Ne—Newark silt loam. This nearly level soil is deep and somewhat poorly drained. It is in low-lying areas on flood plains. Slopes are smooth and slightly concave. Slope is 0 to 2 percent. Areas are 5 acres to more than 50 acres.

Typically, the surface layer is brown silt loam about 7 inches thick. The subsoil extends to a depth of 40 inches. The upper 7 inches of the subsoil is yellowish brown silt loam that has light brownish gray mottles and the lower 26 inches is light brownish gray silt loam. The underlying material to a depth to 65 inches is 20 inches of gray silt loam over 5 inches of gray silty clay loam.

This Newark soil has a deep root zone. Permeability is moderate, surface runoff is very slow, and available water capacity is high. The soil is subject to frequent flooding in winter. A seasonal high water table is at a depth of 6 to 18 inches. Organic matter content is low, and natural fertility is medium. This soil is slightly acid to mildly alkaline throughout. The surface layer is easy to till.

Included with this soil in mapping are small areas of soils that are similar to this soil but are poorly drained. Also included are small areas of soils that are moderately well drained. The included soils make up 15 to 25 percent of this map unit.

Most areas of this soil are used for hay or pasture. Some areas are used for corn and soybeans. This soil has good potential for most cultivated crops commonly grown in the area; however, the frequent flooding is a hazard to crops in winter and in wet periods during the growing season. The hazard of erosion is slight in cultivated areas. Tobacco generally is not grown on this soil because of wetness and flooding. This soil can be continually cultivated if it is effectively drained and the organic matter content and tilth are maintained. Open ditch drainage in combination with grassed waterways or tile drainage systems can be used to remove excess water. If drained, this soil has good potential for hay, and it has good potential for pasture. Tall fescue, alsike clover, annual lespedeza, and plants that tolerate wetness are better suited to this soil than most other pasture and hay plants.

Potential is good for pin oak, eastern cottonwood, yellow-poplar, eastern white pine, American sycamore, and sweetgum. The main concerns in management of woodland are equipment limitations and plant competition. Wetness is a limitation to the use of equipment.

Potential is poor for most urban uses. The frequent flooding and seasonal high water table are the main limitations. The low strength is a limitation if this soil is used for roadfill.

This soil is in capability subclass IIw and woodland group 1w.

NfB—Nicholson silt loam, 2 to 8 percent slopes. This gently sloping to sloping soil is deep and moderately well drained. It has a fragipan. It is on fairly broad ridges that are mostly in the northern part of the survey area. Slopes are smooth and convex. Areas are 10 acres to several hundred acres.

Typically, the surface layer is brown silt loam about 8 inches thick. The subsoil extends to a depth of 60 inches. The upper 18 inches of the subsoil is brown and yellowish brown silty clay loam. The next 12 inches is a firm, compact, brittle fragipan of brown silty clay loam that is mottled with gray, and the lower 22 inches is yellowish brown silty clay. The underlying material to a depth of 65 inches is light olive brown silty clay.

This Nicholson soil has a moderately deep root zone. The penetration of roots and movement of air and water are restricted by the fragipan. Permeability is moderate above the pan, but it is slow in the pan. Because of the fragipan a perched water table is at a depth of 18 to 30 inches after heavy rains. Surface runoff is medium, and available water capacity is moderate. Organic matter content is low, and natural fertility is medium. The soil is strongly acid or medium acid in the upper layers, except in areas that have been limed. The lower part of the subsoil is strongly acid to mildly alkaline. The plow layer is easy to till. Shrink-swell potential is moderate below the fragipan, and strength is low.

Included with this soil in mapping are areas of Nicholson soils that have slopes of less than 2 percent, small areas of soils that have a fragipan less than 7 inches thick, and a few areas of soils in which the fragipan begins at a depth of 30 to 36 inches. Also included in mapping are narrow areas of soils that have a highly mottled silty clay horizon instead of a fragipan and a few small areas of soils that have a concretionary layer instead of a fragipan. The included soils make up about 5 to 15 percent of this map unit.

Areas of this soil are used for burley tobacco, corn, hay, and pasture. This soil has good potential for cultivated crops commonly grown in the area, such as corn, tobacco, and small grain. The hazard of erosion is moderate in cultivated areas. Contour farming, minimum tillage, contour stripcropping, including grasses and legumes in the cropping system, returning crop residue to the soil, no-tillage, and grassed waterways help to reduce runoff and control erosion. The perched seasonal high water table causes some damage to crops in places. This soil has good potential for pasture and hay. Kentucky bluegrass, tall fescue, orchardgrass, red clover, alfalfa, Ladino clover, alsike clover, and annual lespedeza are better suited to this soil than most other hay and pasture plants. Alfalfa may be short-lived because the root zone is saturated with water part of the year.

Potential is good for upland oaks, eastern white pine, white ash, yellow-poplar, and black walnut. The main concern in management of woodland is plant competition.

Potential is fair for most urban uses (fig. 13). The perched seasonal high water table and slow permeability are the main limitations. The low strength is a limitation if this soil is used for roadfill.

This soil is in capability subclass IIe and woodland group 2o.

Figure 13.—A skeet range on Nicholson silt loam, 2 to 8 percent slopes.

No—Nolin silt loam. This nearly level soil is deep and well drained. It is on flood plains. Slopes are smooth and slightly concave or slightly convex. Slope is 0 to 2 percent. Areas are 10 to 100 acres.

Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The subsoil is brown silt loam to a depth of 60 inches.

This Nolin soil has a deep root zone. Permeability is moderate, surface runoff is slow, and available water capacity is high. This soil is subject to occasional flooding in winter. Organic matter content is moderate, and natural fertility is high. The soil is slightly acid to mildly alkaline throughout. The surface layer is easy to till.

Included with this soil in mapping are very narrow areas of soils that are similar to this Nolin soil but have slopes of more than 2 percent, a few small areas of gravelly or stony soils, and areas of moderately well drained soils. Also included in mapping are a few areas of soils that have bedrock at a depth of less than 40 inches, narrow areas of soils that have silty clay loam or silty clay overwash from hillsides, and narrow areas of Elk and Licking soils. The included soils make up about 15 to 25 percent of this map unit.

Most areas of this soil are used for burley tobacco, corn, and hay. This soil has good potential for cultivated crops commonly grown in the area, such as corn, tobacco, and small grain. The occasional flooding on this soil generally is not a hazard to crops. The hazard of erosion is slight if this soil is cultivated. Continuous cultivation is suitable if the organic matter content and tilth are maintained. In places, tobacco, small grain, and alfalfa are damaged by floods. This soil has good potential for hay and pasture. Kentucky bluegrass, orchardgrass, tall fescue, alfalfa, red clover, Ladino clover, and annual

lespedeza are better suited to this soil than most other hay and pasture plants.

Potential is good for sweetgum, yellow-poplar, eastern white pine, eastern cottonwood, and white ash. The main concern in management of woodland is plant competition.

Potential is poor for most urban uses. Occasional flooding is the main limitation. Low strength is a limitation if the soil is used for roadfill.

This soil is in capability class I and woodland group 1o.

Nw—Nolin silt loam, frequently flooded. This nearly level soil is deep and well drained. It is on low-lying flood plains that are subject to rapid overflow. Slopes are irregular because they have been dissected by stream cutting. Slope is 0 to 2 percent. Areas are long and are 10 to more than 100 acres.

Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The subsoil is brown silt loam to a depth of 60 inches.

This Nolin soil has a deep root zone. Permeability is moderate, surface runoff is slow, and available water capacity is high. Organic matter content is moderate, and natural fertility is high. The soil is slightly acid to mildly alkaline throughout.

Included with this soil in mapping are small areas of soils that are similar to this Nolin soil but are gravelly or stony, a few areas of flaggy soils, and small, narrow areas of soils that have bedrock at a depth of less than 40 inches. The included soils make up 15 to 25 percent of this map unit.

Most areas of this soil are wooded. Some areas are in grassland, and a few areas are used for corn. Because this soil is subject to rapid overflow, it is suited only to permanent vegetation, such as grasses or trees. This soil has poor potential for cultivated crops and hay. It has fair potential for pasture. Because of the frequent flooding, protection and management of plant cover is very important. Pasture mixtures that provide adequate ground cover, give satisfactory forage production, and require the least frequent renovation should be grown. Tall fescue and reed canarygrass are better suited to this soil than most other pasture plants.

Potential is good for sweetgum, yellow-poplar, eastern white pine, eastern cottonwood, and white ash. The main concerns in management of woodland are plant competition and equipment limitations.

Potential is poor for most urban uses. Frequent flooding is the main limitation. The low strength is a limitation if this soil is used for roadfill.

This soil is in capability subclass Vw and woodland group 1w.

OtB—Otwell silt loam, 2 to 6 percent slopes. This gently sloping soil is deep and moderately well drained. It has a fragipan. It is on stream terraces, mainly along the Licking River, South Fork Licking River, and Eagle Creek. Slopes are smooth and convex. Areas are 5 acres to more than 50 acres.

Typically, the surface layer is brown silt loam about 7 inches thick. The subsoil extends to a depth of 58 inches. The upper 16 inches of the subsoil is yellowish brown silty clay loam that has a few gray mottles, the next 25 inches is a firm, compact, brittle fragipan of yellowish brown silty clay loam that is mottled with gray, and the lower 10 inches is brown silt loam that is mottled with gray. The underlying material to a depth of 65 inches is stratified silt loam and silty clay loam.

This Otwell soil has a moderately deep root zone. The penetration of roots and movement of air and water are restricted by the fragipan. Permeability is moderate above the pan, but it is slow in the pan. Because of the fragipan, a perched water table is at a depth of 18 to 24 inches after heavy rains. Surface runoff is medium, and available water capacity is moderate. Organic matter content is low, and natural fertility is medium. The soil is strongly acid or very strongly acid through the fragipan, except in areas that have been limed. It is easy to till and can be worked throughout a wide range of soil moisture without clodding or crusting. Strength is low. Some areas of this soil are subject to flooding, if the floodwater is exceptionally high.

Included with this soil in mapping are small areas of Licking and Elk soils, small areas of soils that are similar to this Otwell soil but have a fragipan less than 10 inches thick, and a few areas of somewhat poorly drained soils. Also included are areas that are subject to flooding. The included soils make up about 5 to 10 percent of this map unit.

Areas of this soil are used for hay, pasture, tobacco, corn, and soybeans. This soil has good potential for cultivated crops commonly grown in the area, such as corn, tobacco, and small grain. Flooding on this soil is generally not a hazard to crops. The hazard of erosion is moderate in cultivated areas. Contour farming, minimum tillage, contour stripcropping, including grasses and legumes in the cropping system, returning crop residue to the soil, no-tillage, and grassed waterways help to reduce runoff and control erosion. The perched seasonal high water table can cause some damage to crops. This soil has good potential for pasture and hay. Kentucky bluegrass, tall fescue, orchardgrass, red clover, alsike clover, alfalfa, Ladino clover, and annual lespedeza are better suited to this soil than most other hay and pasture plants. Alfalfa may be short-lived because the root zone is saturated with water part of the year.

Potential is fair for yellow-poplar, white oak, eastern white pine, and white ash. The main concern in management of woodland is plant competition.

Potential is fair for most urban uses. The perched seasonal high water table and slow permeability are the main limitations. In low areas, flooding may occur in places. The low strength is a limitation if the soil is used for roadfill.

This soil is in capability subclass IIe and woodland group 3o.

OtC—Otwell silt loam, 6 to 12 percent slopes. This sloping soil is deep and moderately well drained. It has a fragipan. It is on stream terraces, mostly along the Licking River, South Fork Licking River, and Eagle Creek. Slopes are smooth and convex. Areas are 5 acres to more than 50 acres.

Typically, the surface layer is brown silt loam about 7 inches thick. The subsoil extends to a depth of 58 inches. The upper 16 inches of the subsoil is yellowish brown silty clay loam that has a few gray mottles, the next 25 inches is a firm, compact, brittle fragipan of yellowish brown silty clay loam mottled with gray, and the lower 10 inches is brown silt loam that is mottled with gray. The underlying material to a depth of 65 inches is stratified silt loam and silty clay loam.

This Otwell soil has a moderately deep root zone. The penetration of roots and movement of air and water are restricted by the fragipan. Permeability is moderate above the pan, but it is slow in the pan. Because of the fragipan, a perched water table is at a depth of 18 to 24 inches after heavy rains. Surface runoff is medium to rapid, and available water capacity is moderate. Organic matter content is low, and natural fertility is medium. The soil is strongly acid or very strongly acid through the fragipan, except in areas that have been limed. The plow layer is easy to cultivate. Strength is low. Some areas of this soil are subject to flooding, if the floodwater is exceptionally high.

Included with this soil in mapping are small areas of Elk and Licking soils, areas of soils that are similar to this Otwell soil but have a fragipan less than 10 inches thick, and a few small areas of eroded soils. Also included are areas that are subject to flooding. The included soils make up about 5 to 15 percent of this map unit.

Much of the acreage of this soil is used for hay or pasture, but many areas are used for burley tobacco and corn. This soil has good potential for hay and pasture. Kentucky bluegrass, orchardgrass, tall fescue, alfalfa, red clover, Ladino clover, alsike clover, and annual lespedeza are better suited to this soil than most other hay and pasture plants. Alfalfa may be short-lived because the root zone is saturated with water part of the year. This soil has fair potential for cultivated crops commonly grown in the area. Flooding on this soil is generally not a hazard to crops. The hazard of erosion is severe if this soil is cultivated. Contour farming, minimum tillage, contour stripcropping, including grasses and legumes in the cropping system, returning crop residue to the soil, no-tillage, and grassed waterways help to reduce runoff and control erosion.

Potential is fair for yellow-poplar, white oak, eastern white pine, and white ash. The main concern in management of woodland is plant competition.

Potential is fair for urban uses. The steepness of slope, perched seasonal high water table, and slow permeability are the main limitations. In low areas, flooding may occur in places. The low strength is a limitation if this soil is used for roadfill.

This soil is in capability subclass IIIe and woodland group 3o.

OwA—Otwell silt loam, rarely flooded, 0 to 2 percent slopes. This nearly level soil is deep and moderately well drained. It has a fragipan. It is on stream terraces, mainly along the Licking River and South Fork Licking River. Slopes are smooth and slightly convex to slightly concave. Areas are 10 to 100 acres.

Typically, the surface layer is brown silt loam about 7 inches thick. The subsoil extends to a depth of 58 inches. The upper 16 inches of the subsoil is yellowish brown silty clay loam that has a few gray mottles; the next 25 inches is a firm, compact, brittle fragipan of yellowish brown silty clay loam that is mottled with gray; and the lower 10 inches is brown silt loam that is mottled with gray. The underlying material to a depth of 65 inches is stratified silt loam and silty clay loam.

This Otwell soil has a moderately deep root zone. The penetration of roots and movement of air and water are restricted by the fragipan. Permeability is moderate above the pan, but it is slow in the pan. Because of the fragipan, a perched water table is at a depth of 18 to 24 inches after heavy rains. Surface runoff is slow, and available water capacity is moderate. Organic matter content is moderate, and natural fertility is medium. The soil is strongly acid or very strongly acid through the fragipan, except in areas that have been limed. The surface layer is easy to till and can be worked throughout a wide range of soil moisture without clodding or crusting. Most areas of this soil are subject to rare flooding. Strength of this soil is low.

Included with this soil in mapping are areas of soils that are similar to this Otwell soil but do not have a fragipan. Also included are a few areas of soils that are somewhat poorly drained or poorly drained and areas of soils that are not subject to flooding. The included soils make up about 5 to 10 percent of this map unit.

Most areas of this soil are used for pasture or hay, and some areas are used for corn and tobacco. This soil has good potential for pasture and hay. Tall fescue, red clover, alsike clover, Ladino clover, and annual lespedeza and plants that tolerate slight wetness are better suited to this soil than most other pasture and hay plants. This soil has good potential for cultivated crops commonly grown in the area, but in some years crops may be damaged by wetness. The rare flooding on this soil, however, is generally not a hazard to crops. The hazard of erosion is slight in cultivated areas. Continuous cultivation is suitable if the organic matter content, tilth, and fertility are maintained. Open ditch drainage in combination with grassed waterways help to remove excess water.

Potential is fair for yellow-poplar, white oak, eastern white pine, and white ash. The main concern in management of woodland is plant competition.

Potential is poor for urban uses. The rare flooding, perched seasonal high water table, and slow permeabil-

ity are the main limitations. The low strength is a limitation if this soil is used for roadfill.

This soil is in capability subclass IIw and woodland group 3o.

Pt—Pits-Dumps complex. This complex is on stream terraces that have been disturbed by mining of limestone. Areas vary in shape and range from 30 to 100 acres in size. This complex is 30 to 55 percent Pits and 45 to 70 percent Dumps.

Pits are open excavations from which soil and the underlying material have been removed. Most Pits in the survey area have been quarried for limestone. The rock or other material that is exposed after mining supports few or no plants, and excavations that are left are 10 to 200 feet deep and have vertical walls. The bottom of the quarry is limestone bedrock. One large active quarry is in Pendleton County. A few small quarries have been abandoned, and some of them have filled with water.

Dumps are nearly level to steep areas of smoothed or uneven accumulations, or piles, of waste rock and general refuse. These areas are by-products of limestone mining. Major reclamation of Dumps is needed for suitable plant growth.

Included with this complex in mapping are small areas of Otwell, Nolin, and Licking soils and small, partly excavated areas of soils on terraces. Also included are areas of railroad fill and piles of crushed limestone. The included soils and miscellaneous areas make up about 10 to 30 percent of this map unit.

This complex is not assigned to a capability class or woodland group.

Ro—Robertsville silt loam. This nearly level soil is deep and poorly drained. It has a fragipan. It is on stream terraces along the Licking River. Slopes are smooth and slightly concave. Slope is 0 to 2 percent. Areas are 10 to 100 acres.

Typically, the surface layer is grayish brown silt loam about 5 inches thick. The subsurface layer is light brownish gray silt loam about 8 inches thick. It has yellowish brown mottles. The subsoil extends to a depth of 50 inches. The upper 12 inches of the subsoil is light gray silty clay loam that has yellowish mottles, and the lower 25 inches is a firm, compact, brittle fragipan of light gray silty clay loam layer that is mottled with yellowish brown. The underlying material to a depth of 65 inches is stratified silty clay loam and silty clay that have thin layers of sand.

This Robertsville soil has a moderately deep root zone. The penetration of roots and movement of air and water are restricted by the fragipan. Permeability is moderate above the pan and slow in the pan. Because of the fragipan, a perched water table is near the surface after heavy rains. Surface runoff is very slow, and available water capacity is moderate. Organic matter content and natural fertility are low. The soil is strongly acid or very strongly acid, except in areas that have been limed. The surface layer is easy to till and can be worked throughout a wide range of soil moisture without clodding or crusting. Water is ponded in most areas during wet seasons, and some areas of this soil are subject to occasional flooding in winter.

Included with this soil in mapping are a few small areas of Newark and Zipp soils. Also included are small areas of soils that are similar to this Robertsville soil but do not have a fragipan and a few areas of somewhat poorly drained soils. The included soils make up about 10 to 20 percent of this map unit.

Most areas of this soil are used for pasture. Some areas are used for corn. This soil has poor potential for most cultivated crops because of inadequate drainage. A combination of open ditch drainage and constructed grassed waterways generally help to remove excess water. The occassional flooding on this soil is a hazard to crops in winter and during wet periods in the growing season. This soil is not suited to tobacco or fall-seeded small grain. This soil has fair potential for hay and pasture plants that are tolerant to wetness. Tall fescue, reed canarygrass, Ladino clover, alsike clover, and annual lespedeza are better suited to this soil than most other pasture and hay plants.

Potential is good for yellow-poplar, loblolly pine, American sycamore, and sweetgum. The main concerns in management of woodland are equipment limitations, seedling mortality, and plant competition. Wetness is a limitation to use of equipment.

Potential is poor for urban uses. Water is ponded on most areas during wet seasons, and some areas of this soil are subject to occasional flooding. The perched seasonal high water table and slow permeability are limitations. The low strength is a limitation when the soil is used for roadfill.

This soil is in capability subclass IVw and woodland group 1w.

Wo—Woolper silty clay loam. This nearly level to gently sloping, clayey soil is deep and well drained. It is on low terraces and foot slopes along major streams. Slopes are smooth and slightly concave. Slope is 0 to 4 percent. Areas are 10 to 50 acres.

Typically, the surface layer is dark brown silty clay loam about 9 inches thick. The subsoil extends to a depth of 50 inches. The upper 10 inches of the subsoil is dark brown silty clay loam, and the lower 31 inches is yellowish brown silty clay. The underlying material to a depth of 65 inches is yellowish brown silty clay that is mottled with olive yellow.

This Woolper soil has a deep root zone, but roots are restricted by the clayey subsoil. Surface runoff is medium, permeability is moderately slow or slow, and available water capacity is high. Organic matter content and natural fertility are high. The soil is slightly acid to mildly alkaline throughout. The surface layer must be cultivated under proper moisture conditions to prevent clodding or crusting. Shrink-swell potential is moderate, and strength is low. This soil is subject to rare flooding.

Included with this soil in mapping are small areas of soils that are similar to this Woolper soil but are moderately well drained or somewhat poorly drained. Also included are a few areas of Licking soils, small areas of soils that have slopes of more than 4 percent, and a few areas of soils that have a very dark grayish brown surface layer less than 10 inches thick. The included soils make up about 15 to 25 percent of this map unit.

Most areas of this soil are used for corn or hay. This soil has good potential for crops commonly grown in the area, such as corn, tobacco, and small grain. The rare flooding on this soil is generally not a hazard to crops. The hazard of erosion is slight or moderate in cultivated areas. Contour farming, minimum tillage, contour stripcropping, including grasses and legumes in the cropping system, returning crop residue to the soil, no-tillage, and grassed waterways help to reduce runoff and control erosion. This soil has good potential for hay and pasture. Kentucky bluegrass, tall fescue, orchardgrass, red clover, Ladino clover, and annual lespedeza are better suited to this soil than most other hay and pasture plants.

Potential is good for yellow-poplar, black walnut, and eastern white pine. The main concerns in management of woodland are equipment limitations and plant competition.

Potential is poor for most urban uses. The rare flooding and moderately slow or slow permeability are the main limitations. The low strength is a limitation if this soil is used for roadfill.

This soil is in capability class I and woodland group 2c.

Zp—Zipp silty clay loam. This nearly level, clayey soil is deep and poorly drained. It is on low stream terraces, mainly along South Fork Licking River. Slopes are smooth and slightly concave. Slope is 0 to 2 percent. Areas are 20 to 100 acres (fig. 14).

Typically, the surface layer is dark grayish brown silty clay loam about 7 inches thick. The subsoil extends to a depth of 39 inches. The upper 13 inches of the subsoil is dark gray silty clay, and the lower 19 inches is gray silty clay and clay. The underlying material to a depth of 65 inches is gray silty clay.

This Zipp soil has a deep root zone, but roots are restricted by the clayey subsoil. Permeability is slow, surface runoff is very slow, and available water capacity is moderate. Organic matter content is moderate, and natural fertility is medium. This soil is subject to frequent flooding in winter. A seasonal high water table is near the surface after heavy rains. The soil is slightly acid to mildly alkaline throughout. The surface layer must be cultivated under proper moisture conditions to prevent clodding or crusting. Shrink-swell potential is high, and strength is low.

Figure 14.—Ponds on Zipp silty clay loam. Corn in the background is on Elk silt loam, 0 to 2 percent slopes. Tall fescue in the foreground is on Eden flaggy clay, 20 to 30 percent slopes.

Included with this soil in mapping are a few small areas of soils that are similar to this Zipp soil but the upper part of the subsoil is light silty clay loam. Also included are a few areas of soils that have a weakly developed fragipan and small areas of Woolper, Newark, and McGary soils. The included soils make up about 10 to 20 percent of this map unit.

Most areas of this soil are used for pasture. Some areas are wooded. This soil has poor potential for most cultivated crops because of inadequate drainage. The frequent flooding on this soil is a hazard to crops in winter and during wet periods in the growing season. A combination of open ditch drainage and constructed grassed waterways generally help to remove excess water. This soil is not suited to tobacco or fall-seeded small grain. It has fair potential for hay and pasture plants that are tolerant to wetness. Tall fescue, reed canarygrass, Ladino clover, alsike clover, and annual lespedeza are better suited to this soil than most other hay and pasture plants.

Potential is good for pin oak, red maple, and sweetgum. The main concerns in management of woodland are equipment limitations, seedling mortality, and plant competition. Wetness is a limitation to the use of equipment.

Potential is poor for urban uses. The frequent flooding, slow permeability, and a seasonal high water table near the surface are the main limitations. The low strength is a limitation if this soil is used for roadfill.

This soil is in capability subclass IIIw and woodland group 2w.

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 avoid 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 behavior 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 rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation 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

Frank T. Harris, District conservationist, Soil Conservation Service, assisted in writing 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 Soil 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 "Soil maps for detailed planning." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

About 217,228 acres in the survey area was used for crops and pasture in 1967. Of this total, 137,662 acres was used for permanent pasture; 14,194 acres was used for row crops, mainly corn; 1,485 acres was used for close-grown crops; 38,612 acres was used for rotation hay and pasture; and 25,275 acres was used for hay (*4*).

Soil erosion is a primary concern in management of the soils for row crops and forage in Grant and Pendleton Counties. Controlling erosion increases yields, reduces sedimentation of ponds, lakes, and streams, and improves water quality for municipal, recreation, and fish and wildlife uses. Soils that have slopes of more than 2 percent are susceptible to excessive erosion. Erosion strips the surface layer of vitally needed organic matter, plant nutrients, and micro-organisms. Loss of the surface layer is especially damaging on soils that have a clayey subsoil, such as Eden, Heitt, Licking, and Lowell soils. The production potential of soils that have a layer that limits the root zone depth is greatly impaired when the surface layer is allowed to wash away. Such limiting layers include fragipans, as in Otwell and Nicholson soils, or bedrock, as in Eden and Cynthiana soils. Anytime the soil is exposed during crop production it is vulnerable to erosion. Because soil erosion is so damaging, a cropping system is needed that keeps the loss of soil and water to a tolerable level. A cropping system is

most effective when used with other erosion control practices. Contour farming, minimum tillage, stripcropping, rotating grasses and legumes in the cropping system, managing crop residue, cover crops, grassed waterways, diversions, and terraces help control erosion. The local office of the Soil Conservation Service can provide technical assistance in applying these and other conservation practices.

Many soils in the survey area are naturally low in organic matter content. Most of the organic matter is in the surface layer of the soil and must be maintained to achieve optimum production. This can be accomplished by controlling erosion, adding barnyard manure, managing crop residue, growing cover crops, and including grasses and legumes in the cropping system.

Tilth is important in the germination of seeds and infiltration of water into the soil. Soils that have good tilth are friable, granular, and porous and permit adequate movement of air and water. The penetration of roots and emergence of shoots occur more easily if tilth is good. Most soils used for crops in the survey area have a silt loam surface layer that is granular and porous. However, in areas that have been continually row cropped, the tilth has been damaged and the organic matter depleted. Where the tilth is damaged, the ability of the soil to provide proper amounts of air and water to plants has been hindered.

Tillage for seedbed preparation should be kept to a minimum to prevent the loss of tilth. Adding organic matter is helpful in maintaining tilth.

Soil fertility is naturally medium in most soils in the survey area. The Woolper soils are high in natural fertility, and the Eden, Allegheny, and Robertsville soils are low. Most of the soils in the area require application of fertilizer and lime for adequate crop yields. Addition of lime and fertilizer should be based on the results of soil tests, the need of the crop, and the expected level of yields. The University of Kentucky Cooperative Extension Service can help determine the kinds and amounts of fertilizer and lime to apply.

Open ditches and tile drains are used in draining wet soils. The poorly drained soils, such as Robertsville and Zipp, are so wet that the production of cultivated crops is very difficult. Wetness in the somewhat poorly drained soils, such as Newark and McGary, damages crops in most years if the soils are not artificially drained. Tile drains are more expensive and more effective than open ditches on soils that have a fragipan. Open ditches are effective on fragipan soils if they are used to intercept the water as it moves horizontally above the fragipan. Drainage by tile or open ditches requires suitable outlets. Information on drainage design for each kind of soil is available at local offices of the Soil Conservation Service.

Good pasture management is needed to provide quality forage for livestock and adequate ground cover to prevent erosion. Some common management practices are use of fertilizers and rotation grazing. Some of the more commonly used grasses and legumes are Kentucky bluegrass, tall fescue, orchardgrass, timothy, red clover, alfalfa, Ladino clover, and annual lespedeza. Some severely eroded soils need plant mixtures that are hardy and drought tolerant to provide forage for grazing and to maintain a good ground cover.

Corn and burley tobacco are the main row crops in the survey area. Soybeans are adapted to the soil and climate but are not commonly grown. Wheat is grown and commonly used as a cover crop. Barley, rye, and oats are grown extensively. Specialty crops, such as vegetables, are minor crops in Grant and Pendleton Counties. Latest information and recommendations for specialty crops can be obtained from local offices of the Kentucky Cooperative Extension Service and the Soil Conservation Service.

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 5. 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 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 are also 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 insures 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 5 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 Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils.

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 grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider 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 and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have slight limitations that restrict their use.

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

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

Class IV soils have very severe limitations 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 that make them generally unsuitable for cultivation.

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

Class VIII soils and miscellaneous areas have limitations 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 limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in 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, rangeland, woodland, wildlife habitat, or recreation.

The acreage of soils in each capability class and subclass is shown in table 6. The capability classification of each map unit is given in the section "Soil maps for detailed planning."

Woodland management and productivity

Charles A. Foster, forester, Soil Conservation Service, assisted in the preparation of this section.

Grant and Pendleton Counties are in the Western Mesophytic forest region of the Deciduous Forest Formation of Eastern North America. This region is made up of several forest types. Approximately 77 percent of the forest acreage in these counties is classified as eastern redcedar-hardwoods, oak-hickory, or central mixed-hardwood types.

Grant County has 38,100 acres of commercial forest land covering approximately 24 percent of the land area. Pendleton County, in comparison, has 49,900 acres of forest land covering 28 percent of the land area. Practically all of the forest land is privately owned. Much of it is small, scattered woodlots which are poorly stocked and heavily grazed. Annual growth is 22 cubic feet per acre of growing stock and 84 board feet of sawtimber. If properly managed, most sites have potential to produce more than 50 cubic feet per acre per year (*12*). Site factors that affect tree growth are slope, exposure, and such soil characteristics as fertility, depth, texture, drainage, and available moisture.

Forest land is used mainly for grazing, recreation, or wildlife habitat.

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 (woodland suitability) 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 important trees. The number 1 indicates very high productivity; 2, high; 3, moderately high; 4, moderate; and 5, low. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *x* indicates stoniness or rockiness; *w*, excessive water in or on the soil; *t*, toxic substances in the soil; *d*, restricted root depth; *c*, clay in the upper part of the soil; *s*, sandy texture; *f*, high content of coarse fragments in the soil profile; and *r*, steep slopes. The letter *o* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: x, w, t, d, c, s, f, and r.

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

Ratings of the *erosion hazard* indicate the risk of loss of soil in well managed woodland. The risk is *slight* if the expected soil loss is small, *moderate* if measures are needed to control erosion during logging and road construction, and *severe* if intensive management or special equipment and methods are needed to prevent excessive loss of soil.

Ratings of *equipment limitation* reflect the characteristics and conditions of the soil that restrict use of the

equipment generally needed in woodland management or harvesting. A rating of *slight* indicates that use of equipment is not limited to a particular kind of equipment or time of year; *moderate* indicates a short seasonal limitation or a need for some modification in management or in equipment; and *severe* indicates a seasonal limitation, a need for special equipment or management, or a hazard in the use of equipment.

Seedling mortality ratings indicate the degree to which the soil affects the mortality of tree seedlings. Plant competition is not considered in the ratings. The ratings apply to seedlings from good stock that are properly planted during a period of sufficient rainfall. A rating of *slight* indicates that the expected mortality is less than 25 percent; *moderate*, 25 to 50 percent; and *severe*, more than 50 percent.

Ratings of *plant competition* indicate the degree to which undesirable plants are expected to invade where there are openings in the tree canopy. The invading plants compete with native plants or planted seedlings. A rating of *slight* indicates little or no competition from other plants; *moderate* indicates that plant competition is expected to hinder the development of a fully stocked stand of desirable trees; *severe* indicates that plant competition is expected to prevent the establishment of a desirable stand unless the site is intensively prepared, weeded, or otherwise managed to control undesirable plants.

The *potential productivity* of merchantable or *important trees* on a soil is expressed as a *site index*. This 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 was calculated at age 30 years for eastern cottonwood, 35 years for American sycamore, and 50 years for all other species. The site index applies to fully stocked, even-aged, unmanaged stands. Important 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.

Trees to plant are those that are suited to the soils and to commercial wood production.

Recreation

The soils of the survey area are rated in table 8 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. 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 sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 8, 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 by a combination of these measures.

The information in table 8 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 11 and interpretations for dwellings without basements and for local roads and streets in table 10.

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 have mild slopes 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, horseback riding, and bicycling 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

The estimated wildlife of Grant and Pendleton Counties consists of 34 species of mammals, 33 species of reptiles and amphibians, and 110 species of resident birds. Also, many of the more than 200 other kinds of migratory birds can be found in these counties during certain seasons.

The main kinds of wildlife important to man in Grant and Pendleton Counties are the cottontail rabbit, gray squirrel, fox squirrel, white-tailed deer, raccoon, red fox, mink, muskrat, bobwhite quail, mourning dove, woodcock, several species of ducks, and perhaps a few species of geese. Although there is much overlap in the types of habitat required by these animals, the white-tailed deer and gray squirrel are generally classified as woodland wildlife; the rabbit, quail, and dove are considered openland wildlife; and ducks and geese, plus those mammals such as mink and muskrat that spend much of their time in or about water, are thought of as wetland wildlife.

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 9, 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 established, 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 flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

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, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, lovegrass, bromegrass, clover, and alfalfa.

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 flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, wheatgrass, and grama.

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, the available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, sweetgum, apple, hawthorn, dogwood, hickory, blackberry, and blueberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, autumn-olive, and crabapple.

Coniferous plants furnish browse, seeds, and cones. 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, spruce, fir, 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, saltgrass, cordgrass, rushes, sedges, and reeds.

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. The wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, cottontail, and red fox.

Habitat for woodland wildlife consists of areas of 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, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, deer, and bear.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, 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. The ratings are given in the following tables: 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 need to 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 to 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 (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) 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 10 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, a cemented pan, 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 the 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 dwell-

ings 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, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 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 or to a cemented pan, 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, frost action potential, 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 or to a cemented pan, 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 11 shows the degree and the 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 11 also shows the suitability of the soils for use as daily cover for landfills. 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 or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan 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 effectively filter the effluent. 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 11 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 or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of 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, bedrock, and cemented pans 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 needs to be considered.

The ratings in table 11 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type 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 type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse 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 soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegation. The soil material used as 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 12 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, topsoil, 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 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, 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 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 the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and *gravel* are used in great quantities in many kinds of construction. The ratings in table 12 provide guidance as to where to look for probable sources and are based on the probability that soils in a given area contain sizable quantities of sand or gravel. A soil rated *good* or *fair* has a layer of suitable material at least 3 feet thick, the top of which is within a depth of 6 feet. Coarse fragments of soft bedrock material, such as shale and siltstone, are not considered to be sand and gravel. Fine-grained soils are not suitable sources of sand and gravel.

The ratings do not take into account depth to the water table or other factors that affect excavation of the material. Descriptions of grain size, kinds of minerals, reaction, and stratification are given in the soil series descriptions and in table 14.

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 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 13 gives information on the soil properties and site features that affect water management. The kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees.

This table also gives for each soil the restrictive features that affect drainage, 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 of 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 soil material below the surface layer to a depth of about 5 feet is considered as a source of material for embankment fill. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ability of the natural soil to support an embankment is not considered in the table. 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, organic matter, or salts or sodium. 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, to a cemented pan, 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 potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind 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 or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, 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 characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, 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 14 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 "Soil series and 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. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains particles coarser than sand, 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, SP-SM.

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 larger than 3 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 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 15 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.

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, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

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 change is based on the soil fraction less than 2 millimeters in diameter. 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.

Soil and water features

Table 16 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 intake 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.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes is not considered flooding.

Table 16 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, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

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 absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered is 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 depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 16 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, 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 16.

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. An artesian water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. 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.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

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 specified as 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 excavations.

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 creates a severe corrosion environment. 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 is also 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 (*11*). 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. In table 17, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

ORDER. Ten 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 Entisol.

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 Aquent (*Aqu*, meaning water, plus *ent*, from Entisol).

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 Haplaquents (*Hapl*, meaning minimal horizonation, plus *aquent*, the suborder of the Entisols that have an aquic 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. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Haplaquents.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly 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-loamy, mixed, nonacid, mesic Typic Haplaquents.

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 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. The soil is compared with similar soils and with nearby soils of other

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 (*10*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*11*). 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 "Soil maps for detailed planning."

Allegheny series

The Allegheny series consists of deep, well drained soils on stream terraces near the Licking River. These soils are moderately permeable. They formed in old, mixed alluvium. Slope ranges from 2 to 20 percent.

Allegheny soils are near Eden, Cynthiana, Licking, Elk, and Otwell soils. Eden, Cynthiana, and Licking soils are clayey. Elk soils are fine-silty, and Otwell soils have a slowly permeable fragipan in the subsoil.

Typical pedon of Allegheny loam, 6 to 12 percent slopes, on soil map sheet 52, east-west about 1,992,000 feet and north-south about 405,000 feet by Kentucky coordinate grid values:

Ap—0 to 7 inches; brown (10YR 4/3) loam; common medium faint yellowish brown (10YR 5/4) variegations; moderate fine granular structure; very friable; common roots; very strongly acid; clear smooth boundary.

B21t—7 to 15 inches; strong brown (7.5YR 5/6) clay loam; moderate medium subangular blocky structure parting to weak fine angular blocky; very friable; few roots; common clay films; very strongly acid; clear smooth boundary.

B22t—15 to 36 inches; strong brown (7.5YR 5/6) clay loam; yellowish red (5YR 5/6) on ped faces; moderate medium angular blocky structure; friable; few roots; common clay films; very strongly acid; gradual smooth boundary.

B23t—36 to 42 inches; strong brown (7.5YR 5/6) clay loam; common medium faint yellowish red (5YR 5/6) variegations; weak medium subangular blocky structure; friable; few clay films; 2 percent pebbles; very strongly acid; gradual smooth boundary.

B3—42 to 52 inches; strong brown (7.5YR 5/6) loam; common medium faint yellowish brown variegations; weak medium angular blocky structure; very friable; few clay films; 5 percent pebbles; very strongly acid; gradual smooth boundary.

C—52 to 65 inches; strong brown (7.5YR 5/6 and 5/8) sandy loam; common medium faint yellowish brown (10YR 5/6) variegations; massive; very friable; very strongly acid.

The solum ranges from 30 to more than 60 inches in thickness. Depth to bedrock in most areas is more than 6 feet. Pebbles range from 0 to 10 percent in the Ap horizon and the upper part of the B horizon, from 0 to 30 percent in the lower part of the B horizon, and from 0 to 40 percent in the C horizon. In areas that have not been limed, reaction is very strongly acid or extremely acid.

The A horizon is 5 to 9 inches thick. It has hue of 10YR or 7.5YR, value of 3 or 4, and chroma of 2 to 4. This horizon is loam, silt loam, or fine sandy loam and has weak or moderate, fine or very fine granular structure.

The Bt horizon is 25 to 45 inches thick. It has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 8. This horizon is clay loam, loam, or sandy clay loam, and their gravelly analogs in the lower part. It has weak or moderate, medium angular or subangular blocky structure.

The C horizon is 10 to 18 inches thick. It has hue of 10YR or 7.5YR, value of 5, and chroma of 6 or 8. This horizon ranges from sandy loam to sandy clay loam, and their gravelly analogs.

Cynthiana series

The Cynthiana series consists of shallow, well drained to somewhat excessively drained, droughty soils on hillsides. These soils are moderately slowly permeable. They formed in residuum from limestone that has thin layers of calcareous shale. Slope ranges from 6 percent to more than 50 percent.

Cynthiana soils are near Eden and Heitt soils, but generally are on lower positions on the landscape than those soils. Eden soils are moderately deep, and Heitt soils are deep. Eden and Heitt soils formed in residuum from calcareous shale and thin layers of limestone and siltstone.

Typical pedon of Cynthiana silty clay loam from an area of Cynthiana-Rock outcrop complex, 20 to 50 percent slopes, on soil map sheet 65, east-west about 1,931,200 feet and north-south 375,000 feet by Kentucky coordinate grid values:

Ap—0 to 4 inches; dark grayish brown (10YR 4/2) silty clay loam; weak fine granular structure; firm; many roots; 15 percent flagstones; neutral; clear wavy boundary.

B2t—4 to 18 inches; light olive brown (2.5Y 5/4) flaggy silty clay; brown (10YR 5/3) on outside of peds; moderate medium angular blocky structure; firm, sticky and plastic; common roots; common clay films; 20 percent flagstones; neutral.

R—18 inches; limestone; thin layers of shale.

The solum ranges from 10 to 20 inches in thickness. Depth to bedrock is 10 to 20 inches. Coarse fragments range from 5 to 30 percent in the solum. Reaction ranges from slightly acid to mildly alkaline.

The A horizon is 2 to 4 inches thick. It has hue of 10YR or 2.5Y, value of 4, and chroma of 2 or 3. This

horizon is silt loam or silty clay loam and has weak or moderate, very fine or fine, granular or subangular blocky structure.

The Bt horizon is 8 to 15 inches thick. It has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 4 or 6. This horizon is flaggy silty clay or clay and has weak or moderate, fine or medium angular blocky structure.

A C horizon is in some pedons. It is 3 to 6 inches thick. This horizon is similar to the Bt horizon in color and texture.

Eden series

The Eden series consists of moderately deep, well drained, somewhat droughty soils on narrow ridgetops and hillsides. These soils are slowly permeable. They formed in residuum from calcareous shale interbedded with thin layers of limestone and siltstone. Slope ranges from 6 to 30 percent.

Eden soils are near Cynthiana, Heitt, Lowell, and Nicholson soils. Cynthiana soils are shallow to bedrock, and Heitt and Lowell soils are deep to bedrock. Nicholson soils have a slowly permeable fragipan.

Typical pedon of Eden silty clay loam, 6 to 20 percent slopes, on soil map sheet 55, east-west about 1,902,000 feet and north-south about 391,800 feet by Kentucky coordinate grid values:

Ap—0 to 6 inches; brown (10YR 4/3) silty clay loam and patches of yellowish brown (10YR 5/4) silty clay; moderate fine subangular blocky structure; firm; many fine and medium roots; 2 percent siltstone fragments; neutral; clear smooth boundary.

B2t—6 to 12 inches; yellowish brown (10YR 5/4) silty clay; few fine faint yellowish brown (10YR 5/6) mottles; moderate fine and medium angular blocky structure; firm, sticky and plastic; few fine and coarse roots; many clay films; 5 percent siltstone and 5 percent limestone fragments; few small black concretions; neutral; gradual smooth boundary.

B3—12 to 30 inches; light olive brown (2.5Y 5/4) flaggy silty clay; common fine faint light brownish gray (2.5Y 6/2), grayish brown (2.5Y 5/2), and dark yellowish brown (10YR 4/4) mottles; moderate fine angular blocky and weak fine platy structure; firm, sticky and plastic; few fine roots; few clay films; 10 percent shale, 5 percent siltstone, and 5 percent limestone fragments; few small black concretions; mildly alkaline; gradual wavy boundary.

Cr1—30 to 38 inches; light olive brown (2.5Y 5/4) weathered soft shale and siltstone that crushes to light silty clay or silty clay loam; moderate fine platy structure; firm; very few roots; 60 percent shale, 15 percent siltstone, and 25 percent limestone fragments; dark thin patches between layers of shale; moderately alkaline; gradual wavy boundary.

Cr2—38 inches; olive gray (5Y 5/2) layers of calcareous shale (6 to 18 inches thick), layers of limestone (1 to 3 inches thick), and beds of siltstone.

The solum ranges from 14 to 30 inches in thickness. Depth to unweathered shale ranges from 20 to 40 inches. Coarse fragments range from 0 to 25 percent in the A horizon, 5 to 25 percent in the B horizon, and 25 to 60 percent in the Cr horizon. The solum is mainly slightly acid to moderately alkaline, but in some pedons it ranges from medium acid to moderately alkaline. The Cr horizon is mildly alkaline to strongly alkaline.

The A horizon is 1 to 6 inches thick. It has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 or 3. This horizon ranges from silt loam to silty clay and their flaggy analogs. It has moderate, fine or medium, granular or subangular blocky structure.

The B horizon is 14 to 28 inches thick. It has hue of 10YR, 2.5Y, or 5Y; value of 4 or 6; and chroma of 3, 4, or 6. This horizon is silty clay or clay and their flaggy analogs. It has weak or moderate, fine or medium, angular blocky structure. In places the B3 horizon has mottles with chroma of 2.

The C horizon is 4 to 15 inches thick. It has hue of 2.5Y or 5Y, value of 5, and chroma of 2 or 4.

Elk series

The Elk series consists of deep, well drained soils on stream terraces. These soils are moderately permeable. They formed in mixed alluvium from soils that formed from limestone, shale, and siltstone. Some areas of Elk soils are subject to rare flooding. Slope ranges from 0 to 12 percent.

Elk soils are near Allegheny, McGary, Licking, Otwell, Nolin, and Newark soils. Allegheny soils are fine-loamy and McGary and Licking soils are clayey. Otwell soils have a fragipan, Nolin soils are on flood plains, and Newark soils are somewhat poorly drained.

Typical pedon of Elk silt loam, 2 to 6 percent slopes, on soil map sheet 18, east-west about 1,851,800 feet and north-south 441,800 feet by Kentucky coordinate grid values:

Ap—0 to 8 inches; brown (10YR 4/3) silt loam; moderate fine granular structure; very friable; many roots; medium acid; abrupt smooth boundary.

B1—8 to 15 inches; brown (7.5YR 4/4) silt loam; weak fine granular and weak medium subangular blocky structure; friable; common roots; common clay films; strongly acid; gradual smooth boundary.

B21t—15 to 32 inches; brown (7.5YR 4/4) silty clay loam; moderate medium subangular block structure; friable; few roots; common clay films; few black concretions; strongly acid; gradual smooth boundary.

B22t—32 to 42 inches; strong brown (7.5YR 5/6) silty clay loam; moderate fine and medium subangular blocky structure; friable; common clay films; few brown and black concretions; strongly acid; gradual smooth boundary.

C—42 to 65 inches; yellowish brown (10YR 5/6) silty clay loam; common fine faint strong brown (7.5YR

5/6), dark yellowish brown (10YR 4/4), and light yellowish brown (10YR 6/4) mottles; massive; friable; common black concretions; strongly acid.

The solum ranges from 36 to 50 inches in thickness. Depth to bedrock ranges from 6 to more than 15 feet. In areas that have not been limed, reaction is medium acid to strongly acid.

The A horizon is 6 to 11 inches thick. It has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 or 3. This horizon has weak or moderate, very fine or fine granular structure or fine subangular blocky structure.

The B horizon is 0 to 45 inches thick. It has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 or 6. This horizon is silt loam or silty clay loam.

The C horizon is 15 to 30 inches thick. It is similar to the B horizon in color and has mottles in shades of brown. This horizon is silty clay loam, silt loam, or silty clay.

Heitt series

The Heitt series consists of deep, well drained soils on narrow ridgetops. These soils are moderately slowly permeable. They formed in a thin cap of old, fine textured alluvium and the underlying residuum of calcareous shale interbedded with thin layers of limestone and siltstone. Slope mainly is 6 to 12 percent, but ranges from about 3 to 12 percent.

Heitt soils are near Eden soils, and they are at a lower elevation than Lowell soils. Eden soils are moderately deep, and Lowell soils formed in residuum from mainly limestone with thin layers of shale. The subsoil of Eden and Lowell soils is not so red as that of Heitt soils.

Typical pedon of Heitt silt loam, 6 to 12 percent slopes, on soil map sheet 58, east-west about 1,948,850 feet and north-south 1,395,900 feet by Kentucky coordinate grid values:

Ap—0 to 6 inches; mixed brown (10YR 4/3) and yellowish brown (10YR 5/4) silt loam; weak fine granular structure; friable; many roots; strongly acid; abrupt smooth boundary.

B1—6 to 11 inches; strong brown (7.5YR 5/6) silty clay, yellowish red (5YR 5/6) variegations; moderate fine and medium subangular blocky structure; firm; few roots; common clay films; strongly acid; gradual smooth boundary.

B21t—11 to 24 inches; yellowish red (5YR 5/6) clay; few fine distinct pale brown (10YR 6/3) mottles; moderate very fine and medium subangular blocky structure; firm, sticky and plastic; few roots; many clay films; medium acid; gradual smooth boundary.

B22t—24 to 30 inches; strong brown (7.5Y 5/6) clay; common fine distinct light olive brown (2.5Y 5/4) mottles; moderate fine subangular blocky structure; firm, sticky and plastic; common clay films; medium acid; gradual smooth boundary.

B3—30 to 38 inches; light olive brown (2.5Y 5/4) silty clay; few fine faint yellowish brown (10YR 5/4) and light brownish gray (2.5Y 6/2) mottles; weak medium angular blocky structure; firm, sticky and plastic; few clay films; common black soft concretions; neutral; gradual wavy boundary.

Cr—38 to 56 inches; olive (5Y 5/3) partly weathered soft shale that crushes to silty clay; thin layers of limestone; strongly alkaline.

The solum ranges from 20 to 40 inches in thickness. Depth to unweathered, soft, clay shale ranges from 40 to 60 inches. Coarse fragments are 0 to 5 percent in the B horizon. In areas that have not been limed, the B2 horizon is strongly acid to medium acid, and the B3 horizon and C horizon are slightly acid to mildly alkaline.

The A horizon is 4 to 8 inches thick. It has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. This horizon is silt loam or light silty clay loam and has weak or moderate fine granular structure. A thin A2 horizon is in some pedons.

The B1 horizon is 4 to 10 inches thick. It is strong brown (7.5YR 5/6) silty clay or silty clay loam. The upper part of the B2t horizon is 7 to 15 inches thick. It has hue of 5YR, value of 4 or 5, and chroma of 4 or 6. It has variegations that have hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 3 or 4. This horizon is clay or silty clay and has moderate, very fine to medium subangular blocky structure. The lower part of the B2t horizon is 6 to 15 inches thick. It has hue of 7.5YR, 10YR, or 2.5Y, value of 5 or 6, and chroma of 4 or 6. This horizon is silty clay or clay and has weak to moderate, fine to medium subangular blocky structure. The B3 horizon is 6 to 14 inches thick.

The C horizon is 5 to 30 inches thick. The B3 horizon and C horizon have hue of 10YR, 2.5Y, or 5Y; value of 5 or 6; and chroma of 2 to 4. They are silty clay or clay.

Licking series

The Licking series consists of deep, moderately well drained soils on stream terraces and toe slopes. These soils are slowly permeable. They formed in fine textured alluvium of local origin and old lacustrine deposits. Slope ranges from 2 to about 20 percent.

Licking soils are near Cynthiana, Eden, Allegheny, Elk, Otwell, McGary, and Zipp soils. Cynthiana soils are shallow to bedrock, and Eden soils are moderately deep. Allegheny soils are fine-loamy, and Elk soils are fine-silty. Otwell soils have a fragipan. McGary soils are somewhat poorly drained, and Zipp soils are poorly drained.

Typical pedon of Licking silt loam, 6 to 12 percent slopes, on soil map sheet 18, east-west about 1,850,150 feet and north-south 444,400 feet by Kentucky coordinate grid values:

Ap—0 to 6 inches; brown (10YR 4/3) silt loam; moderate fine granular structure; friable; many roots; slightly acid; clear smooth boundary.

B21t—6 to 18 inches; yellowish brown (10YR 5/6) silty clay loam; few fine faint light brownish gray (10YR 6/2) mottles; yellowish brown (10YR 5/4) on ped faces; moderate medium subangular blocky structure; friable; common roots; common clay films; medium acid; clear smooth boundary.

IIB22t—18 to 32 inches; yellowish brown (10YR 5/4) silty clay; common fine distinct light brownish gray (10YR 6/2) and strong brown (7.5YR 5/6) mottles; pale brown (10YR 6/3) on outside of peds; moderate fine angular blocky structure; firm, sticky and plastic; few roots; many clay films; few dark concretions; medium acid; gradual wavy boundary.

IIB23t—32 to 46 inches; yellowish brown (10YR 5/4) silty clay; common medium distinct light brownish gray (10YR 6/2) mottles; moderate fine and medium angular blocky structure; firm, sticky and plastic; common clay films; few dark concretions; medium acid; gradual wavy boundary.

IIB3t—46 to 65 inches; yellowish brown (10YR 5/4) silty clay; streaks and patches of light brownish gray (10YR 6/2); weak fine angular blocky structure; firm, sticky and plastic; few clay films; 2 percent coarse fragments of limestone; common soft black streaks; mildly alkaline.

The solum ranges from 36 to 70 inches in thickness. Depth to bedrock is 6 to more than 10 feet. Coarse fragments range from 0 to 2 percent. In areas that have not been limed the upper part of the solum is medium acid to very strongly acid. The B3 horizon ranges from medium acid to mildly alkaline.

The A horizon is 4 to 10 inches thick. It has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4. This horizon is silt loam or silty clay loam and has moderate fine granular or weak fine platy structure.

A yellowish brown B1 horizon is in some pedons. It is silt loam or silty clay loam.

The B2t horizon is 17 to 40 inches thick. It has hue of 7.5YR to 2.5Y, value of 4 or 5, and chroma of 4 or 6. This horizon has mottles that have low chroma. It is silty clay loam or silty clay and has moderate or strong, fine or medium, subangular or angular blocky structure.

The B3t horizon is 10 to 30 inches thick. It has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 3 or 4. This horizon is silty clay or clay and has mottles in shades of gray and brown. It has weak angular blocky or weak medium prismatic structure.

A C horizon is in some pedons. It is 8 to more than 20 inches thick. It is similar to the B3 horizon in color and texture.

Lowell series

The Lowell series consists of deep, well drained soils on narrow ridges and the upper part of hillsides. These soils are moderately slowly permeable. They formed in residuum from limestone and siltstone interbedded with thin layers of calcareous shale. Slope ranges from 6 to 20 percent.

Lowell soils are near Nicholson and Eden soils, and they are at a higher elevation than Heitt soils. Nicholson soils have a fragipan in the subsoil. Eden soils are moderately deep, and Heitt soils are underlain by shale interbedded with thin layers of limestone.

Typical pedon of Lowell silt loam, 12 to 20 percent slopes, on soil map sheet 20, east-west about 1,898,500 feet and north-south 446,700 feet by Kentucky coordinate grid values:

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam; moderate medium granular structure; friable; many fine roots; slightly acid; clear smooth boundary.

B1—8 to 18 inches; brown (7.5YR 4/4) silty clay loam; weak medium subangular blocky structure; friable; common fine roots; few clay films; few brown concretions; medium acid; clear wavy boundary.

B21t—18 to 27 inches; brown (7.5YR 5/4) silty clay; few fine faint brown (10YR 5/3) mottles; moderate fine and medium angular blocky structure; firm, sticky and plastic; few fine roots; many clay films; few black concretions; strongly acid; gradual smooth boundary.

B22t—27 to 42 inches; yellowish brown (10YR 5/4) clay; few fine faint pale brown (10YR 6/3) and yellowish brown (10YR 5/6) mottles; moderate medium angular blocky structure; firm, sticky and plastic; few fine roots; many clay films; few black concretions; strongly acid; gradual smooth boundary.

B3—42 to 56 inches; light olive brown (2.5Y 5/4) clay; common fine distinct light brownish gray (2.5Y 6/2) mottles; weak medium angular blocky structure; firm, sticky and plastic; common clay films; few black concretions; strongly acid; clear smooth boundary.

C—56 to 60 inches; variegated light brownish gray (2.5Y 6/2), brown (10YR 4/3), dark yellowish brown (10YR 4/4), yellowish brown (10YR 5/4), and light gray (2.5Y 7/2) silty clay; massive; firm, sticky and plastic; 5 percent coarse fragments of limestone; many black concretions; slightly acid; abrupt smooth boundary.

R—60 inches; limestone; interbedded with thin shale.

The solum ranges from 30 to 60 inches in thickness. Depth to bedrock is 40 to about 72 inches. Coarse fragments range from 0 to 5 percent in the upper part of the solum, 0 to 15 percent in the lower part of the solum, and 1 to 50 percent in the C horizon. In areas that have not been limed, the solum is medium acid to strongly acid, and the C horizon is slightly acid to mildly alkaline.

The Ap horizon is 6 to 8 inches thick. It has hue of 10YR, value of 4, and chroma of 2 or 3. This horizon is silt loam or silty clay loam and has weak or moderate, fine or medium granular structure.

The B1 horizon, if present, is 5 to 10 inches thick. It has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 or 6. This horizon is silt loam or silty clay loam and has weak or moderate subangular blocky or granular structure. It has none to common clay films.

The B2t horizon is 20 to 38 inches thick. It has hue of 7.5YR, 10YR, or 2.5Y; value of 4 or 5; and chroma of 3 or 4. This horizon is silty clay loam, silty clay, or clay and has mottles in shades of brown. The lower part of this horizon has olive colors and gray mottles.

The B3 horizon is 6 to 20 inches thick, and the C horizon is 2 to 19 inches thick. The B3 horizon and C horizons have hue of 10YR, 2.5Y, or 5Y; value of 4 to 7; and chroma of 3 to 6. These horizons are silty clay to clay and have mottles in shades of gray and brown. The matrix of the C horizon is also in shades of gray.

McGary series

The McGary series consists of deep, somewhat poorly drained soils on stream terraces and toe slopes. These soils are slowly permeable. They formed in fine textured lacustrine sediment. Slope ranges from 0 to 4 percent.

McGary soils are on stream terraces with Elk, Otwell, Licking, and Zipp soils. Elk soils are well drained, Otwell and Licking soils are moderately well drained, and Zipp soils are poorly drained.

Typical pedon of McGary silt loam, on soil map sheet 18, east-west about 1,856,800 feet and north-south 440,500 feet by Kentucky coordinate grid values:

Ap—0 to 7 inches; brown (10YR 5/3) silt loam; moderate fine granular structure; friable; many roots; slightly acid; clear smooth boundary.

B21t—7 to 19 inches; yellowish brown (10YR 5/4) silty clay loam; common medium distinct light brownish gray (10YR 6/2) and common fine distinct pale brown (10YR 6/3) mottles; moderate fine and medium subangular blocky structure; firm; common roots; common clay films; medium acid; clear smooth boundary.

B22g—19 to 27 inches; light brownish gray (10YR 6/2) clay; common medium distinct strong brown (7.5YR 5/6) mottles; moderate fine and medium angular blocky structure; firm, sticky and plastic; few roots; common clay films; few brown concretions; medium acid; clear smooth boundary.

B23g—27 to 40 inches; gray (10YR 6/1) silty clay; common medium distinct yellowish brown (10YR 5/6) and few fine faint strong brown (7.5YR 5/6) mottles; weak fine angular blocky structure; firm, sticky and plastic; few clay films, few black concretions; medium acid; gradual wavy boundary.

C—40 to 65 inches; mottled gray (10YR 6/1) and light olive brown (2.5Y 5/4) silty clay; massive; firm, sticky and plastic; few black concretions; mildly alkaline.

The solum ranges from 30 to 40 inches in thickness. Depth to bedrock is more than 10 feet. In areas that have not been limed, the solum ranges from slightly acid to medium acid. The C horizon ranges from medium acid to mildly alkaline.

The Ap horizon is 4 to 8 inches thick. It has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 or 3.

The B21t horizon is 7 to 14 inches thick. It has hue of 10YR or 2.5Y, value of 5, and chroma of 3 or 4. This horizon is silty clay loam or silty clay.

The B2g horizon is 18 to 24 inches thick. It has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 1 or 2. This horizon is silty clay or clay and has weak or moderate, fine and medium angular blocky or prismatic structure.

The C horizon is 8 to more than 30 inches thick. It has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 1 or 4. This horizon is silty clay or clay.

The McGary soils in the survey area do not have carbonates and stratification in the C horizon; therefore, these soils are taxadjuncts to the McGary series.

Newark series

The Newark series consists of deep, somewhat poorly drained soils on flood plains. These soils are moderately permeable. They formed in alluvium that washed from soils formed from calcareous shale, limestone, and siltstone. These soils are subject to common flooding. Slope mainly is less than 2 percent.

Newark soils are near Nolin, Licking, McGary, and Zipp soils. Nolin soils are well drained, and Licking, McGary, and Zipp soils are clayey.

Typical pedon of Newark silt loam, on soil map sheet 18, east-west about 1,851,450 feet and north-south 442,200 feet by Kentucky coordinate grid values:

Ap—0 to 7 inches; brown (10YR 4/3) silt loam; common fine faint pale brown (10YR 6/3) mottles; weak fine granular structure; very friable; many roots; slightly acid; clear smooth boundary.

B1—7 to 14 inches; yellowish brown (10YR 5/4) silt loam, common fine distinct light brownish gray (10YR 6/2) and few fine distinct pale brown (10YR 6/3) mottles; weak fine granular structure; very friable; common roots; slightly acid; clear wavy boundary.

B2g—14 to 40 inches; light brownish gray (10YR 6/2) silt loam, common fine distinct yellowish brown (10YR 5/4), few fine faint gray (10YR 6/1), and few fine distinct dark yellowish brown (10YR 4/4) mottles; weak fine subangular blocky structure; friable; few roots; slightly acid; gradual smooth boundary.

C1g—40 to 60 inches; gray (10YR 6/1) silt loam; common fine distinct dark yellowish brown (10YR 4/4) mottles; massive; friable; common soft black concretions; mildly alkaline; gradual smooth boundary.

C2g—60 to 65 inches; gray (10YR 6/1) silty clay loam; common fine distinct dark yellowish brown (10YR 4/4) mottles; massive; firm; common soft brown concretions; mildly alkaline.

The solum ranges from 22 to 40 inches in thickness. Depth to bedrock is 5 to more than 10 feet. Coarse fragments range from 0 to 5 percent in the solum and 0 to 15 percent in the C horizon. The soil is slightly acid to mildly alkaline throughout.

The A horizon is 7 to 10 inches thick. It has hue of 10YR or 2.5Y, value of 4, and chroma of 2 or 3. This horizon is silt loam or light silty clay loam and has weak or moderate, fine, granular structure.

The B1 horizon is 4 to 10 inches thick. It has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4. This horizon has mottles in shades of gray and brown. The B2g horizon is 5 to 30 inches thick. It has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 2 or less. This horizon has mottles in shades of brown. The B1 and B2g horizons are silt loam or light silty clay loam and have weak or moderate, fine, granular structure or weak, fine, subangular blocky structure.

The C horizon is 20 to more than 32 inches thick. It is similar to the B2g horizon in color. This horizon is silt loam to silty clay.

Nicholson series

The Nicholson series consists of deep, moderately well drained soils on wide ridges. These soils have a slowly permeable fragipan. The upper layers of these soils formed in loess, and the lower layers formed in residuum from limestone and siltstone interbedded with thin layers of shale. Slope ranges from about 2 to 8 percent.

Nicholson soils are near Lowell and Eden soils and are similar to Otwell soils. Lowell and Eden soils are clayey and do not have a fragipan. Otwell soils are on stream terraces, and they formed in old, mixed alluvium.

Typical pedon of Nicholson silt loam, 2 to 8 percent slopes, on soil map sheet 12, east-west about 1,898,200 feet and north-south 454,850 feet by Kentucky coordinate grid values:

Ap—0 to 8 inches; brown (10YR 4/3) silt loam; moderate fine granular structure; very friable; many roots; medium acid; clear smooth boundary.

B21t—8 to 18 inches; brown (7.5YR 4/4) silty clay loam; moderate medium subangular blocky structure; friable; many roots; few clay films; few black concretions; medium acid; gradual smooth boundary.

B22t—18 to 26 inches; yellowish brown (10YR 5/4) silty clay loam; few fine faint dark yellowish brown (10YR 4/4) and brown (7.5YR 4/4) mottles; moderate medium subangular blocky structure; friable; few fine roots; common clay films; few small black concretions; medium acid; clear smooth boundary.

Bx—26 to 38 inches; brown (7.5YR 4/4) silty clay loam; common medium distinct light gray (10YR 7/2) and few fine distinct light brownish gray (10YR 6/2) mottles; moderate very coarse prismatic structure parting to moderate medium angular blocky; firm, compact and brittle; few roots between prisms; common clay films and thick (2 to 7 millimeters) silt coatings between prisms; many small black concretions; strongly acid; gradual smooth boundary.

IIB31t—38 to 46 inches; yellowish brown (10YR 5/4) silty clay; common fine distinct light gray (10YR 7/2) mottles; moderate very coarse prismatic structure parting to moderate fine angular blocky; firm, sticky and plastic; common clay films; many thin black concretions; medium acid; gradual wavy boundary.

IIB32t—46 to 60 inches; yellowish brown (10YR 5/6) silty clay; few medium distinct light brownish gray (10YR 6/2) mottles; weak coarse angular blocky structure; firm, sticky and plastic; common clay films; many thin black concretions; medium acid; gradual wavy boundary.

IIC—60 to 65 inches; light olive brown (2.5Y 5/6) silty clay; common medium distinct dark yellowish brown (10YR 4/4) and light brownish gray (2.5Y 6/2) mottles; massive, relict platy structure; very firm, very sticky and very plastic; 5 percent flaggy siltstone; slightly acid.

The solum ranges from 40 to about 60 inches in thickness. Depth to bedrock is 5 to 8 feet. Depth to the fragipan is 20 to 30 inches. The loamy part of the solum is 30 to about 40 inches thick. In areas that have not been limed, the upper part of the solum is strongly acid or medium acid and below the pan the solum is strongly acid to mildly alkaline.

The A horizon is 6 to 11 inches thick. It has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. This horizon has weak or moderate fine granular structure.

The B2t horizon is 12 to 20 inches thick. It has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 or 6. This horizon is silty clay loam or silt loam and has weak or moderate subangular blocky structure.

The Bx horizon is 7 to 20 inches thick. It has hue of 10YR and 7.5YR, value of 4 or 5, and chroma of 4 or 6. This horizon has mottles in shades of gray and brown. It has very coarse prismatic structure and weak or moderate, fine or medium angular blocky structure.

The IIB horizon is 8 to 30 inches thick, and the IIC horizon is 5 to 25 inches thick. The IIB horizon and IIC horizon have hue of 10YR and 2.5Y, value of 5 to 7, and chroma of 2 to 6. These horizons are silty clay or clay and have mottles in shades of gray.

Nolin series

The Nolin series consists of deep, well drained soils on flood plains. These soils are moderately permeable. They formed in alluvium from soils formed from calcare-

ous shale, limestone, and siltstone. These soils are subject to flooding, mainly in winter and spring. Slope ranges from 0 to about 2 percent.

Nolin soils are near Newark, Woolper, Licking, and Elk soils. Newark soils are somewhat poorly drained. Woolper and Licking soils have a clayey argillic B horizon. Elk soils are on stream terraces and have an argillic horizon.

Typical pedon of Nolin silt loam, on soil map sheet 62, east-west about 1,883,600 feet and north-south 384,200 feet by Kentucky coordinate grid values:

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam; moderate very fine and fine granular structure; very friable; many fine and medium roots; 2 percent coarse fragments of limestone; mildly alkaline; clear smooth boundary.

B21—7 to 30 inches; brown (10YR 4/3) silt loam; weak very fine granular structure and weak medium subangular blocky; friable; few fine and medium roots; few black concretions; mildly alkaline; gradual wavy boundary.

B22—30 to 60 inches; brown (10YR 4/3) silt loam; weak fine granular structure; friable; few fine roots; mildly alkaline.

The solum is more than 40 inches thick. Depth to bedrock is more than 60 inches. Coarse fragments range from 0 to 5 percent. Reaction is slightly acid to mildly alkaline throughout.

The A horizon is 6 to 12 inches thick. It has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 or 3. This horizon is silt loam or light silty clay loam.

The B horizon is 20 to 55 inches thick. It has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 3 or 4. This horizon is silt loam or light silty clay loam and has weak to moderate, very fine to fine, granular structure or weak, medium, subangular blocky structure.

A C horizon is in some pedons. It is 20 to 30 inches thick. This horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4. It is silt loam, silty clay loam, or gravelly silty clay loam.

Otwell series

The Otwell series consists of deep, moderately well drained soils on high and low stream terraces. These soils have a slowly permeable fragipan. They formed in lacustrine sediment or mixed alluvium from soils formed in limestone and shale. Slope ranges from 0 to about 12 percent.

Otwell soils are near Allegheny, Elk, McGary, and Licking soils. Otwell soils have a fragipan which is not present in the other soils. Allegheny soils are well drained, and McGary and Licking soils are clayey. Nicholson soils are similar to Otwell soils, but they are on uplands and they formed in loess deposits and residuum from limestone.

Typical pedon of Otwell silt loam, 2 to 6 percent slopes, on soil map sheet 27, east-west about 1,856,100 feet and north-south 433,900 feet by Kentucky coordinate grid values:

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

B21t—7 to 19 inches; yellowish brown (10YR 5/6) light silty clay loam; yellowish brown (10YR 5/4) on the outside of peds; moderate medium subangular blocky structure; friable; few fine roots; few clay films; strongly acid; clear smooth boundary.

B22t—19 to 23 inches; yellowish brown (10YR 5/4) silty clay loam; common medium faint brown (7.5YR 4/4) and common fine distinct light brownish gray (10YR 6/2) mottles; moderate fine and medium subangular blocky structure; friable; few fine roots; common clay films; few brown concretions; very strongly acid; clear wavy boundary.

Bx—23 to 48 inches; yellowish brown (10YR 5/6) silty clay loam; common medium faint yellowish brown (10YR 5/4), common medium distinct light brownish gray (10YR 6/2), common medium distinct gray (10YR 6/1), and common fine distinct brown (7.5YR 5/4) mottles; moderate very coarse prismatic structure parting to moderate medium platy; very firm, brittle; few roots between prisms; common clay films; common black concretions; very strongly acid; clear smooth boundary.

B3—48 to 58 inches; brown (10YR 5/3) silt loam; common fine faint yellowish brown (10YR 5/6) and light brownish gray (10YR 6/2) mottles; weak fine angular blocky structure; friable; few clay films; common black concretions; strongly acid; gradual wavy boundary.

C—58 to 65 inches; yellowish brown (10YR 5/6) stratified silt loam and silty clay loam; common fine distinct light brownish gray (10YR 6/2) mottles; massive; friable; common black concretions; strongly acid.

The solum ranges from 40 to more than 60 inches in thickness. Depth to bedrock is more than 10 feet. Depth to the fragipan is 18 to 32 inches. In areas that have not been limed, reaction is strongly acid or very strongly acid throughout the fragipan and strongly acid to neutral in the B3 horizon and C horizon.

The A horizon is 5 to 9 inches thick. It has hue of 10YR, value of 4, and chroma of 2 or 3. This horizon has weak or medium fine granular structure.

A B1 horizon is in some pedons. It is 3 to 12 inches thick. This horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 or 6. It is silt loam.

The B2t horizon is 6 to 28 inches thick. It has hue of 10YR, value of 4 or 5, and chroma of 4 or 6. The lower part of this horizon generally is mottled in colors of low chroma. This horizon is heavy silt loam or light silty clay

loam and has weak or moderate, fine or medium, subangular blocky structure.

The Bx horizon is 10 to 25 inches thick. It is very firm or firm. This horizon has hue of 10YR or 7.5YR, value of 5 or 6, chroma of 2 to 6. It is silt loam or silty clay loam and is mottled in shades of gray and brown.

The B3 horizon is 8 to 20 inches thick, and the C horizon is 7 inches to more than 20 inches thick. These horizons range from silt loam to light silty clay and are similar to the Bx horizon in color.

Robertsville series

The Robertsville series consists of deep, poorly drained soils on stream terraces that are subject to occasional flooding. These soils have a slowly permeable fragipan. They formed in mixed alluvium from limestone, shale, and siltstone. Slope ranges from 0 to 2 percent.

Robertsville soils are near Licking, Otwell, Zipp, and Newark soils. Licking soils are clayey and moderately well drained. Otwell soils are moderately well drained. Zipp soils are clayey, and Newark soils do not have a fragipan.

Typical pedon of Robertsville silt loam, on soil map sheet 8, east-west about 1,972,500 feet and north-south 468,500 feet by Kentucky coordinate grid values:

Ap—0 to 5 inches; grayish brown (10YR 5/2) silt loam; common fine faint light brownish gray (10YR 6/2) mottles; weak fine granular structure; friable; many roots; strongly acid; clear smooth boundary.

A2g—5 to 13 inches; light brownish gray (10YR 6/2) silt loam; common fine distinct yellowish brown (10YR 5/4) and common fine faint pale brown (10YR 6/3) mottles; weak fine and medium granular structure; friable; common roots; few small brown concretions; very strongly acid; clear smooth boundary.

B2g—13 to 25 inches; light gray (2.5Y 7/2) silty clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; weak fine and medium angular blocky structure; friable; few roots; few brown and black concretions; very strongly acid; clear wavy boundary.

Bx—25 to 50 inches; light gray (10YR 7/1) silty clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; moderate coarse prismatic structure parting to moderate medium angular blocky; firm, brittle and compact; few roots between prisms; continuous silt coatings (5 to 15 millimeters thick) on outside of prisms; few clay films on blocks inside prisms; few black concretions; very strongly acid; gradual wavy boundary.

Cg—50 to 65 inches; light brownish gray (10YR 6/2) silty clay loam; thin patches and layers of sandy loam, silt, and silty clay; massive; firm; few brown concretions; strongly acid.

The solum ranges from 40 to about 60 inches in thickness. Depth to bedrock is more than 10 feet. Depth to the fragipan is 18 to 30 inches. In areas that have not been limed, the solum is strongly acid to very strongly acid throughout.

The A horizon is 5 to 13 inches thick. The Ap horizon has hue of 10YR or 2.5Y, value of 4 or 6, and chroma of 1 or 2. An A1 horizon is in some wooded areas. It has value of 3 or 4 and chroma of 1 or 2. The A2 horizon has hue of 10YR or 2.5Y, value of 6 or 7, and chroma of 1 or 2.

The B2g horizon is 10 to 17 inches thick. The Bx horizon is 12 to 25 inches thick. The B horizon has hue of 10YR or 2.5Y, value of 6 or 7, and chroma of 1 or 2. This horizon is silt loam or silty clay loam.

The Cg horizon is 12 to more than 20 inches thick. It ranges from silt loam to silty clay and has thin layers of sandy loam.

Woolper series

The Woolper series consists of deep, well drained soils on foot slopes and low terraces that are subject to rare flooding. These soils have a dark surface layer and subsoil. They are moderately slowly permeable or slowly permeable. They formed in colluvium mainly from limestone. Slope ranges from 0 to 4 percent.

Woolper soils are near Elk, Licking, Newark, Nolin, and Cynthiana soils. Elk and Nolin soils are fine-silty. Newark soils are somewhat poorly drained, and Licking soils are moderately well drained. Cynthiana soils have limestone at a depth of less than 20 inches.

Typical pedon of Woolper silty clay loam, on soil map sheet 58, east-west about 1,957,950 feet and north-south 399,625 feet by Kentucky coordinate grid values:

Ap—0 to 9 inches; dark brown (10YR 3/3) silty clay loam, very dark grayish brown (10YR 3/2) coatings; moderate medium granular structure; very friable; many roots; neutral; clear smooth boundary.

B21t—9 to 19 inches; dark brown (10YR 3/3) silty clay loam; moderate medium subangular blocky structure; firm; few small roots; common very dark grayish brown clay films; neutral; clear smooth boundary.

B22t—19 to 37 inches; yellowish brown (10YR 5/6) silty clay; moderate medium subangular blocky structure; very firm; few small roots; many dark brown and brown clay films; few small soft brown concretions; neutral; gradual smooth boundary.

B3t—37 to 50 inches; yellowish brown (10YR 5/6) silty clay; weak medium subangular blocky structure; very firm; patches of brown clay films; few small soft brown concretions; neutral; gradual smooth boundary.

C—50 to 65 inches; yellowish brown (10YR 5/6) silty clay; common fine faint olive yellow (2.5Y 6/6) and yellowish brown (10YR 5/8) mottles; massive; very firm; few small soft brown concretions; neutral.

The solum ranges from 40 to 60 inches in thickness. Depth to bedrock ranges from 6 to more than 15 feet.

Reaction ranges from slightly acid to mildly alkaline. The mollic epipedon ranges from 10 to 24 inches in thickness.

The Ap horizon is 6 to 12 inches thick. It has hue of 7.5YR, 10YR, or 2.5Y; value of 3; and chroma of 2 or 3. This horizon is silty clay loam or silt loam.

The upper part of the B2t horizon is 0 to 18 inches thick. It is silty clay loam, silty clay, or clay and is similar to the A horizon in color. The lower part of the B2t horizon is 10 to 25 inches thick, and the B3 horizon is 0 to 25 inches thick. The lower part of the B2t horizon and the B3 horizon have hue of 7.5YR, 10YR, or 2.5Y; value of 4 or 5; and chroma of 3 to 6. These horizons are silty clay or clay and have weak or moderate, fine or medium, angular or subangular blocky structure.

The C horizon is 10 to more than 20 inches thick. It has hue of 7.5YR, 10YR, or 2.5Y; value of 4 to 6; and chroma of 3 to 8. This horizon ranges from silty clay loam to clay and has mottles in shades of brown or gray.

Zipp series

The Zipp series consist of deep, poorly drained soils on low stream terraces that are subject to flooding. These soils are slowly permeable. They formed in fine textured lacustrine deposits. Slope is 0 to 2 percent.

Zipp soils are near Woolper, Licking, McGary, Elk, Nolin, and Newark soils. Woolper soils are well drained, Licking soils are moderately well drained, and McGary soils are somewhat poorly drained. Elk, Nolin, and Newark soils are fine-silty.

Typical pedon of Zipp silty clay loam, on soil map sheet 58, east-west about 1,954,150 feet and north-south about 399,800 feet by Kentucky grid values:

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silty clay loam; moderate fine angular blocky structure; firm; common roots; slightly acid; clear smooth boundary.

B21g—7 to 20 inches; dark gray (10YR 4/1) silty clay; common fine distinct brown (10YR 4/3) mottles; weak medium prismatic structure parting to moderate medium angular blocky; firm, sticky and plastic; few roots; neutral; gradual wavy boundary.

B22g—20 to 30 inches; dark gray (5Y 4/1) silty clay; common fine distinct brown (10YR 4/3) mottles; weak medium prismatic structure parting to moderate fine and medium angular blocky; firm, sticky and plastic; few roots; thin clay films or pressure faces on numerous peds; few brown concretions; mildly alkaline; gradual wavy boundary.

B3g—30 to 39 inches; gray (10YR 5/1) clay; common fine distinct dark yellowish brown (10YR 4/4) mottles; weak fine subangular blocky structure; firm, very sticky and very plastic; few roots; few small brown concretions; mildly alkaline; abrupt smooth boundary.

Cg—39 to 65 inches; gray (10YR 6/1) silty clay; many medium dark yellowish brown (10YR 4/4) mottles; massive; firm, very sticky and very plastic; few small brown concretions; mildly alkaline.

The solum ranges from 35 to 40 inches in thickness. Depth to bedrock is 5 to more than 10 feet. The solum ranges from slightly acid to mildly alkaline, and the C horizon ranges from mildly alkaline to moderately alkaline.

The A horizon is 5 to 8 inches thick. It has hue of 10YR, value of 3 or 4, and chroma of 1 or 2. This horizon is silt loam, silty clay loam, or silty clay and has moderate or fine, angular blocky structure or weak, fine, granular structure.

The Bg horizon is 16 to 32 inches thick. It has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or less. This horizon ranges from silty clay loam to clay.

The Cg horizon is 14 to more than 30 inches thick. It has hue of 10YR to 5Y, value of 4 to 6, and chroma of 2 or less. This horizon is silty clay or clay and has thin strata of silt loam and sandy loam.

Formation of the soils

In this section the factors of soil formation are discussed and related to the soils in the survey area. In addition, the processes of soil formation are described.

The characteristics of soils depend on climate, the chemical and physical composition of parent material, relief, plant and animal life, and time. Soils are formed by the interaction of these factors, but the relative importance of a factor from one soil to another is not constant. In some areas one factor can dominate the formation of soil characteristics, and in other areas another factor can dominate. The effects of climate and plant and animal life are not likely to vary much throughout the survey area, but the effects of local differences in relief and parent material may vary considerably. The interrelationships between these five factors are so complex that the effect of any one factor on the formation of a soil is difficult to determine. The following is a brief discussion on the factors that influence soil formation in Grant and Pendleton Counties.

Climate

Climate affects the physical, chemical, and biological relationships of the soil. It influences the kind and number of plants and animals, the weathering of rocks and minerals, erosion, and the rate of soil formation.

The two most commonly measured features of climate related to soil properties are rainfall and temperature. The climate of the survey area is humid-temperate. The soils are never dry and are subject to leaching throughout most of the year.

The soils in Grant and Pendleton Counties that show the influence of climate more than most other soils are leached, are naturally acid, and have an eluvial surface

layer and an illuvial subsoil. The illuvial subsoil has more clay than the surface layer. Also, because the soil is frozen for only short periods and to only a shallow depth, the processes of weathering and translocation of materials continue almost without interruption. The well drained Lowell soils that have a silt loam surface layer and a clayey subsoil are an example of these processes.

Certain local variations in climate (microclimate) show the influence of the climatic factor on soil formation within relatively small areas. However, the magnitude of climatic control on soil formation can best be seen by making comparisons that are global in scope.

Parent material

Parent material is the unconsolidated mass of geologic materials from which soils develop. The materials formed mainly from the weathering or decomposition of rocks and minerals. In the survey area, the soils formed from residuum, rock partly weathered in place; alluvium, material carried and deposited by streams; lacustrine deposits, material deposited by lake water; loess, material carried and deposited by wind; and colluvium, material accumulated at the base of steep slopes as a result of gravitational action.

The Eden and Heitt soils developed on uplands in residuum that weathered mainly from calcareous shale with thin layers of limestone and beds of siltstone. The Cynthiana, Lowell, and Nicholson soils developed mainly from material that weathered from limestone imbedded with thin layers of shale. All of these soils that formed in residuum have a clayey subsoil. The upper part of Nicholson soils formed from loess deposits, which explains why the upper part of the subsoil is loamy. The Nicholson soil is an example of a soil that formed from two distinctly different parent materials. The Nolin, Elk, and Newark soils formed in loamy alluvial deposits. The McGary, Licking, and Zipp soils formed dominantly in moderately fine textured and fine textured lacustrine sediments. The Woolper soils formed in colluvium that originated from soils formed in residuum weathered from limestone.

Relief

Relief is the elevation or inequalities of the land surface considered collectively, or the shape and slope of the landscape as it influences the formation of soils.

Relief controls the surface drainage and affects the percolation of water through the soil. It also influences the formation of soils through variations in air drainage, exposure to sun or wind, and plant cover.

The Eden soils and some of the Cynthiana soils developed in a highly dissected area of narrow ridges, V-shaped valleys, steep side slopes, and crooked courses. Elevation ranges from about 580 to 960 feet above sea level. Much of the rainfall is lost through runoff, so not enough water enters the soil for the soil forming processes to be very active. Soils on the steeper slopes generally are thin and have only slightly leached horizons because erosion removes the soil almost as fast as it forms.

Gently sloping to sloping soils are likely to be deep and have well defined horizons. Enough rainfall infiltrates and percolates downward to cause pronounced leaching of the surface layer and an accumulation of clay in the subsoil. Also, plant growth is likely to be more luxuriant than on steeper slopes, so the effects of vegetation are more pronounced. Nicholson and Lowell soils are on ridgetops above the Eden soils and are examples of deep, gently sloping to sloping soils, respectively.

Nearly level or depressional soils are likely to be saturated for long periods, because most of the rainfall infiltrates and runoff is slow or very slow. The excess water restricts air movement, reduces iron compounds, and causes gray colors to develop in the subsoil. Robertsville, McGary, Zipp, and Newark soils are examples of nearly level to depressional soils that have been affected by excessive wetness.

In Grant and Pendleton Counties, the difference in soils because of variation in exposure to sun or wind, air drainage, and plant cover is not enough to separate these soils in mapping.

Plant and animal life

Plants and animals affect soil formation mainly by adding organic matter. Animals also mix the soil and help keep it aerated and porous. Bacteria and fungi contribute mainly by decomposing the organic matter and releasing plant nutrients.

Most of the soils in the survey area formed under hardwood forest. Calcium and other bases are leached from the soil more readily under hardwood trees than under grasses. If such soils remain in woodland, they have a thin dark colored surface layer, or A1 horizon, that is lower in organic matter content than soils formed under grass. The soils in woodland also have a highly leached, light colored A2 horizon. If the soils are plowed, as the Lowell and Nicholson soils have been, the dark colored surface layer is mixed with the lighter colored layer below.

The Woolper soils have a thick, dark colored surface layer of organic matter accumulation. This thick layer of organic matter did not form because of grass vegetation, but from surface layers that have eroded from soils upslope.

When the trees were cleared from the soils, the environment of the soils changed. Most of the soils have been limed, seeded to grasses and legumes, and plowed many times since the trees were removed. In many places the plow layer consists of a mixture of the original surface layer and material from the subsoil because most of the original surface layer has been removed by erosion.

Time

The formation of soil requires time for change to take place in the parent material. The length of time the parent material has been in place and exposed to active soil forming forces, such as climate, strongly influences the nature of the soil. Less time is required for soil to form in a warm, moist climate than in a cool, dry climate. Also, some parent materials are more resistant to the soil-forming processes than others.

The maturity of a soil is determined by the relative degree of horizon formation within a soil profile, rather than by the number of years that a soil has been forming. For example, Lowell soils are classified as being older than Newark soils because they have distinct horizons and a definite arrangement of soil particles. Newark soils are on flood plains and are considered younger than Lowell soils because they have faint horizons and alluvium still accumulates.

References

(1) American Association of State Highway (and Transportation) Officials. 1970. Standard specifications for highway materials and methods of sampling and testing. Ed. 10, 2 vol., illus.

(2) American Society for Testing and Materials. 1974. Method for classification of soils for engineering purposes. ASTM Stand. D 2487-69. *In* 1974 Annual Book of ASTM Standards, Part 19, 464 pp., illus.

(3) Collins, Lewis and Richard H. Collins. 1874. Historical sketches of Kentucky. History of Kentucky, 2 v., 804 pp., illus. (Reprinted in 1966)

(4) Kentucky Conservation Needs Inventory Committee. 1970. Kentucky Soil and Water Conservation Needs Inventory, 256 pp., illus.

(5) Kentucky Crop and Livestock Reporting Service. 1977. Ky. Agric. Stat. 1976-1977, 90 pp., illus.

(6) Luft, Stanley J. 1971. Geologic map of the Goforth quadrangle, Pendleton and Grant Counties, Kentucky. U.S. Geol. Surv., Map GQ-925, illus.

(7) Luft, Stanley J. 1973. Geologic map of Williamstown quadrangle, Grant and Pendleton Counties, Kentucky. U.S. Geol. Surv., Map GQ-1104, illus.

(8) The Kentucky Department of Commerce in cooperation with the Grant County Chamber of Commerce. 1974. Industrial resources Williamstown, Dry Ridge and Crittenden, Kentucky. Ky. Dep. of Commer., Div. of Res. and Plan., 30 pp., illus.

(9) The Kentucky Department of Commerce in cooperation with the Pendleton County Chamber of Commerce. 1975. Industrial resources Falmouth and Butler, Kentucky. Ky. Dep. of Commer., Div. of Res. and Plan., 30 pp., illus.

(10) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus. (Supplements replacing pp. 173-188 issued May 1962)

(11) United States Department of Agriculture. 1975. Soil taxonomy: a basic system of soil classification for making and interpreting soil surveys. U.S. Dep. Agric. Handb. 436, 754 pp., illus.

(12) United States Department of Agriculture. 1977. A preview of Kentucky's forest resource. Forest Serv., Northwest Expt. Sta. Res. Note NE-234. 11 pp., illus.

(13) United States Department of Commerce. 1971. Number of inhabitants in Kentucky, 1970 census of population. Bur. of Census. Final Report PC(1)-A19 Kentucky. 35 pp., illus.

(14) United States Department of Commerce. 1977. 1974 census of agriculture. Soc. and Econ. Statis. Admin., Bur. of the Census. Vol. 1, pt. 17, book 2, p. 726.

Glossary

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.

Aerial photograph. A photograph of the earth's surface taken from airborne equipment, sometimes called aerial photo or air photograph.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Argillic horizon. A mineral soil horizon that is characterized by the illuvial accumulation of layer-lattice silicate clays. The argillic horizon has a certain minimum thickness depending on the thickness of the solum, has a minimum quantity of clay in comparison with an overlying eluvial horizon depending on the clay content of the eluvial horizon, and usually has coatings of oriented clay on the surface of pores, or peds, or bridging sand grains.

Aspect (forestry). The direction toward which a slope faces. Synonym: Exposure.

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 40-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 2.4
Low	2.4 to 3.2
Moderate	3.2 to 5.2
High	More than 5.2

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Chroma. One of the three variables of color. A notation of color that indicates its strength (or departure) from a neutral of the same lightness. See Munsell notation.

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.

Coarse fragments. Mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

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.

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.

Very firm.—When moist, crushes under strong pressure; barely crushable between thumb and forefinger.

Contour farming. Plowing, cultivating, planting, and harvesting in rows that are at right angles to the natural direction of the slope or that are parallel to terrace grade.

Contour stripcropping (or contour farming). 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.

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.

Cropland. Land used primarily for the production of adapted, cultivated, close-growing fruit or nut crops for harvest, alone or in association with sod crops.

Crop residue. The portion of a plant or crop left in the field after harvest.

Crop rotation. The growing of different crops in recurring succession on the same land.

Cultivation. A mechanical stirring of the soil in place, as for preparation of a seedbed or control of weeds.

Deferred grazing. Postponing grazing or arresting grazing for a prescribed period.

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 for 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.

Dust mulch. Loose, dry soil material at the surface achieved by cultivation; formerly thought to be effective in conserving soil moisture.

Effluent. The outflow of water from a subterranean storage space. The term is also used in reference to septic tank absorption systems.

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.

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 the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

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.

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.

Fine textured soil. Sandy clay, silty clay, and clay.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist, 6 to 15 inches (15 to 37.5 centimeters) long.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Forage. Plant material that can be used as feed by domestic animals; it may be grazed or cut for hay.

Fragipan. A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or moderate in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.

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.

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.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

Green manure (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

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.

Habitat. The natural abode of a plant or animal; it refers to the kind of environment in which a plant or animal normally lives as opposed to its range or geographical distribution.

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 upper case letter represents the major horizons. Numbers or lower case letters that follow

represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

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, a plowed surface horizon, most of which was originally part of a B horizon.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A 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) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

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 A or B 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, the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Hue. One of the three variables of color. The dominant spectral (rainbow) color; it is related to the dominant wavelength of the light. See Munsell notation.

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.

Immature soil. A soil lacking clearly defined horizons because the soil-forming forces have acted on the parent material for only a relatively short time since it was deposited or exposed.

Intermittent stream. A stream or part of a stream that flows only in direct response to precipitation. It receives little or no water from springs and no long-continued supply from melting snow or other sources.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

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.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Landscape. All the characteristics that distinguish a certain kind of area on the earth's surface and give it a distinguishing pattern, in contrast to other kinds of areas. Any one kind of soil is said to have a characteristic natural landscape, and under different uses it has one of more characteristic cultural landscapes.

Leached soil. A soil in which most of the soluble materials have been removed from the entire profile or have been removed from one part of the profile and have accumulated in another part.

Leaching. The removal of soluble material from soil or other material by percolating water.

Legume. A member of the legume or pulse family (*Leguminosae*). One of the most important and widely distributed plant families. Includes many valuable forage species, such as peas, beans, peanuts, clover, alfalfa, sweet clover, lespedeza, vetch, and kudzu. Practically all legumes are nitrogen-fixing plants, and many of the herbaceous species are

used as cover and green-manure crops. Even some of the legumes that have no forage value (crotalaria and some lupines) are used for soil improvement. Other legumes are locust, honeylocust, redbud, mimosa, wisteria, and many tropical plants.

Lime. Chemically, lime is calcium oxide (CaO), but its meaning has been extended to include all limestone-derived materials applied to neutralize acid soils. Agricultural lime can be obtained as ground limestone, hydrated lime, or burned lime, with or without magnesium minerals. Basic slag, oystershells, and marl also contain calcium.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Mature soil. Any soil having well-developed horizons with characteristics produced by the natural processes of soil formation and is in near equilibrium with its present environment.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Miscellaneous areas. Areas that have little or no natural soil and support little or no vegetation.

Mollic epipedon. A surface horizon of mineral soil that is dark colored and relatively thick, contains at least 0.58 percent organic carbon, is not massive and hard or very hard when dry, has a base saturation of more than 50 percent when measured at pH 7, has less than 250 parts per million of phosphorus pentoxide soluble in 1 percent citric acid, and is dominately saturated with bivalent cations.

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).

Mulch. A natural or artificially applied layer of plant residue or other material on the surface of the soil. Mulches are generally used to help conserve moisture, control temperature, prevent surface compaction or crusting, reduce runoff and erosion, improve soil structure, or control weeds. Common mulching materials are wood chips, plant residue, sawdust, and compost.

Mulch tillage. Tillage or preparation of soil in such a way that plant residue is left on the surface.

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

No-tillage. A method of planting crops that involves no seedbed preparation other than opening the soil for the purpose of placing the seed at the intended depth.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Overgrazing. Grazing so heavy as to impair future forage production and to deteriorate plants, soil, or both. Contrasts with undergrazing.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Percolation. The downward movement of water through the soil.

Permanent pasture. Pasture that is on the soil for a long time, in contrast to rotation pasture, which is on the soil only a year or two because it is grown in rotation with other crops.

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. For example, slope, differences in slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, 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.

Plow layer. The soil ordinarily moved in tillage; equivalent to surface soil.

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 be-

cause it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

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.

Riprap. Stone, brush and stone, or matresses of brush and poles placed on earth surfaces, such as the faces of dams or the banks of streams, for protection against water erosion.

Root zone. The part of the soil that can be penetrated by plant roots.

Rotation grazing. Grazing two or more pastures, or parts of a range, in regular order, with definite recovery periods between grazing periods. Contrasts with continuous grazing.

Rotation pasture. A cultivated area used as a pasture one or more years as a part of crop rotation. Contrasts with permanent pasture.

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.

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.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

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 underlying material. 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 runoff water.

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.

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.

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.

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 map. A map designed to show the distribution of soil map units in relation to the prominent physical and cultural features of the earth's surface.

Soil separates. Mineral particles less than 2 mm in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
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

Soil survey. A systematic examination, description, classification, and mapping of soils in an area.

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 and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Splash erosion. The removal of soil particles from their position by the beating effect of raindrops.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind 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 grained* (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 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.

Substratum. The part of the soil below the solum.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it can soak into the soil or flow slowly to a prepared outlet without harm. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

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, silt loam, 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."

Tile drain. Concrete, pottery, or plastic pipe placed at suitable spacings and depths in the soil or subsoil to provide water outlets from the soil.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Timber. A term loosely applied to forest stands or their products; often used for wood prepared forms suitable for heavy construction; specifically, sawed lumber 5 by 5 inches or more in breadth and thickness.

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.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

Underlying material. Technically, the C or R horizon, or both. The layer that is generally unaffected by living organisms. It commonly is under the subsoil but may be under the surface layer.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the low lands along streams.

Value (color). One of three variables of color. Value increases as the relative intensity of reflected light increases. See Munsell notation.

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.

Woodland suitability grouping. The grouping of soils that are similar in parent material, topographic position, subsoil features, drainage, or some combination of characteristics affecting the growth of trees, for the purpose of specifying management.

TABLES

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1951-74 at Williamstown, Ky.]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days[1]	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	40.3	21.4	30.9	67	-9	8	2.97	1.64	4.05	6	4.6
February---	43.7	23.3	33.6	69	-4	8	2.95	1.36	4.24	6	4.1
March------	52.6	31.4	42.1	79	10	60	4.78	2.40	6.72	9	4.3
April------	65.3	42.8	54.0	84	24	162	4.06	2.22	5.56	9	.2
May--------	74.4	51.9	63.2	90	31	416	4.17	2.74	5.46	8	.0
June-------	82.3	60.4	71.4	95	43	642	3.61	2.00	4.92	7	.0
July-------	85.8	64.4	75.1	97	51	778	4.43	2.77	5.92	8	.0
August-----	85.3	62.7	74.1	97	49	747	3.21	1.83	4.32	5	.0
September--	79.8	56.5	68.2	95	37	546	3.26	1.41	4.75	5	.0
October----	68.8	45.2	57.0	87	26	241	2.41	1.27	3.34	5	.0
November---	53.9	34.3	44.1	77	11	16	3.66	2.04	4.98	8	1.8
December---	43.3	25.6	34.5	69	-1	21	3.20	1.73	4.39	7	2.7
Yearly:											
Average--	64.6	43.3	54.0	---	---	---	---	---	---	---	---
Extreme--	---	---	---	99	-10	---	---	---	---	---	---
Total----	---	---	---	---	---	3,645	42.71	37.41	47.83	83	17.7

[1]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 (50° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Recorded in the period 1951-74 at Williamstown, Ky.]

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--	April 10	April 23	May 7
2 years in 10 later than--	April 6	April 17	May 1
5 years in 10 later than--	March 29	April 7	April 20
First freezing temperature in fall:			
1 year in 10 earlier than--	October 30	October 19	October 12
2 years in 10 earlier than--	November 3	October 24	October 16
5 years in 10 earlier than--	November 11	November 2	October 24

TABLE 3.--GROWING SEASON

[Recorded in the period 1951-74 at Williamstown, Ky.]

Probability	Daily minimum temperature during growing season		
	Higher than 24° F	Higher than 28° F	Higher than 37° F
	Days	Days	Days
9 years in 10	209	186	166
8 years in 10	215	193	173
5 years in 10	226	207	186
2 years in 10	238	221	199
1 year in 10	244	229	206

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Grant county	Pendleton county	Total-- Area	Total-- Extent
		Acres	Acres	Acres	Pct
AlB	Allegheny loam, 2 to 6 percent slopes	0	220	220	0.1
AlC	Allegheny loam, 6 to 12 percent slopes	0	390	390	0.1
AlD	Allegheny loam, 12 to 20 percent slopes	0	560	560	0.2
ChD	Cynthiana silty clay loam, very rocky, 6 to 20 percent slopes	0	1,730	1,730	0.5
CyF	Cynthiana-Rock outcrop complex, 20 to 50 percent slopes	1,770	16,970	18,740	5.5
EdD	Eden silty clay loam, 6 to 20 percent slopes	35,220	49,150	84,370	25.0
EfE3	Eden flaggy silty clay, 20 to 30 percent slopes, severely eroded	78,140	74,960	153,100	45.3
EkB	Elk silt loam, 2 to 6 percent slopes	210	370	580	0.2
EkC	Elk silt loam, 6 to 12 percent slopes	130	340	470	0.1
ElA	Elk silt loam, rarely flooded, 0 to 2 percent slopes	140	1,170	1,310	0.4
ElB	Elk silt loam, rarely flooded, 2 to 6 percent slopes	50	740	790	0.2
ElC	Elk silt loam, rarely flooded, 6 to 12 percent slopes	0	250	250	0.1
En	Elk-Newark complex	0	1,300	1,300	0.4
HeC	Heitt silt loam, 6 to 12 percent slopes	2,530	4,460	6,990	2.1
LcB	Licking silt loam, 2 to 6 percent slopes	0	1,040	1,040	0.3
LcC	Licking silt loam, 6 to 12 percent slopes	900	2,270	3,170	0.9
LcD	Licking silt loam, 12 to 20 percent slopes	620	1,010	1,630	0.5
LoC	Lowell silt loam, 6 to 12 percent slopes	5,920	4,840	10,760	3.2
LoD	Lowell silt loam, 12 to 20 percent slopes	15,170	1,260	16,430	4.9
Mc	McGary silt loam	250	500	750	0.2
Ne	Newark silt loam	400	340	740	0.2
NfB	Nicholson silt loam, 2 to 8 percent slopes	10,760	1,090	11,850	3.5
No	Nolin silt loam	4,520	5,310	9,830	2.9
Nw	Nolin silt loam, frequently flooded	1,060	1,720	2,780	0.8
OtB	Otwell silt loam, 2 to 6 percent slopes	780	3,310	4,090	1.2
OtC	Otwell silt loam, 6 to 12 percent slopes	230	1,450	1,680	0.5
OwA	Otwell silt loam, rarely flooded, 0 to 2 percent slopes	0	470	470	0.1
Pt	Pits-Dumps complex	0	270	270	0.1
Ro	Robertsville silt loam	0	360	360	0.1
Wo	Woolper silty clay loam	180	330	510	0.2
Zp	Zipp silty clay loam	0	230	230	0.1
	Water (Areas of water less than 40 acres)	190	210	400	0.1
	Total land area	159,170	178,620	337,790	100.0

TABLE 5.--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	Tobacco	Corn	Wheat	Soybeans	Alfalfa hay	Grass-legume hay	Pasture
	Lb	Bu	Bu	Bu	Ton	Ton	AUM*
AlB---- Allegheny	3,000	115	45	40	4.0	4.0	7.5
AlC---- Allegheny	2,750	105	40	35	3.5	3.5	6.5
AlD---- Allegheny	2,400	90	35	---	3.0	3.0	5.5
ChD---- Cynthiana	---	---	---	---	---	---	3.5
CyF**---- Cynthiana-Rock outcrop	---	---	---	---	---	---	---
EdD---- Eden	---	70	20	---	2.5	2.5	5.0
EfE3---- Eden	---	---	---	---	---	---	4.0
EkB---- Elk	3,200	125	45	45	4.5	4.5	9.0
EkC---- Elk	2,900	110	40	35	4.0	4.5	9.0
ElA---- Elk	3,200	130	45	45	4.5	4.5	9.0
ElB---- Elk	3,200	125	45	45	4.5	4.5	9.0
ElC---- Elk	2,900	110	40	35	4.0	4.0	8.0
En**---- Elk-Newark	---	---	---	---	---	---	6.0
HeC---- Heitt	2,375	90	35	30	4.0	4.0	8.0
LcB---- Licking	2,700	95	35	30	4.0	4.0	7.5
LcC---- Licking	2,400	95	35	30	3.5	3.5	7.0
LcD---- Licking	2,100	85	30	---	3.0	3.0	6.0
LoC---- Lowell	2,600	100	35	30	4.5	4.0	8.0
LoD---- Lowell	2,300	85	30	---	4.0	3.5	7.0
Mc---- McGary	---	80	---	30	---	3.5	6.5
Ne---- Newark	2,500	100	45	40	---	4.5	8.5

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Tobacco	Corn	Wheat	Soybeans	Alfalfa hay	Grass-legume hay	Pasture
	Lb	Bu	Bu	Bu	Ton	Ton	AUM*
NfB---- Nicholson	3,000	130	40	40	3.5	3.5	7.0
No---- Nolin	3,300	135	45	45	5.0	4.5	8.5
Nw---- Nolin	---	---	---	---	---	2.5	5.0
OtB---- Otwell	2,600	105	40	40	3.0	3.5	7.0
OtC---- Otwell	2,300	85	40	35	2.5	3.5	7.0
OwA---- Otwell	2,500	105	40	40	2.5	3.5	7.0
Pt**---- Pits-Dumps	---	---	---	---	---	---	---
Ro---- Robertsville	---	70	---	30	---	3.0	6.0
Wo---- Woolper	3,000	120	45	40	5.0	4.0	8.0
Zp---- Zipp	---	80	---	35	---	3.5	6.5

* 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 6.--CAPABILITY CLASSES AND SUBCLASSES

[Miscellaneous areas are excluded. Dashes indicate no acreage]

Class	Total acreage	Major management concerns (Subclass)		
		Erosion (e)	Wetness (w)	Soil problem (s)
		Acres	Acres	Acres
I:				
Grant County	4,840	---	---	---
Pendleton County	6,810	---	---	---
II:				
Grant County	12,450	11,800	650	---
Pendleton County	8,080	6,770	1,310	---
III:				
Grant County	9,710	9,710	---	---
Pendleton County	14,230	14,000	230	---
IV:				
Grant County	51,010	51,010	---	---
Pendleton County	52,340	51,980	360	---
V:				
Grant County	1,060	---	1,060	---
Pendleton County	1,720	---	1,720	---
VI:				
Grant County	---	---	---	---
Pendleton County	1,730	---	---	1,730
VII:				
Grant County	79,910	78,140	---	1,770
Pendleton County	93,230	76,260	---	16,970
VIII:				
Grant County	---	---	---	---
Pendleton County	---	---	---	---

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	Plant competition	Important trees	Site index	
AlB, AlC---------- Allegheny	2o	Slight	Slight	Slight	Severe	Northern red oak----	80	Eastern white pine, yellow-poplar, black walnut.
						Yellow-poplar-------	83	
						Virginia pine-------	75	
						Eastern white pine--	94	
						Shortleaf pine------	77	
AlD---------- Allegheny	2r	Moderate	Moderate	Slight	Severe	Northern red oak----	80	Eastern white pine, yellow-poplar, black walnut.
						Yellow-poplar-------	90	
						Virginia pine-------	75	
						Eastern white pine--	90	
						Shortleaf pine------	75	
ChD---------- Cynthiana	4d	Moderate	Moderate	Severe	Slight	Eastern redcedar----	42	Eastern redcedar, Virginia pine.
CyF*: Cynthiana----------	4d	Severe	Severe	Severe	Slight	Eastern redcedar----	42	Eastern redcedar, Virginia pine.
Rock outcrop.								
EdD---------- Eden	3c	Moderate	Moderate	Moderate	Moderate	Eastern redcedar----	44	Eastern redcedar, Virginia pine, Scotch pine, Austrian pine.
						White oak----------	64	
EfE3---------- Eden	4c	Severe	Severe	Moderate	Slight	Eastern redcedar----	35	Eastern redcedar, Virginia pine, Scotch pine, Austrian pine.
EkB, EkC, ElA, ElB, ElC---------- Elk	2o	Slight	Slight	Slight	Severe	Northern red oak----	80	Eastern white pine, yellow-poplar, black walnut, loblolly pine.
						Yellow-poplar-------	90	
						Shortleaf pine------	80	
						Eastern white pine--	90	
En*: Elk----------	2r	Moderate	Moderate	Slight	Severe	Northern red oak----	80	Eastern white pine, yellow-poplar, black walnut, loblolly pine.
						Yellow-poplar-------	90	
						Shortleaf pine------	80	
						Eastern white pine--	90	
Newark----------	1w	Slight	Moderate	Slight	Severe	Pin oak----------	99	Eastern cottonwood, sweetgum, loblolly pine, red maple, American sycamore, eastern white pine, yellow-poplar.
						Eastern cottonwood--	89	
						Sweetgum----------	85	
HeC---------- Heitt	3c	Slight	Moderate	Slight	Moderate	Northern red oak----	70	Shortleaf pine, eastern white pine.
						Virginia pine-------	70	
LcB, LcC---------- Licking	2o	Slight	Slight	Slight	Severe	White oak----------	76	Eastern white pine, yellow-poplar.
						Northern red oak----	80	
						Yellow-poplar-------	90	
LcD---------- Licking	2r	Moderate	Moderate	Slight	Severe	White oak----------	76	Eastern white pine, yellow-poplar.
						Northern red oak----	80	
						Yellow-poplar-------	90	
LoC---------- Lowell	2c	Slight	Slight	Slight	Moderate	Northern red oak----	70	Yellow-poplar, eastern white pine, shortleaf pine, Virginia pine, loblolly pine.
						Yellow-poplar-------	90	
						Shortleaf pine------	80	
						Virginia pine-------	80	

See footnote 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	Plant competition	Important trees	Site index	
LoD---------- Lowell	2c	Moderate	Moderate	Slight	Moderate	Northern red oak---- Yellow-poplar------- Shortleaf pine------ Virginia pine-------	70 90 80 80	Yellow-poplar, eastern white pine, shortleaf pine, Virginia pine, loblolly pine.
Mc---------- McGary	3w	Slight	Moderate	Slight	Moderate	White oak---------- Pin oak---------- Yellow-poplar------- Sweetgum----------	65 85 85 80	Eastern white pine, baldcypress, white ash, red maple, yellow-poplar, American sycamore.
Ne---------- Newark	1w	Slight	Moderate	Slight	Severe	Pin oak---------- Eastern cottonwood-- Sweetgum----------	99 89 85	Eastern cottonwood, sweetgum, loblolly pine, red maple, American sycamore, eastern white pine, yellow-poplar.
NfB---------- Nicholson	2o	Slight	Slight	Slight	Severe	Northern red oak---- Sweetgum---------- Yellow-poplar-------	75 85 107	Black walnut, yellow-poplar, eastern white pine, shortleaf pine, white ash.
No---------- Nolin	1o	Slight	Slight	Slight	Severe	Sweetgum----------	99	Sweetgum, yellow-poplar, eastern white pine, eastern cottonwood, white ash, cherrybark oak.
Nw---------- Nolin	1w	Slight	Moderate	Slight	Severe	Sweetgum----------	99	Sweetgum, yellow-poplar, eastern white pine, eastern cottonwood, white ash, cherry bark oak.
OtB, OtC, OwA------ Otwell	3o	Slight	Slight	Slight	Moderate	White oak----------	69	Eastern white pine, yellow-poplar, white ash.
Ro---------- Robertsville	1w	Slight	Severe	Severe	Severe	Pin oak---------- Yellow-poplar------- Sweetgum---------- Shumard red oak-----	85 89 96 90	Sweetgum, loblolly pine, American sycamore.
Wo---------- Woolper	2c	Slight	Moderate	Slight	Severe	Northern red oak---- Yellow-poplar------- Shortleaf pine------	80 90 80	Black walnut, yellow-poplar, eastern white pine.
Zp---------- Zipp	2w	Slight	Severe	Severe	Severe	Pin oak---------- Sweetgum----------	102 90	Baldcypress, red maple, sweetgum.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
AlB Allegheny	Slight	Slight	Moderate: slope.	Slight	Slight.
AlC Allegheny	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
AlD Allegheny	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
ChD Cynthiana	Severe: large stones.	Moderate: too clayey, large stones.	Severe: slope, depth to rock.	Moderate: too clayey, large stones.	Severe: depth to rock.
CyF*: Cynthiana	Severe: slope, large stones.	Severe: slope.	Severe: slope, depth to rock.	Severe: slope.	Severe: slope, depth to rock.
Rock outcrop.					
EdD Eden	Moderate: slope, percs slowly.	Moderate: slope, too clayey.	Severe: slope.	Moderate: too clayey.	Moderate: too clayey.
EfE3 Eden	Severe: slope, too clayey.	Severe: slope, too clayey.	Severe: slope, too clayey.	Severe: slope, too clayey.	Severe: slope.
EkB Elk	Slight	Slight	Moderate: slope.	Slight	Slight.
EkC Elk	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
ElA Elk	Severe: floods.	Slight	Slight	Slight	Slight.
ElB Elk	Severe: floods.	Slight	Moderate: slope.	Slight	Slight.
ElC Elk	Severe: floods.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
En*: Elk	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Newark	Severe: floods, wetness.	Moderate: wetness, floods.	Severe: wetness, floods.	Moderate: wetness, floods.	Severe: floods.
HeC Heitt	Moderate: slope, percs slowly.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
LcB Licking	Moderate: wetness, percs slowly.	Moderate: wetness.	Moderate: slope, wetness, percs slowly.	Slight	Moderate: wetness.
LcC Licking	Moderate: slope, wetness, percs slowly.	Moderate: slope, wetness.	Severe: slope.	Slight	Moderate: wetness, slope.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
LcD---- Licking	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
LoC---- Lowell	Moderate: percs slowly, slope.	Moderate: slope.	Severe: slope.	Slight----	Moderate: slope.
LoD---- Lowell	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Mc---- McGary	Severe: percs slowly, wetness.	Moderate: wetness.	Severe: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
Ne---- Newark	Severe: floods, wetness.	Moderate: wetness, floods.	Severe: wetness, floods.	Moderate: wetness, floods.	Severe: floods.
NfB---- Nicholson	Moderate: percs slowly, wetness.	Moderate: wetness.	Moderate: slope, percs slowly, wetness.	Slight----	Slight.
No---- Nolin	Severe: floods.	Slight----	Moderate: floods.	Slight----	Moderate: floods.
Nw---- Nolin	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.	Severe: floods.
OtB---- Otwell	Moderate: percs slowly, wetness.	Moderate: percs slowly, wetness.	Moderate: percs slowly, wetness.	Slight----	Slight.
OtC---- Otwell	Moderate: percs slowly, wetness.	Moderate: slope, percs slowly, wetness.	Severe: slope.	Slight----	Moderate: slope.
OwA---- Otwell	Severe: floods.	Moderate: percs slowly, wetness.	Moderate: percs slowly, wetness.	Slight----	Slight.
Pt*: Pits.					
Dumps.					
Ro---- Robertsville	Severe: floods, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: floods, wetness.
Wo---- Woolper	Severe: floods.	Moderate: too clayey.	Moderate: percs slowly.	Moderate: too clayey.	Moderate: too clayey.
Zp---- Zipp	Severe: floods, wetness, percs slowly.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.	Severe: floods, wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
AlB---- Allegheny	Good	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
AlC---- Allegheny	Fair	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.
AlD---- Allegheny	Poor	Fair	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor.
ChD---- Cynthiana	Poor	Poor	Fair	Poor	Poor	Very poor	Very poor	Poor	Poor	Very poor.
CyF*: Cynthiana----	Very poor	Poor	Fair	Poor	Poor	Very poor	Very poor	Poor	Poor	Very poor.
Rock outcrop.										
EdD---- Eden	Fair	Good	Fair	Fair	Fair	Very poor	Very poor	Fair	Fair	Very poor.
EfE3---- Eden	Very poor	Fair	Fair	Fair	Fair	Very poor	Very poor	Poor	Fair	Very poor.
EkB---- Elk	Good	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
EkC---- Elk	Fair	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.
ElA, ElB---- Elk	Good	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
ElC---- Elk	Fair	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.
En*: Elk----	Fair	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.
Newark----	Poor	Fair	Fair	Good	Good	Fair	Fair	Fair	Good	Fair.
HeC---- Heitt	Fair	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.
LcB---- Licking	Good	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
LcC---- Licking	Fair	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.
LcD---- Licking	Poor	Fair	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor.
LoC---- Lowell	Fair	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.
LoD---- Lowell	Poor	Fair	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor.
Mc---- McGary	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
Ne---------- Newark	Poor	Fair	Fair	Good	Good	Fair	Fair	Fair	Good	Fair.
NfB---------- Nicholson	Good	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
No---------- Nolin	Good	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
Nw---------- Nolin	Poor	Fair	Fair	Good	Good	Poor	Very poor	Fair	Fair	Very poor.
OtB---------- Otwell	Good	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
OtC---------- Otwell	Fair	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.
OwA---------- Otwell	Good	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
Pt*: Pits.										
Dumps.										
Ro---------- Robertsville	Poor	Poor	Fair	Fair	Fair	Good	Good	Poor	Fair	Good.
Wo---------- Woolper	Good	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
Zp---------- Zipp	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
AlB---------- Allegheny	Slight---------	Slight---------	Slight---------	Moderate: slope.	Moderate: low strength.	Slight.
AlC---------- Allegheny	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, low strength.	Moderate: slope.
AlD---------- Allegheny	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
ChD---------- Cynthiana	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: depth to rock.
CyF*: Cynthiana--------	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.
Rock outcrop.						
EdD---------- Eden	Severe: too clayey.	Moderate: slope, shrink-swell.	Moderate: slope, depth to rock, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: too clayey.
EfE3---------- Eden	Severe: slope, too clayey.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, low strength.	Severe: slope.
EkB---------- Elk	Slight---------	Slight---------	Slight---------	Moderate: slope.	Moderate: low strength.	Slight.
EkC---------- Elk	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, low strength.	Moderate: slope.
ElA, ElB---------- Elk	Moderate: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods, low strength.	Slight.
ElC---------- Elk	Moderate: slope, floods.	Severe: floods.	Severe: floods.	Severe: slope, floods.	Moderate: slope, floods.	Moderate: slope.
En*: Elk----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Newark----------	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods.
HeC---------- Heitt	Moderate: slope, too clayey.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: slope, low strength, shrink-swell.	Moderate: slope.
LcB---------- Licking	Severe: wetness.	Severe: shrink-swell.	Severe: shrink-swell, wetness.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Moderate: wetness.
LcC---------- Licking	Severe: wetness.	Severe: shrink-swell,	Severe: shrink-swell, wetness.	Severe: shrink-swell, slope.	Severe: low strength, shrink-swell.	Moderate: wetness, slope.

See footnote at end of table.

TABLE 10.--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
LcD---- Licking	Severe: slope, wetness.	Severe: shrink-swell, slope.	Severe: shrink-swell, wetness, slope.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: slope.
LoC---- Lowell	Severe: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
LoD---- Lowell	Severe: slope, too clayey.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, low strength.	Severe: slope.
Mc---- McGary	Severe: wetness, too clayey.	Severe: shrink-swell, wetness.	Severe: wetness, shrink-swell.	Severe: shrink-swell, wetness.	Severe: shrink-swell, low strength.	Moderate: wetness.
Ne---- Newark	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods.
NfB---- Nicholson	Severe: wetness, too clayey.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: slope, wetness, shrink-swell.	Severe: low strength.	Slight.
No---- Nolin	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods.
Nw---- Nolin	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
OtB---- Otwell	Slight----	Slight----	Moderate: wetness.	Moderate: slope.	Severe: low strength.	Slight.
OtC---- Otwell	Moderate: slope.	Moderate: slope.	Moderate: slope, wetness.	Severe: slope.	Severe: low strength.	Moderate: slope.
OwA---- Otwell	Moderate: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength.	Slight.
Pt*: Pits.						
Dumps.						
Ro---- Robertsville	Severe: floods, wetness, too clayey.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness, low strength.	Severe: floods, wetness.
Wo---- Woolper	Severe: too clayey.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength.	Moderate: too clayey.
Zp---- Zipp	Severe: wetness, floods.	Severe: wetness, shrink-swell, floods.	Severe: wetness, shrink-swell, floods.	Severe: wetness, shrink-swell, floods.	Severe: wetness, floods, low strength, shrink-swell.	Severe: floods, wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," and "fair." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
AlB Allegheny	Slight	Moderate: slope, seepage.	Slight	Slight	Good.
AlC Allegheny	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.	Fair: slope.
AlD Allegheny	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.	Poor: slope.
ChD Cynthiana	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Moderate: slope.	Poor: thin layer, too clayey.
CyF*: Cynthiana	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.	Poor: slope, thin layer, too clayey.
Rock outcrop.					
EdD Eden	Severe: percs slowly, depth to rock.	Severe: slope.	Severe: too clayey, depth to rock.	Moderate: slope.	Poor: too clayey, thin layer.
EfE3 Eden	Severe: slope, percs slowly, depth to rock.	Severe: slope.	Severe: slope, too clayey, depth to rock.	Severe: slope.	Poor: slope, too clayey, thin layer.
EkB Elk	Slight	Moderate: slope, seepage.	Slight	Slight	Good.
EkC Elk	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.	Fair: slope.
ElA, ElB Elk	Moderate: floods.	Severe: floods.	Moderate: floods.	Moderate: floods.	Good.
ElC Elk	Moderate: slope, floods.	Severe: slope, floods.	Moderate: floods.	Moderate: slope, floods.	Fair: slope.
En*: Elk	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.	Poor: slope.
Newark	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.
HeC Heitt	Severe: percs slowly.	Severe: slope.	Severe: depth to rock.	Moderate: slope.	Poor: too clayey.
LcB Licking	Severe: percs slowly, wetness.	Moderate: slope.	Severe: too clayey, wetness.	Moderate: wetness.	Poor: too clayey.
LcC Licking	Severe: percs slowly, wetness.	Severe: slope.	Severe: too clayey, wetness.	Moderate: slope, wetness.	Poor: too clayey.

See footnote at end of table.

TABLE 11.--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
LcD---------- Licking	Severe: percs slowly, slope, wetness.	Severe: slope.	Severe: too clayey, wetness.	Severe: slope.	Poor: too clayey, slope.
LoC---------- Lowell	Severe: percs slowly.	Severe: slope.	Severe: depth to rock, too clayey.	Moderate: slope.	Poor: too clayey.
LoD---------- Lowell	Severe: slope, percs slowly.	Severe: slope.	Severe: depth to rock, too clayey.	Severe: slope.	Poor: slope, too clayey.
Mc---------- McGary	Severe: wetness, percs slowly.	Slight----------	Severe: too clayey, wetness.	Severe: wetness.	Poor: too clayey, wetness.
Ne---------- Newark	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.
NfB---------- Nicholson	Severe: percs slowly, wetness.	Severe: wetness.	Severe: wetness, too clayey.	Moderate: wetness.	Fair: too clayey.
No, Nw---------- Nolin	Severe: floods.	Severe: floods.	Severe: wetness, floods.	Severe: floods.	Good.
OtB---------- Otwell	Severe: percs slowly, wetness.	Moderate: slope.	Moderate: too clayey, wetness.	Slight----------	Fair: too clayey.
OtC---------- Otwell	Severe: percs slowly, wetness.	Severe: slope.	Moderate: too clayey, wetness.	Moderate: slope.	Fair: slope, too clayey.
OwA---------- Otwell	Severe: percs slowly, wetness.	Severe: floods.	Moderate: floods, wetness, too clayey.	Moderate: floods.	Fair: too clayey.
Pt*: Pits.					
Dumps.					
Ro---------- Robertsville	Severe: floods, percs slowly, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.
Wo---------- Woolper	Severe: percs slowly.	Slight----------	Severe: too clayey.	Moderate: floods.	Poor: too clayey.
Zp---------- Zipp	Severe: wetness, percs slowly, floods.	Slight----------	Severe: wetness, too clayey, floods.	Severe: wetness, floods.	Poor: too clayey, wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and "poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
AlB Allegheny	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
AlC Allegheny	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope, thin layer.
AlD Allegheny	Fair: slope, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
ChD Cynthiana	Poor: low strength, thin layer.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer, too clayey.
CyF*: Cynthiana	Poor: slope, low strength, thin layer.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope, thin layer, too clayey.
Rock outcrop.				
EdD Eden	Poor: thin layer, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: large stones, too clayey.
EfE3 Eden	Poor: slope, thin layer, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope, too clayey, large stones.
EkB Elk	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
EkC Elk	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
ElA, ElB Elk	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
ElC Elk	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
En*: Elk	Fair: slope, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
Newark	Poor: wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
HeC Heitt	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
LcB Licking	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
LcC Licking	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, slope.
LcD Licking	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
LoC---------- Lowell	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope, thin layer.
LoD---------- Lowell	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
Mc---------- McGary	Poor: shrink-swell, low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Ne---------- Newark	Poor: wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
NfB---------- Nicholson	Poor: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
No, Nw---------- Nolin	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
OtB---------- Otwell	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
OtC---------- Otwell	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope, thin layer.
OwA---------- Otwell	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Pt*: Pits.				
Dumps.				
Ro---------- Robertsville	Poor: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
Wo---------- Woolper	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
Zp---------- Zipp	Poor: wetness, shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey, wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Terraces and diversions	Grassed waterways
AlB, AlC, AlD----- Allegheny	Seepage----------	Piping----------	Not needed-------	Slope----------	Slope.
ChD---------- Cynthiana	Depth to rock, slope.	Thin layer, hard to pack.	Not needed-------	Depth to rock, slope.	Slope, rooting depth.
CyF*: Cynthiana--------	Depth to rock, slope.	Thin layer, hard to pack.	Not needed-------	Depth to rock, slope.	Slope, rooting depth.
Rock outcrop.					
EdD, EfE3--------- Eden	Depth to rock-----	Hard to pack, thin layer.	Not needed-------	Slope, erodes easily, percs slowly.	Slope, erodes easily, percs slowly.
EkB, EkC, ElA, ElB, ElC--------- Elk	Seepage----------	Piping----------	Not needed-------	Slope----------	Slope.
En*: Elk----------	Seepage----------	Piping----------	Not needed-------	Slope----------	Slope.
Newark----------	Seepage----------	Wetness----------	Floods----------	Not needed-------	Wetness, erodes easily.
HeC---------- Heitt	Slope----------	Hard to pack------	Not needed-------	Slope----------	Erodes easily, slope.
LcB---------- Licking	Favorable---------	Wetness, hard to pack.	Percs slowly-----	Wetness, erodes easily.	Wetness, erodes easily.
LcC---------- Licking	Slope----------	Wetness, hard to pack.	Slope, percs slowly.	Wetness, erodes easily.	Slope, wetness, erodes easily.
LcD---------- Licking	Slope----------	Wetness, hard to pack.	Slope, percs slowly.	Slope, wetness, erodes easily.	Slope, wetness, erodes easily.
LoC---------- Lowell	Slope----------	Hard to pack------	Not needed-------	Favorable--------	Slope, erodes easily.
LoD---------- Lowell	Slope----------	Hard to pack------	Not needed-------	Slope----------	Slope, erodes easily.
Mc---------- McGary	Favorable---------	Hard to pack, wetness.	Percs slowly-----	Wetness, erodes easily, percs slowly.	Percs slowly, wetness, erodes easily.
Ne---------- Newark	Seepage----------	Wetness----------	Floods----------	Not needed-------	Wetness, erodes easily.
NfB---------- Nicholson	Favorable---------	Hard to pack------	Percs slowly, slope.	Rooting depth, wetness, erodes easily.	Rooting depth, erodes easily.
No, Nw---------- Nolin	Seepage----------	Piping----------	Not needed-------	Not needed-------	Erodes easily.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Terraces and diversions	Grassed waterways
OtB---------- Otwell	Favorable----------	Favorable----------	Not needed-------	Erodes easily, rooting depth.	Erodes easily, rooting depth.
OtC---------- Otwell	Slope----------	Favorable----------	Not needed-------	Erodes easily, rooting depth.	Slope, erodes easily, rooting depth.
OwA---------- Otwell	Favorable----------	Favorable----------	Not needed-------	Erodes easily, rooting depth, percs slowly.	Erodes easily, rooting depth.
Pt*: Pits.					
Dumps.					
Ro---------- Robertsville	Favorable----------	Wetness----------	Percs slowly, floods.	Erodes easily, wetness, rooting depth.	Wetness, erodes easily, rooting depth.
Wo---------- Woolper	Favorable----------	Hard to pack------	Not needed-------	Slope----------	Erodes easily, slope.
Zp---------- Zipp	Favorable----------	Wetness, hard to pack.	Percs slowly, floods.	Not needed-------	Wetness, percs slowly.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--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		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
AlB, AlC, AlD---- Allegheny	0-7	Loam----------	ML, CL, CL-ML	A-4	0	90-100	80-100	65-100	55-95	<35	NP-10
	7-52	Clay loam, loam, sandy clay loam.	ML, CL, SM, SC	A-4, A-6	0	90-100	80-100	65-95	35-80	<35	NP-15
	52-65	Clay loam, sandy loam, gravelly sandy loam.	SM, GC, ML, CL	A-4, A-6, A-2, A-1	0-5	65-100	55-100	35-95	20-75	<35	NP-15
ChD---------- Cynthiana	0-4	Silty clay loam	ML, CL, CL-ML	A-4, A-6, A-7	0	85-100	85-100	70-100	60-100	25-42	4-20
	4-18	Flaggy clay, flaggy silty clay, clay.	MH, CH, CL	A-7	5-30	70-100	65-100	60-100	55-100	45-75	20-45
	18	Unweathered bedrock.									
CyF*: Cynthiana---------	0-4	Silty clay loam	ML, CL, CL-ML	A-4, A-6, A-7	0	85-100	85-100	70-100	60-100	25-42	4-20
	4-18	Flaggy clay, flaggy silty clay, clay.	MH, CH, CL	A-7	5-30	70-100	65-100	60-100	55-100	45-75	20-45
	18	Unweathered bedrock.									
Rock outcrop.											
EdD---------- Eden	0-6	Silty clay loam	ML, CL, MH, CH	A-7, A-6	0-5	85-100	85-100	75-100	70-100	35-65	12-35
	6-30	Flaggy silty clay, flaggy clay, silty clay.	MH, CH, CL	A-7	10-30	75-100	70-100	65-100	60-100	45-75	20-45
	30	Weathered bedrock.									
EfE3---------- Eden	0-6	Flaggy silty clay.	ML, CL, MH, CH	A-7, A-6	10-30	65-75	60-70	60-70	55-65	35-65	12-35
	6-30	Flaggy silty clay, flaggy clay, silty clay.	MH, CH, CL	A-7	10-30	75-100	70-100	65-100	60-100	45-75	20-45
	30	Weathered bedrock.									
EkB, EkC, ElA, ElB, ElC---------- Elk	0-8	Silt loam-------	ML, CL, CL-ML	A-4	0	95-100	95-100	85-100	70-95	25-35	3-10
	8-42	Silty clay loam, silt loam.	ML, CL, CL-ML	A-4, A-6	0	95-100	90-100	85-100	75-100	25-40	5-15
	42-65	Silty clay loam, silt loam.	ML, CL, CL-ML, SM-SC	A-4, A-6	0	75-100	50-100	45-100	40-95	25-40	5-15
En*: Elk----------	0-8	Silt loam-------	ML, CL, CL-ML	A-4	0	95-100	95-100	85-100	70-95	25-35	3-10
	8-42	Silty clay loam, silt loam.	ML, CL, CL-ML	A-4, A-6	0	95-100	90-100	85-100	75-100	25-40	5-15
	42-65	Silty clay loam, silt loam.	ML, CL, CL-ML, SM-SC	A-4, A-6	0	75-100	50-100	45-100	40-95	25-40	5-15

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
En*:											
Newark	0-7	Silt loam	ML, CL, CL-ML	A-4	0	95-100	90-100	80-100	55-95	<32	NP-10
	7-40	Silt loam, silty clay loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	95-100	90-100	85-100	70-95	22-42	4-20
	40-65	Silt loam, silty clay loam.	ML, CL, CL-ML	A-4, A-6, A-7	0-3	75-100	70-100	65-100	55-95	22-42	4-20
HeC	0-6	Silt loam	ML, CL, CL-ML	A-6, A-4	0-5	100	95-100	90-100	80-100	25-35	4-12
Heitt	6-38	Silty clay, clay, silty clay loam.	CL, CH, MH	A-7, A-6	0-5	100	95-100	90-100	85-100	35-65	15-35
	38	Weathered bedrock.									
LcB, LcC, LcD	0-6	Silt loam	ML, CL-ML, CL	A-4	0	95-100	95-100	90-100	70-90	22-35	4-10
Licking	6-18	Silty clay loam	CL	A-7, A-6	0	100	100	90-100	70-95	30-50	15-25
	18-65	Silty clay, clay	CH	A-7	0	100	100	95-100	75-95	45-70	26-42
LoC, LoD	0-8	Silt loam	ML, CL, CL-ML	A-4	0	100	95-100	90-100	85-100	22-32	4-10
Lowell	8-56	Silty clay, clay, silty clay loam.	CL, CH, MH	A-7, A-6	0	100	95-100	90-100	85-100	35-65	15-32
	56-60	Clay, silty clay	CH, MH, CL	A-7	0-5	95-100	90-100	85-100	75-100	45-75	20-40
	60	Unweathered bedrock.									
Mc	0-7	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-95	25-40	5-15
McGary	7-40	Silty clay, silty clay loam.	CL, CH	A-7	0	100	100	95-100	90-100	45-60	25-35
	40-65	Stratified silty clay loam to clay.	CL, CH	A-6, A-7	0	95-100	95-100	95-100	85-100	35-55	20-35
Ne	0-7	Silt loam	ML, CL, CL-ML	A-4	0	95-100	90-100	80-100	55-95	<32	NP-10
Newark	7-40	Silt loam, silty clay loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	95-100	90-100	85-100	70-95	22-42	4-20
	40-65	Silt loam, silty clay loam.	ML, CL, CL-ML	A-4, A-6, A-7	0-3	75-100	70-100	65-100	55-95	22-42	4-20
NfB	0-8	Silt loam	ML, CL, CL-ML	A-4	0	95-100	95-100	85-100	80-95	25-35	5-10
Nicholson	8-26	Silty clay loam, silt loam.	CL, CL-ML	A-6, A-4, A-7	0	95-100	95-100	85-100	80-100	25-45	5-20
	26-38	Silty clay loam, silt loam.	CL, CL-ML	A-6, A-4, A-7	0	95-100	90-100	80-100	75-95	25-45	5-20
	38-65	Silty clay, clay, channery clay.	CH, CL	A-7	0-10	80-100	70-100	60-100	55-95	40-70	16-40
No, Nw	0-7	Silt loam	ML, CL, CL-ML	A-4, A-6	0	100	95-100	90-100	80-100	25-40	5-18
Nolin	7-60	Silt loam, silty clay loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	100	95-100	85-100	75-100	25-46	5-23

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
OtB, OtC	0-7	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-95	25-35	5-15
Otwell	7-23	Silty clay loam, silt loam.	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-95	25-40	5-20
	23-48	Silty clay loam, loam, silt loam.	CL	A-6, A-7	0	95-100	95-100	85-100	65-90	35-50	20-30
	48-65	Stratified silt loam to silty clay.	CL	A-6, A-7	0	95-100	90-100	85-100	80-95	35-50	15-25
OwA	0-7	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-95	25-35	5-15
Otwell	7-23	Silty clay loam, silt loam.	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-95	25-40	5-20
	23-48	Silty clay loam, loam, silt loam.	CL	A-6, A-7	0	95-100	95-100	85-100	65-90	35-50	15-30
	48-65	Stratified silt loam to silty clay.	CL	A-6, A-7	0	95-100	75-100	75-100	75-95	35-50	15-30
Pt*:											
Pits.											
Dumps.											
Ro	0-13	Silt loam	ML	A-4	0	95-100	95-100	85-100	75-100	25-35	2-10
Robertsville	13-25	Silt loam, silty clay loam.	ML, CL, CL-ML	A-4, A-6	0	95-100	95-100	90-100	80-100	25-40	3-20
	25-50	Silty clay loam, silt loam.	ML, CL, CL-ML	A-4, A-6	0	95-100	95-100	90-100	80-100	25-40	3-20
	50-65	Silty clay loam, silty clay, silt loam.	CL, CH, CL-ML	A-6, A-7, A-4	0-5	80-100	75-100	70-100	60-100	25-60	5-35
Wo	0-9	Silty clay loam	CL	A-6, A-7	0-5	95-100	90-100	85-100	75-100	34-42	15-22
Woolper	9-19	Silty clay, silty clay loam, clay.	CL, CH	A-7, A-6	0-10	95-100	90-100	85-100	75-100	35-65	15-40
	19-65	Clay, silty clay	CH, CL	A-7	0-10	95-100	90-100	85-100	75-100	45-75	20-45
Zp	0-7	Silty clay loam	CL, CH	A-7, A-6	0	100	100	95-100	90-95	35-55	20-30
Zipp	7-39	Clay, silty clay, silty clay loam.	CL, CH	A-7	0	100	100	95-100	90-95	45-60	25-35
	39-65	Clay, silty clay	CL, CH	A-7	0	100	100	90-100	75-95	45-60	25-35

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than. Entries under "Erosion factors--T" apply to the entire profile. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors	
						K	T
	In	In/hr	In/in	pH			
AlB, AlC, AlD----	0-7	0.6-2.0	0.12-0.22	3.6-5.0	Low----------	0.32	5
Allegheny	7-52	0.6-2.0	0.13-0.18	3.6-5.0	Low----------	0.28	
	52-65	0.6-2.0	0.08-0.17	3.6-5.0	Low----------	0.28	
ChD----------	0-4	0.6-2.0	0.15-0.20	6.1-7.8	Moderate-------	0.37	2
Cynthiana	4-18	0.2-0.6	0.08-0.15	6.1-7.8	Moderate-------	0.28	
	18	---	---	---	----------	----	
CyF*:							
Cynthiana-------	0-4	0.6-2.0	0.15-0.20	6.1-7.8	Moderate-------	0.37	2
	4-18	0.2-0.6	0.08-0.15	6.1-7.8	Moderate-------	0.28	
	18	---	---	---	----------	----	
Rock outcrop							
EdD----------	0-6	0.06-0.6	0.12-0.18	5.6-8.4	Moderate-------	0.43	2
Eden	6-30	0.06-0.2	0.10-0.15	5.6-8.4	Moderate-------	0.28	
	30	---	---	---	----------	0.17	
EfE3----------	0-6	0.06-0.6	0.12-0.18	5.1-8.4	Moderate-------	0.43	3
Eden	6-30	0.06-0.2	0.10-0.15	5.1-8.4	Moderate-------	0.28	
	30	---	---	---	----------	0.17	
EkB, EkC, ElA,							
ElB, ElC--------	0-8	0.6-2.0	0.19-0.23	5.1-6.0	Low----------	0.32	4
Elk	8-42	0.6-2.0	0.18-0.22	5.1-6.0	Low----------	0.28	
	42-65	0.6-2.0	0.14-0.20	5.1-6.0	Low----------	0.28	
En*:							
Elk----------	0-8	0.6-2.0	0.19-0.23	5.1-6.0	Low----------	0.32	4
	8-42	0.6-2.0	0.18-0.22	5.1-6.0	Low----------	0.28	
	42-65	0.6-2.0	0.14-0.20	5.1-6.0	Low----------	0.28	
Newark----------	0-7	0.6-2.0	0.15-0.23	6.1-7.8	Low----------	0.43	5
	7-40	0.6-2.0	0.18-0.23	6.1-7.8	Low----------	0.43	
	40-65	0.6-2.0	0.15-0.22	6.1-7.8	Low----------	0.43	
HeC----------	0-6	0.6-2.0	0.18-0.23	5.1-6.0	Low----------	0.37	3
Heitt	6-38	0.2-2.0	0.13-0.19	5.1-6.0	Moderate-------	0.28	
	38	---	---	---	----------	----	
LcB, LcC, LcD----	0-6	0.6-2.0	0.14-0.18	4.5-6.0	Low----------	0.43	3
Licking	6-18	0.2-0.6	0.12-0.16	4.5-6.0	Moderate-------	0.43	
	18-65	0.06-0.2	0.10-0.14	5.6-7.8	High----------	0.32	
LoC, LoD---------	0-8	0.6-2.0	0.18-0.23	5.1-6.0	Low----------	0.37	3
Lowell	8-56	0.2-0.6	0.13-0.19	5.1-6.5	Moderate-------	0.28	
	56-60	0.2-0.6	0.12-0.17	6.1-7.8	Moderate-------	0.28	
	60	---	---	---	----------	----	
Mc----------	0-7	0.6-2.0	0.22-0.24	5.6-7.3	Low----------	0.43	3
McGary	7-40	<0.2	0.11-0.13	5.6-6.5	High----------	0.32	
	40-65	<0.2	0.14-0.16	5.6-7.8	High----------	0.32	
Ne----------	0-7	0.6-2.0	0.15-0.23	6.1-7.8	Low----------	0.43	5
Newark	7-40	0.6-2.0	0.18-0.23	6.1-7.8	Low----------	0.43	
	40-65	0.6-2.0	0.15-0.22	6.1-7.8	Low----------	0.43	
NfB----------	0-8	0.6-2.0	0.19-0.23	4.5-6.0	Low----------	0.43	3
Nicholson	8-26	0.6-2.0	0.18-0.22	4.5-6.0	Low----------	0.43	
	26-38	0.06-0.2	0.07-0.12	4.5-6.0	Low----------	0.43	
	38-65	0.06-0.6	0.07-0.12	5.1-7.8	Moderate-------	0.37	

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--CONTINUED

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors	
						K	T
	In	In/hr	In/in	pH			
No, Nw	0-7	0.6-2.0	0.18-0.23	6.1-7.8	Low	0.43	5
Nolin	7-60	0.6-2.0	0.18-0.23	6.1-7.8	Low	0.43	
OtB, Otc	0-7	0.6-2.0	0.22-0.24	4.5-7.3	Low	0.43	3
Otwell	7-23	0.06-0.2	0.18-0.22	4.5-5.5	Low	0.43	
	23-48	0.06-0.2	0.06-0.08	4.5-5.5	Low	0.43	
	48-65	0.06-0.2	0.19-0.21	5.1-7.3	Low	0.43	
OwA	0-7	0.6-2.0	0.22-0.24	4.5-7.3	Low	0.43	3
Otwell	7-23	0.06-0.2	0.18-0.22	4.5-5.5	Low	0.43	
	23-48	0.06-0.2	0.06-0.08	4.5-5.5	Low	0.43	
	48-65	0.06-0.2	0.06-0.08	5.1-7.3	Low	0.43	
Pt*:							
Pits.							
Dumps.							
Ro	0-13	0.6-2.0	0.19-0.23	4.5-5.5	Low	0.43	3
Robertsville	13-25	0.6-2.0	0.18-0.22	4.5-5.5	Low	0.43	
	25-50	0.06-0.2	0.18-0.12	4.5-5.5	Low	0.43	
	50-65	0.2-0.6	0.08-0.12	4.5-7.3	Low	0.37	
Wo	0-9	0.6-2.0	0.18-0.22	6.1-7.8	Low	0.37	3
Woolper	9-19	0.2-2.0	0.13-0.19	6.1-7.8	Moderate	0.28	
	19-65	0.06-0.6	0.12-0.17	6.1-7.8	Moderate	0.28	
Zp	0-7	0.2-2.0	0.12-0.21	6.1-7.8	High	0.28	5
Zipp	7-39	<0.2	0.11-0.13	6.1-7.8	High	0.28	
	39-65	<0.2	0.08-0.10	7.4-8.4	High	0.28	

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--SOIL AND WATER FEATURES

[See text for definitions of terms such as "rare," "brief," "apparent," and "perched." The symbol > means more than. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	Uncoated steel	Concrete
					Ft			In			
AlB, AlC, AlD----- Allegheny	B	None--------	---	---	>6.0	---	---	>60	---	Low------	High.
ChD---------- Cynthiana	D	None--------	---	---	>6.0	---	---	10-20	Hard	Moderate	Low.
CyF*: Cynthiana--------	D	None--------	---	---	>6.0	---	---	10-20	Hard	Moderate	Low.
Rock outcrop.											
EdD, EfE3--------- Eden	C	None--------	---	---	>6.0	---	---	20-40	Soft	Moderate	Low.
EkB, EkC---------- Elk	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate.
ElA, ElB, ElC----- Elk	B	Rare--------	Brief-----	Jan-Apr	>6.0	---	---	>60	---	Moderate	Moderate.
En*: Elk----------	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate.
Newark----------	C	Frequent----	Brief-----	Dec-May	0.5-1.5	Apparent	Dec-May	>60	---	High-----	Low.
HeC---------- Heitt	C	None--------	---	---	>6.0	---	---	>40	Soft	Moderate	Moderate.
LcB, LcC, LcD----- Licking	C	None--------	---	---	1.5-3.0	Apparent	Jan-Apr	>60	---	High-----	High.
LoC, LoD---------- Lowell	C	None--------	---	---	>6.0	---	---	>40	Hard	High-----	Moderate.
Mc---------- McGary	C	None--------	---	---	1.0-3.0	Apparent	Jan-Apr	>60	---	High-----	Low.
Ne---------- Newark	C	Frequent----	Brief-----	Dec-May	0.5-1.5	Apparent	Dec-May	>60	---	High-----	Low.
NfB---------- Nicholson	C	None--------	---	---	1.5-2.5	Perched	Jan-Apr	>60	---	High-----	Moderate.
No---------- Nolin	B	Occasional	Brief to long.	Feb-May	3.0-6.0	Apparent	Feb-Mar	>60	---	Low------	Moderate.
Nw---------- Nolin	B	Frequent----	Brief to long.	Dec-Jul	3.0-6.0	Apparent	Feb-Mar	>60	---	Low------	Moderate.
OtB, OtC---------- Otwell	C	None--------	---	---	1.5-2.0	Perched	Jan-Apr	>60	---	Moderate	High.
OwA---------- Otwell	C	Rare--------	Brief-----	Jan-Apr	1.5-2.0	Perched	Jan-Apr	>60	---	Moderate	High.
Pt*: Pits.											
Dumps.											
Ro---------- Robertsville	D	Occasional	Brief-----	Dec-May	0-1.0	Perched	Jan-Apr	>60	---	High-----	High.
Wo---------- Woolper	C	Rare--------	---	---	>6.0	---	---	>60	---	Moderate	Low.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	Uncoated steel	Concrete
					Ft			In			
Zp---------- Zipp	C/D	Frequent----	Brief-----	Dec-May	0-1.0	Apparent	Dec-May	>60	---	High-----	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--CLASSIFICATION OF THE SOILS

[An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series]

Soil name	Family or higher taxonomic class
Allegheny	Fine-loamy, mixed, mesic Typic Hapludults
Cynthiana	Clayey, mixed, mesic Lithic Hapludalfs
Eden	Fine, mixed, mesic Typic Hapludalfs
Elk	Fine-silty, mixed, mesic Ultic Hapludalfs
Heitt	Fine, mixed, mesic Typic Hapludalfs
Licking	Fine, mixed, mesic Aquic Hapludalfs
Lowell	Fine, mixed, mesic Typic Hapludalfs
*McGary	Fine, mixed, mesic Aeric Ochraqualfs
Newark	Fine-silty, mixed, nonacid, mesic Aeric Fluvaquents
Nicholson	Fine-silty, mixed, mesic Typic Fragiudalfs
Nolin	Fine-silty, mixed, mesic Dystric Fluventic Eutrochrepts
Otwell	Fine-silty, mixed, mesic Typic Fragiudalfs
Robertsville	Fine-silty, mixed, mesic Typic Fragiaqualfs
Woolper	Fine, mixed, mesic Typic Argiudolls
Zipp	Fine, mixed, nonacid, mesic Typic Haplaquepts

☆ U.S. GOVERNMENT PRINTING OFFICE: 1980-299-862/74

NRCS Accessibility Statement

This document is not accessible by screen-reader software. The Natural Resources Conservation Service (NRCS) is committed to making its information accessible to all of its customers and employees. If you are experiencing accessibility issues and need assistance, please contact our Helpdesk by phone at 1-800-457-3642 or by e-mail at ServiceDesk-FTC@ftc.usda.gov. For assistance with publications that include maps, graphs, or similar forms of information, you may also wish to contact our State or local office. You can locate the correct office and phone number at http://offices.sc.egov.usda.gov/locator/app.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.