United States
Department of
Agriculture

Soil
Conservation
Service

In cooperation with
Ohio Department of
Natural Resources,
Division of Soil and Water
Conservation, and Ohio
Agricultural Research and
Development Center

Soil Survey of Noble County, Ohio

How To Use This Soil Survey

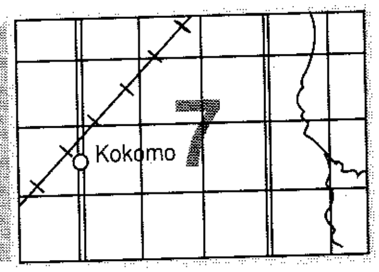
General Soil Map

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

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

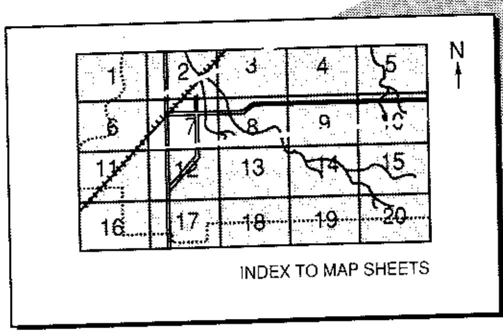
Detailed Soil Maps

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



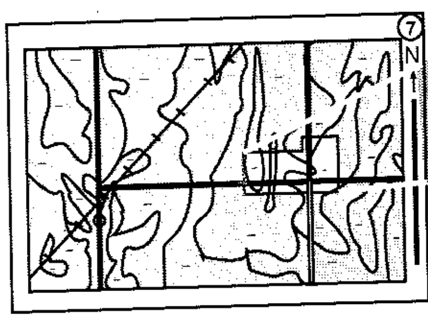
MAP SHEET

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

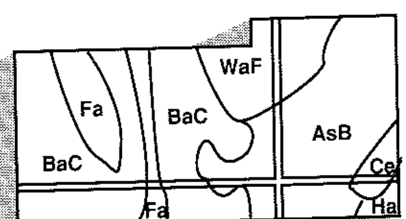


INDEX TO MAP SHEETS

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



MAP SHEET



AREA OF INTEREST

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

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

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1985. Soil names and descriptions were approved in 1986. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1986. This survey was made cooperatively by the Soil Conservation Service, the Ohio Department of Natural Resources, Division of Soil and Water Conservation, and the Ohio Agricultural Research and Development Center. It was funded in part by contributions from the local coal mining industry through local units of government. This survey is part of the technical assistance furnished to the Noble Soil and Water Conservation District.

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

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

Cover: A typical narrow valley in Noble County, Ohio. Nolin silt loam, frequently flooded, is on the flood plain, and Lowell and Gilpin soils are on the hillsides.

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Issued September 1990

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Foreword

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

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

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some soils have a limited depth 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.

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State Conservationist
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Soil Survey of Noble County, Ohio

By Dwain D. Waters and Linn E. Roth, Ohio Department of Natural Resources, Division of Soil and Water Conservation

Fieldwork by Dwain D. Waters, Linn E. Roth, and Timothy Wiaters, Ohio Department of Natural Resources, Division of Soil and Water Conservation

United States Department of Agriculture, Soil Conservation Service, in cooperation with Ohio Department of Natural Resources, Division of Soil and Water Conservation, and Ohio Agricultural Research and Development Center

General Nature of the County

NOBLE COUNTY is in the southeastern part of Ohio (fig. 1). The total area of the county is 254,976 acres, or 398 square miles. In 1980, the population was 11,310 *(19)*. Caldwell, the county seat and the largest town, had a population of 1,935. Batesville, Belle Valley, Dexter City, Sarahsville, and Summerfield are some of the other communities in the county. The county is in the unglaciated part of the Allegheny Plateau. Streams deeply dissect much of the upland areas, giving the county a hilly topography.

State and federal highways provide access to nearly all parts of the county. Interstate 77 is the main north-south route in the county, and Ohio Route 78, which passes through Caldwell and Summerfield, is the main east-west road. Ohio Route 147 links the northeastern part of the county to Barnesville in Belmont County.

Woodland covers about 46 percent of the acreage in the county, cropland about 12 percent, and pasture about 29 percent *(18)*. The acreage in woodland has been increasing as cropland and pasture are allowed to revert to native vegetation. Slope, erosion, and a slippage hazard are the main limitations for farming.

Figure 1.—Location of Noble County in Ohio.

History

Larry Ruthford, former Noble Soil and Water Conservation District technician, prepared this section.

Noble County, in 1851, was the last county formed in Ohio *(1)*. It was made up of land from parts of Monroe, Washington, Guernsey, and Morgan Counties. Settlers first entered what is now Noble County in the early 1800's. Most of them came from neighboring states east of Ohio. Some came from Europe in the 1840's and 1850's, however, and again in the early part of the 20th century. By 1880, the population of the county had reached about 21,000.

The main enterprise of those early settlers was farming, and the main crops were corn, tobacco (the major commercial crop), wheat, rye, and oats. The 1880 census of agriculture listed over 90,000 sheep and 12,000 cattle in the county.

A decline in the productivity of the intensively farmed steep hillsides combined with the availability of cheap fertile land to the west led to a decline in farming and population in the county. By 1900, the population was about 19,000.

Coal mining after 1900 in the area from Caldwell north through Belle Valley, Coal Ridge, and Ava resulted in a rapid increase in population in those areas, but by 1940 all the mines in those areas were closed. The rise of large industries and associated job opportunities in the northern cities of Ohio before and after World War II accelerated the population shift out of Noble County. In 1960, the population was about 10,500, only half of what it had been 80 years before.

Since 1960 the population has increased slightly, by about 9 percent, mainly because of the availability of jobs at small manufacturing plants in Caldwell and a road system that enables commuters to live in the county while working elsewhere.

Surface (strip) mining of coal began on a large scale after 1950. Almost 26,000 acres is mined for coal.

Physiography, Geology, Relief, and Drainage

Noble County is on the unglaciated, dissected Allegheny Plateau. The underlying bedrock is mainly shale, limestone, sandstone, siltstone, and coal.

The underlying sedimentary rocks are in the Conemaugh and Monongahela series of the Pennsylvanian System and in the Dunkard series of the Permian System. Because of a regional dip of the strata toward the southeast, the oldest beds are at the surface in the north-central part of the county and the younger and overlying members in the series outcrop progressively to the southeast. The main exposures of Conemaugh rocks are in a V-shaped area northward from Caldwell *(6)*. In the eastern and southeastern parts of the county, the Conemaugh is exposed in the deepest valleys. The areas of Monongahela exposures are divided into two parts by the valley of Duck Creek and its chief tributaries. West of that valley, the Monongahela series is exposed over much of Brookfield, Sharon, and Jackson Townships and the southwestern parts of Noble and Olive Townships. The eastern belt of exposures is in parts of every township in the eastern half of the county *(10)*. The main exposures of Permian System rock are on the high hills and ridges to the east and west of Duck Creek in the southwestern and southeastern parts of the county *(9)*.

The lacustrine sediments and alluvium in the stream valleys in the county consist of nonglacial deposits of the Pleistocene age that formed while water was ponded by ice and by downstream glacial-outwash dams *(13)*.

Noble County consists mainly of steep hills and ridges and many intervening valleys. The upland is rounded and slopes toward the valleys, providing little level land except along streams *(6)*. In the northern part of the county, flat-topped hills that have an elevation of about 1,000 feet are common. Adjacent to these but at a slightly lower elevation are broad, gently sloping, loess-covered ridgetops in the north-central and southwestern parts of the county.

The highest point in the county, in Beaver Township near the Belmont County line, is about 1,340 feet above sea level. The lowest point is along Duck Creek at the Washington County line, where the streambed is about 675 feet above sea level *(6)*.

A high ridge in the central part of the county is the divide between drainage to the Muskingum River and drainage to the Ohio River. The northern part of the county is drained by tributaries of Wills Creek, which flow into the Muskingum River. This is part of the Muskingum Watershed Conservancy District. Sharon and Jackson Townships, in the southwestern part of the county, are drained by branches of Olive Green Creek and other streams that empty into the Muskingum River. Much of the southern half of the county is drained to the Ohio River by Duck Creek and its three main branches—East, Middle, and West Forks.

Farming and Other Land Uses

The Soil and Water Conservation District Resource Inventory for Noble County shows about 87 percent of the county used for farms. Of the land used for farming, 46 percent is woodland, 29 percent is pasture, and 12 percent is cropland *(18)*. Nearly three-quarters of the cropland produces hay *(17)*. The other common crops are corn, wheat, oats, tobacco, and soybeans. Most of the cash receipts from the farms are from the sale of livestock and livestock products *(7)*. Most of the farms are managed by the owner, who typically resides on the farm. Most of the farmers work at least part-time off the farm *(17)*.

About 1 percent of the land in Noble County is in urban uses. Most of the commercial and industrial land is in or near Caldwell. Much of the most recent residential development is on the east side of Caldwell.

The creation of Seneca Lake in the Muskingum Watershed Conservancy District has spurred development of recreation areas in the county, including a number of privately owned areas and summer youth campgrounds that provide opportunities for camping, fishing, hiking, swimming, picnicking, and similar activities. Nonresidents own many lots near Seneca Lake. Wolf Run State Park, in the central part of the county, has sites for camping, fishing, hiking, and swimming. In the western part of the county, the Ohio Power Company has developed recreation areas on land that had been surface-mined.

Natural Resources

The major natural resources in Noble County are soil, coal, limestone, water, and oil and natural gas. Areas of various sizes throughout the county have been surface-mined, mainly for coal and limestone deposits of the Monongahela Formation. Wells and springs provide most of the water for rural domestic use. Most farms have one or more springs suitable for watering livestock.

Climate

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

Table 1 gives data on temperature and precipitation for the survey area as recorded at Caldwell, Ohio, in the period 1954 to 1981. 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 30 degrees F and the average daily minimum temperature is 20 degrees. The lowest temperature on record, which occurred at Caldwell on January 24, 1963, is -20 degrees. In summer, the average temperature is 71 degrees and the average daily maximum temperature is 83 degrees. The highest recorded temperature, which occurred at Caldwell on July 3, 1966, is 98 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.

The total annual precipitation is about 38 inches. Of this, nearly 23 inches, or 60 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 26 inches. The heaviest 1-day rainfall during the period of record was 3.84 inches at Caldwell on July 13, 1964. Thunderstorms occur on about 42 days each year.

The average seasonal snowfall is about 24 inches. The greatest snow depth at any one time during the period of record was 18 inches. On the average, 22 days of the year have at least 1 inch of snow 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 60 percent of the time possible in summer and 40 percent in winter. The prevailing wind is from the south-southwest. Average windspeed is highest, 11 miles per hour, in spring.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

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

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

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

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

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

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

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

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

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

Survey Procedures

The general procedures followed in making this survey are described in the National Soils Handbook of the Soil Conservation Service. The soil survey maps made for conservation planning on individual farms prior to the start of the project and the map "Geology of the Caldwell North Quadrangle" *(13)* were among the references used.

Before the actual fieldwork began, preliminary boundaries of slopes and landforms were plotted stereoscopically on aerial photographs taken in 1974 at a scale of 1:40,000 and enlarged to a scale of 1:15,840. U.S. Geological Survey topographic maps, at a scale of 1:24,000, helped the soil scientists to relate land and image features.

The soil scientists traversed the surface on foot, examining the soils. In areas such as the Nolin-Sarahsville-Omulga association of the general soil map, where the soil pattern is very complex, traverses were as close as 200 yards *(11)*. In areas such as the moderately steep to very steep hillsides of the Berks-Vandalia-Guernsey association, where land use is less intensive, traverses were about ¼ mile apart.

The soil scientists divided the landscape into segments based on use and management of the soils. A hillside would be separated from a terrace and a gently sloping ridgetop from a strongly sloping side slope. In most areas, soil examinations along the traverses were made 100 to 300 yards apart, depending on the landscape and soil pattern.

Observations of such items as landforms, blown-down trees, vegetation, roadbanks, bedrock highwalls in surface-mined areas, and animal burrows were made without regard to spacing. Soil boundaries were determined on the basis of soil examinations, observations, and photo interpretation. The soil material was examined with the aid of a ¾-inch diameter soil sampling tube, bucket auger, or a spade to a depth of about 4 feet or to bedrock if the bedrock was at a depth of less than 4 feet. Examinations of selected areas of deeper soils were made by using a truck-mounted, hydraulic soil coring rig to a depth of 8 feet or more. The pedons described as typical were observed and studied in pits that were dug with shovels, spades, and digging bars.

Soil mapping was recorded on the 1974 photo base maps and later transferred to film positive mylars of aerial photographs taken in 1982. Surface drainage was mapped in the field. Most cultural features were recorded from observations, but some were transferred from U.S. Geological Survey 7½-minute topographic maps.

At the beginning of the survey, sample areas were selected to represent the major landscape in the county. These areas were mapped at a rate roughly half that used in the rest of the county. Extensive notes were taken on the composition of map units in these preliminary study areas. As mapping progressed, these preliminary notes were modified and a final assessment of the composition of the individual map units was made. Many transects were made to determine the composition of soil complexes, such as the Gilpin-Upshur and Lowell-Gilpin complexes.

Samples for chemical and physical analyses and for analyses of engineering properties were taken from representative sites of several of the soils in the survey area. The chemical and physical analyses were made by the Soil Characterization Laboratory, Department of Agronomy, Ohio State University, Columbus, Ohio. The results of the analyses are stored in a computerized data file at the laboratory. The analyses of engineering properties were made by the Ohio Department of Transportation, Division of Highways, Bureau of Testing, Soils and Foundation Section, Columbus, Ohio. The laboratory procedures can be obtained by request from these two laboratories. The results of the studies can be obtained from the Department of Agronomy, Ohio State University, Columbus, Ohio; the Ohio Department of Natural Resources-Division of Soil and Water Conservation, Columbus, Ohio; and the state office of the Soil Conservation Service, Columbus, Ohio.

General Soil Map Units

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

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

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

Some soil boundaries and soil names in this survey do not fully match those in the surveys of adjoining counties that were published at an earlier date. Differences are the result of changes and refinement in series concepts and the application of the latest soil classification system.

Soil Descriptions

Soils on Uplands

These soils are on hillsides and ridgetops and make up about 93 percent of the county. They are deep and moderately deep, nearly level to very steep, and well drained and moderately well drained. Some large areas have been surface-mined for coal. Most areas are used as woodland, pasture, or cropland. Slope, erosion hazard, stoniness, bedrock at a depth of 20 to 40 inches, a high shrink-swell potential, seasonal wetness, droughtiness, slow or moderately slow permeability, and susceptibility to slippage are the major land-use limitations.

1. Lowell-Gilpin Association

Deep and moderately deep, strongly sloping to very steep, well drained soils formed in colluvium and residuum derived from limestone, siltstone, shale, and sandstone

This association is on dissected hillsides and narrow ridgetops. Small intermittent streams are in very narrow valleys. Springs and seeps are common, and hillside slips are in some areas. Slope ranges from 8 to 70 percent.

This association makes up about 32 percent of the county. The association is about 40 percent Lowell soils, 15 percent Gilpin soils, and 45 percent soils of minor extent (fig. 2).

Lowell soils are deep. Typically, the surface layer is very dark grayish brown silt loam or silty clay loam. The subsoil is yellowish brown and light yellowish brown silt loam, silty clay, and clay. Permeability is moderately slow, the available water capacity is moderate, and the organic matter content is moderate or moderately low.

Gilpin soils are moderately deep. Typically, the surface layer is dark grayish brown silt loam. The subsoil is brown silt loam and channery silt loam in the upper part and yellowish brown very channery silt loam in the lower part. Permeability is moderate, the available water capacity is low, and the organic matter content is moderately low.

The most extensive minor soils in this association are Chagrin, Dekalb, Nolin, and Upshur soils. Chagrin and Nolin soils formed in alluvium on flood plains. Dekalb and Upshur soils are in landscape positions similar to those of the Lowell and Gilpin soils. Dekalb soils have more coarse fragments in the subsoil than the Lowell and Gilpin soils. Upshur soils have redder colors in the subsoil.

This association is used mainly as pasture, cropland, or woodland. Most of the buildings and local roads are on the narrow ridgetops or in the narrow valleys. The steeper soils are generally unsuited to cropland,

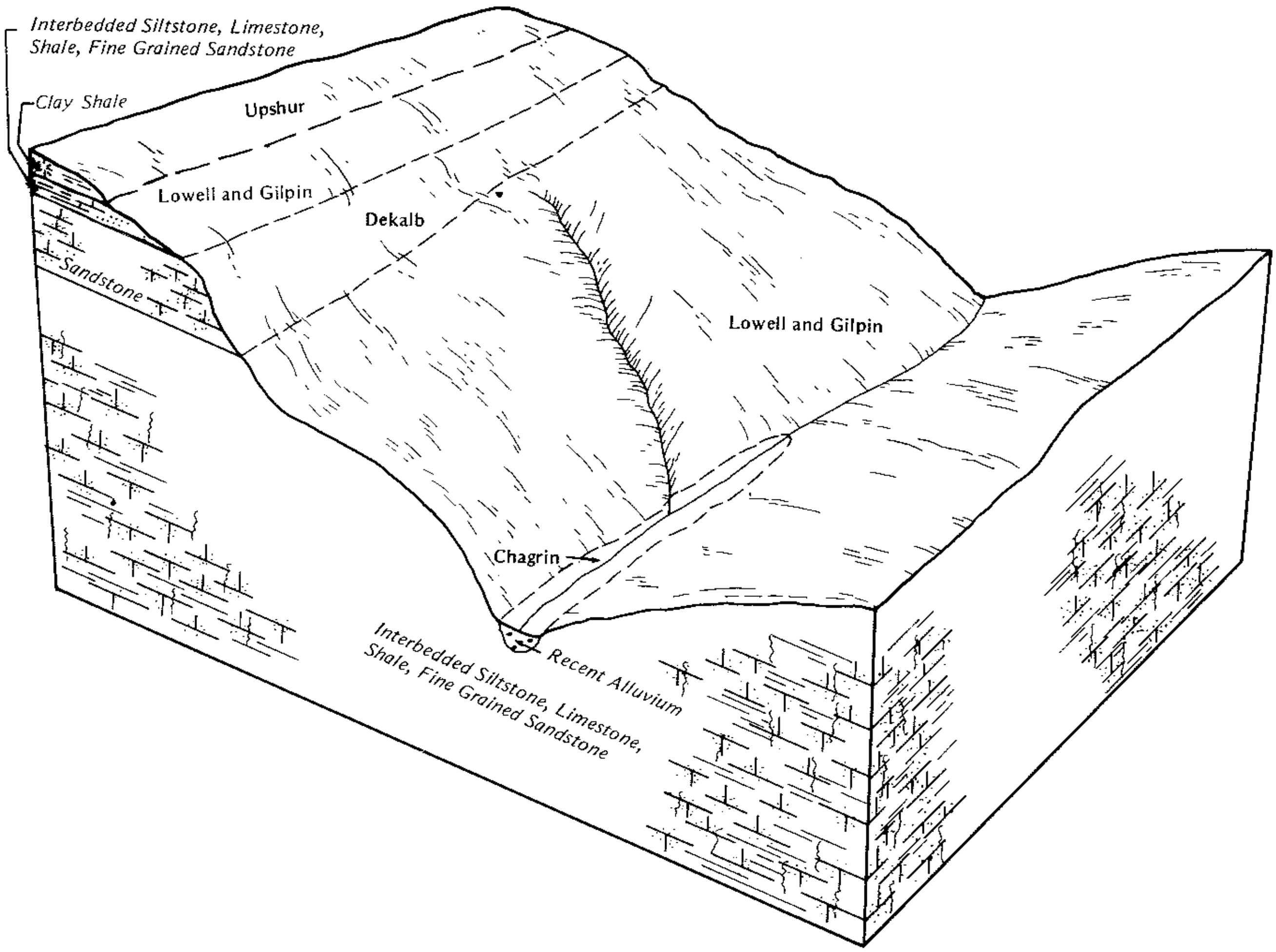

Figure 2.—Typical pattern of soils and parent material in the Lowell-Gilpin association.

pasture, and urban uses. They are well suited or moderately well suited to woodland. The strongly sloping soils on narrow ridgetops are moderately suited to corn, small grain, and building site development. They are well suited to hay, pasture, and woodland.

The major land-use limitations are slope, erosion hazard, droughtiness, moderately slow permeability, and bedrock between depths of 20 and 40 inches.

2. Gilpin-Enoch-Barkcamp Association

Moderately deep and deep, nearly level to very steep, well drained soils formed in siltstone, sandstone, and shale residuum and in ultra acid material mixed by surface mining

This association is on hillsides, ridgetops, and mine-spoil benches. Many areas have been surface mined. Spoil ridges and clifflike walls of exposed bedrock are common. Slope ranges from 0 to 70 percent.

This association makes up about 11 percent of the county. The association is about 45 percent Gilpin soils, 10 percent Enoch soils, 10 percent Barkcamp soils, and 35 percent soils of minor extent.

Gilpin soils are moderately deep and are strongly sloping to very steep. They are on ridgetops and hillsides. Typically, the surface layer is dark grayish brown silt loam. The subsoil is brown silt loam and channery silt loam in the upper part and yellowish brown very channery silt loam in the lower part. Permeability is moderate, the available water capacity is low, and the organic matter content is moderately low.

Enoch soils are deep and are nearly level to very steep. They are on spoil side slopes, ridgetops, and benches. Slips are on some hillsides. Typically, the surface layer is dark grayish brown shaly silty clay loam. The substratum is multicolored very shaly clay loam, very shaly loam, and very channery loam. These soils are very stony. Permeability is moderately slow, the available water capacity is low, and the organic matter content is very low.

Barkcamp soils are deep and are nearly level to very steep. They are on spoil ridgetops, benches, and side slopes. Typically, the surface layer is variegated brown and light gray channery sandy loam. The substratum is multicolored very channery sandy loam and extremely channery sandy loam. These soils are very stony. Permeability is moderately rapid or rapid, the available water capacity is low, and the organic matter content is very low.

The most extensive minor soils in this association are Brookside, Elba, Guernsey, Nolin, and Upshur soils in unmined areas. Brookside soils are on foot slopes and the lower parts of side slopes. Elba, Guernsey, and Upshur soils are on ridgetops and hillsides. Brookside, Elba, Guernsey, and Upshur soils have more clay in the subsoil than the major soils. Nolin soils formed in alluvium on flood plains.

The Gilpin soils in the unmined areas are used as cropland, pasture, or woodland. The mined areas are idle or are reverting to trees. Vegetation is sparse in those areas. The less sloping areas of the Gilpin soils are moderately suited to corn, small grain, and building site development. They are well suited to hay, pasture, and woodland. The steep areas of the Gilpin soils are generally unsuited to cropland, pasture, and urban uses. They are well suited or moderately suited to woodland. The Barkcamp and Enoch soils are generally unsuited to cropland and pasture. Some areas are suitable for urban uses after the soil has settled.

The major land-use limitations are slope, droughtiness, erosion hazard, and moderately slow permeability. Bedrock between depths of 20 and 40 inches in the Gilpin soils and the stoniness of the Barkcamp and Enoch soils are also limitations. The moderately rapid or rapid permeability of the Barkcamp soils causes a hazard of ground-water pollution in areas used for onsite waste disposal.

3. Berks-Vandalia-Guernsey Association

Moderately deep and deep, moderately steep to very steep, well drained and moderately well drained soils formed in residuum and colluvium derived from shale, siltstone, sandstone, and limestone

This association consists of dissected hillsides, foot slopes, and narrow ridgetops. Slopes are long, and some are benched. Hillside slips are common. Slope ranges from 15 to 70 percent.

This association makes up about 14 percent of the county. The association is about 35 percent Berks soils, 20 percent Vandalia soils, 10 percent Guernsey soils, and 35 percent soils of minor extent.

Berks soils are moderately deep, moderately steep to very steep, and well drained. They are on hillsides. Typically, the surface layer is brown shaly silt loam. The subsoil is yellowish brown very shaly silt loam and extremely shaly silt loam. Permeability is moderately rapid, the available water capacity is very low, and the organic matter content is moderately low.

Vandalia soils are deep, moderately steep and steep, and well drained. They are on foot slopes and on benches on side slopes. Typically, the surface layer is dark reddish brown silty clay loam. The subsoil is dark reddish brown and reddish brown silty clay. Permeability is moderately slow or slow, the available water capacity is moderate, and the organic matter content is moderately low. A seasonal high water table is at a depth of 48 to 72 inches during extended wet periods. The shrink-swell potential is high, and these soils are subject to hillside slippage.

Guernsey soils are deep, moderately steep and steep, and moderately well drained. They are on side slopes, on foot slopes, and on benches on hillsides. Typically, the surface layer is brown silt loam or silty clay loam. The subsoil is yellowish brown and brown silt loam in the upper part and dark yellowish brown and grayish brown, mottled silty clay and silty clay loam in the lower part. Permeability is moderately slow or slow, the available water capacity is moderate, and the organic matter content is moderate or moderately low. A seasonal high water table is at a depth of 24 to 42 inches during extended wet periods. The shrink-swell potential is high in the lower part of the subsoil and in the substratum, and these soils are subject to hillside slippage.

The most extensive minor soils in this association are Gilpin, Nolin, Sarahsville, and Zanesville soils. The moderately deep Gilpin soils are on hillsides and ridgetops. Nolin soils formed in alluvium on flood plains. The somewhat poorly drained Sarahsville soils are on low slackwater terraces and flood plains. Zanesville soils have a fragipan. They are on ridgetops.

This association is used for hay, pasture, or woodland. The soils are poorly suited or generally unsuited to cropland and urban development. The moderately steep soils are moderately suited to pasture, and the steep and very steep soils are generally unsuitable for this use. The soils are moderately suited or well suited to woodland.

The slope, bedrock between depths of 20 and 40 inches, the high shrink-swell potential, seasonal wetness, droughtiness, moderately slow or slow permeability, and erosion and slippage hazards are major land-use limitations. Cutting and filling increase the hazard of slippage.

4. Morristown-Lowell-Gilpin Association

Deep and moderately deep, nearly level to very steep, well drained soils formed in calcareous material mixed by surface mining and in colluvium and residuum derived from limestone, siltstone, sandstone, and shale

This association is in areas where coal mining has occurred. The landscape consists of hillsides and narrow to broad, undulating ridges. It is drained by small, intermittent drainageways that have narrow flood plains. Coal underlies much of the unmined part of the association, and most mined areas have not been regraded. Slips are common on the steeper slopes. Slope ranges from 0 to 70 percent.

This association makes up about 7 percent of the county. The association is about 50 percent Morristown soils, 15 percent Lowell soils, 10 percent Gilpin soils, and 25 percent soils of minor extent.

Morristown soils are deep and are nearly level to very steep. They are on mine-spoil ridgetops and hillsides. Typically, the surface layer is brown silty clay loam or channery silty clay loam. The substratum is multicolored channery silty clay loam and extremely channery silty clay loam. Permeability is moderately slow, the available water capacity is low, and the organic matter content is low or very low.

Lowell soils are deep and are strongly sloping to very steep. They are on ridgetops and hillsides. Typically, the surface layer is very dark grayish brown silt loam or silty clay loam. The subsoil is yellowish brown and light yellowish brown silt loam, silty clay, and clay. Permeability is moderately slow, the available water capacity is moderate, and the organic matter content is moderate or moderately low.

Gilpin soils are moderately deep and are strongly sloping to very steep. They are on hillsides and ridgetops. Typically, the surface layer is dark grayish brown silt loam. The subsoil is brown silt loam and channery silt loam in the upper part and yellowish brown very channery silt loam in the lower part. Permeability is moderate, the available water capacity is low, and the organic matter content is moderately low.

The most extensive minor soils in this association are Nolin, Upshur, Vandalia, and Zanesville soils. Nolin soils formed in alluvium on flood plains. Upshur soils are on ridgetops and hillsides. Vandalia soils are on foot slopes and on benches on side slopes. Upshur and Vandalia soils have redder colors in the subsoil than the major soils. Zanesville soils are on ridgetops. They have a fragipan.

The ridgetops in this association are commonly used as pasture or cropland, and the hillsides are wooded. In many areas the Morristown soils support grasses and are reverting to trees. They need sufficient time to settle before they are used for urban purposes. The less sloping parts of ridgetops are poorly suited or moderately suited to corn, small grain, and building site development. They are well suited or moderately suited to hay and pasture. The steeper soils are generally unsuited to cropland, pasture, and urban uses. The Lowell and Gilpin soils are well suited or moderately suited to woodland.

The slope, moderately slow permeability, bedrock between depths of 20 and 40 inches, droughtiness, and erosion hazard are major land-use limitations. Uneven settlement, slippage, and the droughtiness of the Morristown soils also limit use.

5. Guernsey-Elba-Berks Association

Deep and moderately deep, strongly sloping to steep, moderately well drained and well drained soils formed in colluvium and residuum derived from limestone, shale, siltstone, and sandstone

This association is on hillsides and narrow ridgetops. Slope ranges from 8 to 40 percent.

This association makes up about 7 percent of the county. The association is about 35 percent Guernsey soils, 30 percent Elba soils, 10 percent Berks soils, and 25 percent soils of minor extent.

Guernsey soils are deep, strongly sloping to steep, and moderately well drained. Typically, the surface layer is brown silt loam or silty clay loam. The subsoil is brown and yellowish brown silt loam in the upper part and dark yellowish brown and grayish brown, mottled silty clay and silty clay loam in the lower part. Permeability is slow or moderately slow, the available water capacity is moderate, and the organic matter content is moderate or moderately low. A seasonal high water table is at a depth of 24 to 42 inches during extended wet periods. The shrink-swell potential is high, and these soils are subject to hillside slippage.

Elba soils are deep, moderately steep and steep, and well drained. Typically, the surface layer is dark grayish brown silty clay loam. The subsoil is yellowish brown silty clay and shaly silty clay in the upper part and light olive brown and yellowish brown channery silty clay and very channery silty clay in the lower part. Permeability is slow, the available water capacity is moderate, and the organic matter content is moderately low or moderate. The shrink-swell potential is high.

Berks soils are moderately deep, strongly sloping to steep, and well drained. Typically, the surface layer is brown shaly silt loam. The subsoil is yellowish brown very shaly silt loam and extremely shaly silt loam. Permeability is moderate or moderately rapid, the available water capacity is very low, and the organic matter content is moderately low.

The most extensive minor soils in this association are Bethesda, Nolin, and Zanesville soils. Bethesda soils are in mined areas. They do not have a subsoil. Nolin soils formed in alluvium on narrow flood plains. Zanesville soils are on ridgetops. They have a fragipan.

This association is used as cropland, pasture, or woodland. The soils are well suited or moderately suited to woodland. The less sloping soils on ridgetops are moderately suited to corn, small grain, and building site development. They are well suited to hay and pasture. The steeper soils are generally unsuited to row crops, small grain, hay, and urban uses. They are poorly suited to pasture.

The slope, erosion hazard, moderately slow or slow permeability, seasonal wetness, the high shrink-swell potential, slippage hazard, droughtiness, and bedrock between depths of 20 and 40 inches are major land-use limitations.

6. Gilpin-Lowell-Upshur Association

Moderately deep and deep, strongly sloping to very steep, well drained soils formed in colluvium and residuum derived from siltstone, sandstone, shale, and limestone

The soils in this association are on hillsides and rounded ridgetops. Most slopes are long and have benches. Most areas are drained by small streams. Slope ranges from 8 to 70 percent.

This association makes up about 8 percent of the county. The association is about 35 percent Gilpin soils, 15 percent Lowell soils, 15 percent Upshur soils, and 35 percent soils of minor extent.

Gilpin soils are moderately deep and are strongly sloping to very steep. Typically, the surface layer is dark grayish brown silt loam. The subsoil is brown silt loam and channery silt loam in the upper part and yellowish brown very channery silt loam in the lower part. Permeability is moderate, the available water capacity is low, and the organic matter content is moderately low.

Lowell soils are deep and are strongly sloping to very steep. Typically, the surface layer is very dark grayish brown silt loam or silty clay loam. The subsoil is yellowish brown and light yellowish brown silt loam, silty clay, and clay. Permeability is moderately slow, the available water capacity is moderate, and the organic matter content is moderate or moderately low.

Upshur soils are deep and are strongly sloping to very steep. Typically, the surface layer is reddish brown silty clay, silt loam, or silty clay loam. The subsoil is reddish brown, red, and dark reddish brown silty clay. Permeability is slow, the available water capacity is moderate or low, and the organic matter content is low or moderately low. The shrink-swell potential is high in the subsoil, and these soils are subject to hillside slippage.

The most extensive minor soils in this association are Chagrin, Dekalb, Nolin, and Zanesville soils. Chagrin and Nolin soils formed in alluvium on flood plains. Dekalb soils are on ridgetops and hillsides. They have more coarse fragments in the subsoil than the major soils. Zanesville soils are on ridgetops. They have a fragipan.

This association is used as cropland, pasture, or woodland. The soils are well suited or moderately suited to woodland. The less sloping soils on ridgetops are moderately suited or poorly suited to corn, small grain, and building site development. Except where severely eroded, they are well suited or moderately suited to hay and pasture. The steeper soils are generally unsuited to row crops, small grain, hay, pasture, and urban uses.

The slope, erosion hazard, moderately slow or slow permeability, droughtiness, the high shrink-swell potential, slippage hazard, and bedrock between depths of 20 and 40 inches are major land-use limitations.

7. Upshur-Gilpin-Zanesville Association

Deep and moderately deep, nearly level to very steep, well drained and moderately well drained soils formed in loess and in colluvium and residuum derived from shale, siltstone, and sandstone

The soils in this association are on hillsides and narrow to broad ridgetops. Slope ranges from 1 to 70 percent.

This association makes up about 9 percent of the county. The association is about 40 percent Upshur soils, 20 percent Gilpin soils, 10 percent Zanesville soils, and 30 percent soils of minor extent.

Upshur soils are deep, gently sloping to very steep, and well drained. They are on ridgetops and hillsides. Typically, the surface layer is reddish brown silty clay, silt loam, or silty clay loam. The subsoil is reddish brown, red, and dark reddish brown silty clay. Permeability is slow, the available water capacity is moderate or low, and the organic matter content is low or moderately low. The shrink-swell potential is high in the subsoil, and these soils are subject to hillside slippage.

Gilpin soils are moderately deep, strongly sloping to very steep, and well drained. They are on ridgetops and hillsides. Typically, the surface layer is dark grayish brown silt loam. The subsoil is brown silt loam and channery silt loam in the upper part and yellowish brown very channery silt loam in the lower part. Permeability is moderate, the available water capacity is low, and the organic matter content is moderately low.

Zanesville soils are deep, nearly level to strongly sloping, and moderately well drained and well drained. They are on ridgetops. Typically, the surface layer is brown silt loam. The upper part of the subsoil is yellowish brown and brown silt loam and silty clay loam. The lower part is a fragipan of brown silty clay loam. Permeability is moderate above the fragipan and moderately slow or slow in the fragipan. The available water capacity is low, and the organic matter content is moderate. A perched seasonal high water table is at a depth of 24 to 36 inches during extended wet periods.

The most extensive minor soils in this association are Berks, Guernsey, Lowell, and Nolin soils. Berks, Guernsey, and Lowell soils are on hillsides and ridgetops. Berks soils have more coarse fragments in the subsoil than the major soils. Guernsey and Lowell soils are not as red in the subsoil as the Upshur soils and have more clay in the subsoil than the Gilpin and Zanesville soils. Nolin soils formed in alluvium on flood plains.

The wider ridgetops of this association are used as cropland or pasture. The hillsides are used dominantly as woodland. The soils are well suited or moderately well suited to woodland. The more nearly level parts of ridgetops are well suited or moderately suited to cropland, pasture, hay, and building site development. The steeper soils are generally unsuited to row crops, small grain, hay, pasture, and urban uses.

The slope, moderately slow or slow permeability, the high shrink-swell potential, droughtiness, seasonal wetness, bedrock between depths of 20 and 40 inches, and erosion and slippage hazards are major land-use limitations.

8. Guernsey-Vandalia-Elba Association

Deep, nearly level to very steep, moderately well drained and well drained soils formed in colluvium and residuum derived from limestone, shale, and siltstone

This association is on hillsides and ridgetops. Hillside slips are common. Slope ranges from 1 to 70 percent.

This association makes up about 5 percent of the county. The association is about 40 percent Guernsey soils, 25 percent Vandalia soils, 15 percent Elba soils, and 20 percent soils of minor extent.

Guernsey soils are nearly level to steep and are moderately well drained. They are on ridgetops and hillsides. Typically, the surface layer is brown silt loam or silty clay loam. The subsoil is brown and yellowish brown silt loam in the upper part and dark yellowish brown and grayish brown, mottled silty clay and silty clay loam in the lower part. Permeability is slow or moderately slow, the available water capacity is moderate, and the organic matter content is moderate or moderately low. A seasonal high water table is at a depth of 24 to 42 inches during extended wet periods. The shrink-swell potential is high, and these soils are subject to hillside slippage.

Vandalia soils are strongly sloping to steep and are well drained. They are on foot slopes, the lower parts of side slopes, and benches on side slopes. Typically, the surface layer is dark reddish brown silty clay loam. The subsoil is dark reddish brown and reddish brown silty clay. Permeability is moderately slow or slow, the available water capacity is moderate, and the organic matter content is moderately low. A seasonal high water table is at a depth of 48 to 72 inches during extended wet periods. The shrink-swell potential is high, and these soils are subject to hillside slippage.

Elba soils are moderately steep to very steep and are well drained. They are on ridgetops and hillsides. Typically, the surface layer is dark grayish brown silty clay loam. The subsoil is yellowish brown silty clay and shaly silty clay in the upper part and light olive brown channery silty clay and very channery silty clay in the lower part. Permeability is slow, the available water capacity is moderate, and the organic matter content is moderately low or low. The shrink-swell potential is high.

The most extensive minor soils in this association are Berks and Newark soils. Berks soils are on hillsides and ridgetops. They have more coarse fragments in the subsoil than the major soils. The somewhat poorly drained Newark soils are on flood plains.

This association is used as cropland, pasture, or woodland. The soils on the more nearly level parts of ridgetops are well suited or moderately suited to corn and small grain. They are well suited to hay and pasture and moderately suited to building site development. The steeper soils on hillsides are generally unsuited to cropland, pasture, and urban uses. The soils in this association are well suited or moderately suited to woodland.

The slope, erosion and slippage hazards, the high shrink-swell potential, seasonal wetness, and moderately slow or slow permeability are major land-use limitations.

Soils on Flood Plains and Terraces

These soils are in valleys and make up about 7 percent of the county. They are deep, nearly level to strongly sloping, and well drained to somewhat poorly drained. They are used mostly as cropland, pasture, or woodland or for building site development. Flooding, seasonal wetness, slow or very slow permeability, a high shrink-swell potential, and erosion hazard are the main land-use limitations.

9. Nolin-Sarahsville-Omulga Association

Deep, nearly level to strongly sloping, well drained to somewhat poorly drained soils formed in alluvium, lacustrine sediments, and loess

This association is on flood plains and terraces in valleys. Narrow stream channels cross some of the flood plains. Flooding occurs during extended rainy periods. Slope ranges from 0 to 15 percent.

This association makes up about 7 percent of the county. The association is about 45 percent Nolin soils, 20 percent Sarahsville soils, 10 percent Omulga soils, and 25 percent soils of minor extent.

Nolin soils are nearly level and well drained. They are on flood plains. Typically, the surface layer is brown silt loam. The subsoil is dark brown and dark yellowish brown silt loam. Permeability is moderate, the available water capacity is high, and the organic matter content is moderate. These soils are subject to frequent flooding. A seasonal high water table is at a depth of 36 to 72 inches during extended wet periods.

Sarahsville soils are nearly level and somewhat poorly drained. They are on low slackwater terraces and on flood plains. Typically, the surface layer is brown silty clay. The subsoil is strong brown and brown, mottled silty clay and silty clay loam. Permeability is very slow, the available water capacity is moderate, and the organic matter content is moderate. The shrink-swell potential is high. These soils are subject to frequent flooding. A seasonal high water table is at a depth of 12 to 30 inches during extended wet periods.

Omulga soils are nearly level to strongly sloping and are moderately well drained. They are on high terraces. Typically, the surface layer is brown silt loam. The upper part of the subsoil is yellowish brown, brown, and strong brown silt loam; the middle part is a fragipan of yellowish brown silty clay loam; and the lower part is yellowish brown silt loam. The subsoil is mottled below a depth of about 28 inches. Permeability is moderate above the fragipan and slow in the fragipan. The available water capacity and the organic matter content are moderate. A perched seasonal high water table is at a depth of 24 to 42 inches during extended wet periods.

The most extensive minor soils in this association are Chagrin, Guernsey, and Vandalia soils. Chagrin soils are on flood plains. They have more sand in the subsoil than the Nolin soils. Guernsey and Vandalia soils are on foot slopes and side slopes. They are better drained than the Sarahsville soils and have more clay in the subsoil than the Omulga soils.

This association is used as cropland, pasture, or woodland or for building site development. The soils have a wide range in suitability for different uses. The soils on flood plains and low slackwater terraces are generally unsuitable as sites for buildings. They are well suited or poorly suited to cropland, depending on drainage. The soils on high terraces are moderately well suited to building site development. They are well suited or moderately well suited to corn, wheat, and woodland and are well suited to hay and pasture.

Frequent flooding, seasonal wetness, slow or very slow permeability, erosion hazard, and the high shrink-swell potential are land-use limitations.

Detailed Soil Map Units

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

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

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

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

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, 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, Lowell silt loam, 8 to 15 percent slopes, is a phase of the Lowell 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, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Lowell-Upshur silty clay loams, 15 to 25 percent slopes, eroded, 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. The Pits component of the map unit Udorthents-Pits 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.

Some soil boundaries and soil names in this survey do not fully match those in the surveys of adjoining counties that were published at an earlier date. Most differences are the result of a better knowledge of soils or of modification and refinement of the concept of soil series. Some differences result from a predominance of different soils in map units consisting of soils of two or more series and from variations in the range in slope allowed within the map units in different surveys.

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

Soil Descriptions

BaB—Barkcamp channery sandy loam, 0 to 8 percent slopes, very stony. This soil is deep, nearly level and gently sloping, and well drained. It is mainly on mine-spoil benches and on a few mine-spoil ridgetops. These areas have been surface-mined for coal. Stones cover from less than 1 percent to 3 percent of the surface. They are rounded or angular and range in diameter from 10 inches to almost 4 feet. They are about 5 to 30 feet apart. The soil is a mixture of rock fragments and of partly weathered, ultra acid, fine earth material that was in or below the original soil. The rock fragments in the soil are mainly medium- and coarse-grained sandstone and smaller amounts of coal, carbonaceous shale, and siltstone. Slopes are dominantly smooth. Rills and small gullies are in some areas. Most areas of this soil are irregularly shaped and range from 10 to 100 acres.

Typically, the surface layer is variegated brown and light gray, very friable channery sandy loam about 7 inches thick. The substratum to a depth of about 72 inches is variegated brown, yellowish brown, and strong brown, friable very channery sandy loam and extremely channery sandy loam. Some small areas have layers that are less acid.

Included with this soil in mapping are small areas of Bethesda soils near high walls. These soils are less acid than the Barkcamp soil. Included soils make up about 5 percent of most areas.

Permeability is moderately rapid or rapid in the Barkcamp soil. Root growth is restricted to the upper few inches of the soil. The available water capacity is low. Runoff is slow or medium. The risk of corrosion is high for uncoated steel and concrete. The organic matter content is very low in the surface layer. Natural fertility also is very low.

Most areas of this soil are covered by sparse vegetation.

This soil is generally unsuited to corn, small grain, hay, pasture, and woodland because of a severe hazard of erosion, stoniness, limited depth of rooting, high acidity, and droughtiness. The soil is too acid to support most types of vegetation. Reducing the acidity, adding nutrients, and blanketing the soil with suitable soil material help to make the unit suitable for plants and trees. Some acid-tolerant plants are suitable if large amounts of sewage sludge, manure, fly ash, and soil material that was present before mining are incorporated into the soil. Stones interfere with the use of equipment. Establishing a plant cover as soon as possible after reclamation helps to control the erosion hazard. Reclaimed areas would be suitable for limited grazing, trees, and habitat for openland wildlife. Movement of soluble salts into the reclaimed surface layer, however, can lower the pH to the point where it is toxic to the plants.

Onsite investigation is needed to determine the suitability of the soil as a site for buildings and local roads. After settling, the soil is moderately suited or poorly suited to building site development. The thickness of the soil over bedrock, the stones on the surface, and the control of storm-water runoff are major concerns. The deeper areas usually require more time to settle. In a few places where the premining use was woodland, the hazard of subsidence is severe because of the buried trees and woody debris. Stones in and on the soil and sloughing of banks hinder excavation. Blanketing sites with a more suitable soil for lawns provides a favorable root zone, increases the available water capacity, and covers the stones on and in the soil.

This soil is moderately well suited to septic tank absorption fields. Settlement of the mine spoil and a hazard of ground-water contamination are the major concerns. Placing the absorption field in suitable fill material improves the filtering of effluent.

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

BaF—Barkcamp channery sandy loam, 25 to 70 percent slopes, very stony. This soil is deep, steep and very steep, and well drained. It is mainly on mine-spoil benches and a few mine-spoil side slopes and narrow mine-spoil ridges adjacent and parallel to a high wall. These areas have been surface-mined for coal. Most areas have not been graded. Stones larger than 1 foot in diameter are 5 to 10 feet apart on the surface, and boulders are common. The stones and boulders cover from less than 1 percent to 3 percent of the surface. The soil is a mixture of rock fragments and of partly weathered fine earth material that was in or below the original soil. The rock fragments, which are flat and round, are mainly medium- and coarse-grained sandstone and some siltstone and shale. Hillside slips are in some areas. Most areas of this soil are long and narrow and range from 10 to 30 acres.

Typically, the surface layer is yellowish brown, friable channery sandy loam about 5 inches thick. The substratum to a depth of about 72 inches is variegated yellowish brown, strong brown, and light yellowish brown, friable very channery sandy loam and extremely channery sandy loam.

Included with this soil in mapping are small areas of Bethesda soils near high walls. These soils are less acid than the Barkcamp soil. Included soils make up about 5 percent of most areas.

Permeability is moderately rapid or rapid in the Barkcamp soil. Root growth is restricted to the upper few inches of the soil. The available water capacity is low. Runoff is very rapid. The risk of corrosion is high for uncoated steel and concrete. The organic matter content is very low in the surface layer. Natural fertility also is very low.

Most areas of this soil are covered by sparse vegetation.

This soil is generally unsuited to cropland, pasture, and woodland because of the slope, a very severe hazard of erosion, stoniness, limited depth of rooting, and droughtiness. The soil is too acid to support most types of vegetation. Reducing the acidity, adding nutrients, and blanketing the soil with suitable soil material help to make the unit suitable for plants and trees. The stones and boulders interfere with the use of equipment.

This soil is generally unsuitable as a site for buildings and septic tank absorption fields because of the slope, the stoniness, instability, and the very severe erosion hazard. Sloughing is a hazard in excavations.

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

BkC—Berks shaly silt loam, 8 to 15 percent slopes. This soil is moderately deep, strongly sloping, and well drained. It is on ridgetops in the uplands. Slopes are convex or smooth. Most areas are long and narrow or oval and range from 5 to 20 acres. Rills are in some cultivated areas.

Typically, the surface layer is dark grayish brown, friable shaly silt loam about 4 inches thick. The subsoil is yellowish brown, friable very shaly silt loam about 20 inches thick. Fractured shale bedrock is at a depth of about 24 inches. In some places the depth to bedrock is less than 10 inches.

Included with this soil in mapping, in areas that have smooth slopes, are deep soils that have fewer rock fragments in the subsoil than the Berks soil. Also included are small areas of the moderately well drained Guernsey soils near the center of the broader ridgetops. A few seeps and springs are in these areas. Inclusions make up about 10 percent of most mapped areas.

Permeability is moderately rapid in the Berks soil. The root zone is moderately deep. The available water capacity is very low. Runoff is medium. In the surface layer, the content of organic matter is moderately low and tilth is good. The depth to bedrock is 20 to 40 inches.

Most areas of this soil are used for pasture, corn, small grain, hay, or woodland.

This soil is moderately suited to corn, small grain, and hay. It is droughty, however, and subject to erosion. The hazard of erosion is severe if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour stripcropping, and cover crops conserve moisture, reduce runoff, and help to control erosion. The shale fragments in the surface layer hinder tillage.

This soil is well suited to pasture. If the pasture is overgrazed or the soil is plowed during seedbed preparation, however, the hazard of erosion is severe. Proper stocking rates and rotation grazing help to prevent overgrazing and control erosion. No-till seeding also helps to control erosion. Timely applications of lime and fertilizer are needed.

This soil is moderately suited to trees. Seedling mortality is the main management concern. Using seedlings that have been transplanted once and mulching around the seedlings reduce seedling mortality.

This soil is moderately suited to building site development. The slope and the depth to bedrock are the major limitations. Designing the buildings so that they conform to the natural slope of the land helps to overcome the slope. The bedrock especially limits the soil as a site for dwellings with basements, but the bedrock commonly is rippable. Erosion is a hazard on construction sites. It can be controlled, however, by removing as little vegetation as possible, by mulching, and by establishing a temporary plant cover. Building local roads and streets on the contour and seeding road cuts also help to control erosion.

This soil is poorly suited to septic tank absorption fields because of the slope and the depth to bedrock. Installing the leach lines on the contour helps to prevent seepage of the effluent to the surface. The filtering capacity can be improved by installing the fields in suitable fill material.

The land capability classification is IIIe. The woodland ordination symbol is 4F.

BkD—Berks shaly silt loam, 15 to 25 percent slopes. This soil is moderately deep, moderately steep, and well drained. It is on ridgetops and side slopes in the uplands. Most areas are long and narrow or oval and range from 5 to 80 acres.

Typically, the surface layer is dark grayish brown, friable shaly silt loam about 3 inches thick. The subsoil is yellowish brown, friable very shaly silt loam about 28 inches thick. Fractured shale bedrock is at a depth of about 31 inches.

Included with this soil in mapping are small areas of the deep, moderately well drained Guernsey soils on slightly convex slopes and the deep Upshur soils on slopes that are similar to those of the Berks soil. A few seeps and springs are in the areas of Upshur soils. Inclusions make up about 10 percent of most mapped areas.

Permeability is moderately rapid in the Berks soil.

The root zone is moderately deep. The available water capacity is very low. Runoff is rapid. In the surface layer, the content of organic matter is moderately low and tilth is good. The depth to bedrock is 20 to 40 inches.

Most areas of this soil are wooded. Some areas are used for crops or pasture.

This soil is poorly suited to corn and moderately suited to hay. It is droughty and subject to erosion. The hazard of erosion is very severe if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour stripcropping, and cover crops conserve moisture, reduce runoff, and help to control erosion. The slope limits the use of some types of equipment, and the shale fragments in the surface layer hinder tillage.

This soil is moderately suited to pasture. If the pasture is overgrazed or the soil is plowed during seedbed preparation, however, the hazard of erosion is very severe. Proper stocking rates and rotation grazing help to prevent overgrazing and control erosion. No-till seeding also helps to control erosion. Timely applications of lime and fertilizer are needed.

This soil is moderately suited to trees. Coves and north- and east-facing slopes are especially suitable because they are cooler and less subject to evapotranspiration. Seedling mortality is the main management concern. Using seedlings that have been transplanted onoe and mulching around the seedlings reduce seedling mortality. The use of equipment, which is limited by the slope, increases the hazard of erosion. Building logging roads and skid trails on the contour helps to overcome the slope and control erosion.

This soil is poorly suited to building site development. The slope and the depth to bedrock are the major limitations. Designing the buildings so that they conform to the natural slope of the land helps to overcome the slope. The bedrock especially limits the soil as a site for dwellings with basements, but the bedrock commonly is rippable. Erosion is a hazard on construction sites. It can be controlled, however, by removing as little vegetation as possible, by mulching, and by establishing a temporary plant cover. Building local roads and streets on the contour and seeding road cuts also help to control erosion.

This soil is poorly suited to septic tank absorption fields because of the slope and the depth to bedrock. Installing the leach lines on the contour helps to prevent seepage of the effluent to the surface. The filtering capacity can be improved by installing the fields in suitable fill material.

The land capability classification is IVe. The woodland ordination symbol is 4R on north aspects and 3R on south aspects.

BkE—Berks shaly silt loam, 25 to 35 percent slopes. This soil is moderately deep, steep, and well drained. It is on hillsides in the uplands. Most areas are long and narrow or irregularly shaped and range from 10 to 200 acres.

Typically, the surface layer is dark grayish brown, friable shaly silt loam about 3 inches thick. The subsoil is yellowish brown, friable very shaly silt loam about 28 inches thick. Fractured siltstone bedrock is at a depth of about 31 inches. In some small areas the soil has fewer rock fragments in the subsoil.

Included with this soil in mapping are small areas of the deep, moderately well drained Guernsey soils on slightly concave slopes and the deep Upshur soils on benches. Slips are in some areas of the Upshur soils. Also included, on the lower parts of some hillsides, are strips of soils that are in the flood pool of Senecaville Lake. Inclusions make up about 10 percent of most mapped areas.

Permeability is moderately rapid in the Berks soil. The root zone is moderately deep. The available water capacity is very low. Runoff is very rapid. In the surface layer, the content of organic matter is moderately low and tilth is good. The depth to bedrock is 20 to 40 inches.

Most areas of this soil are wooded. Some areas are used for pasture.

This soil is poorly suited to pasture and generally unsuited to corn and small grain. It is droughty, and the hazard of erosion is very severe. Proper stocking rates and rotation grazing help to prevent overgrazing and control erosion. No-till seeding reduces the hazard of erosion, but a permanent plant cover is especially effective in controlling erosion.

This soil is moderately suited to trees. Coves and north- and east-facing slopes are especially suitable because they are cooler and less subject to evapotranspiration. Seedling mortality is the main management concern. Using seedlings that have been transplanted once and mulching around the seedlings reduce seedling mortality. The use of equipment, which is limited by the slope, increases the hazard of erosion. Building logging roads and skid trails on the contour helps to overcome the slope and control erosion.

This soil is generally unsuitable as a site for buildings or septic tank absorption fields. The slope and the depth to bedrock are the major limitations. Cutting and filling increase the hazard of hillside slippage in areas of the included Guernsey and Upshur soils.

The land capability classification is VIe. The woodland ordination symbol is 4R on north aspects and 3R on south aspects.

BkF—Berks shaly silt loam, 35 to 70 percent slopes. This soil is moderately deep, very steep, and well drained. It is on hillsides in the uplands. Most areas are long and narrow and range from 20 to 300 acres. Deep drainageways cross many of the areas.

Typically, the surface layer is brown, friable shaly silt loam about 3 inches thick. The subsoil is yellowish brown, friable very shaly and extremely shaly silt loam about 28 inches thick. The substratum is yellowish brown, friable extremely shaly silt loam. Light olive brown, fractured shale and siltstone bedrock is at a depth of about 31 inches.

Included with this soil in mapping are a few small areas of the deep, moderately well drained Guernsey soils on the slightly concave parts of slopes and the deep Upshur soils on benches. A few seeps, springs, and slips are in the areas of Guernsey and Upshur soils. Gullies are in some areas. Inclusions make up about 10 percent of most mapped areas.

Permeability is moderately rapid in the Berks soil. The root zone is moderately deep. The available water capacity is very low. Runoff is very rapid. The depth to bedrock is 20 to 40 inches.

Almost all areas of this soil are wooded.

This soil is generally unsuited to crops and pasture. Slope, erosion, and the restricted available water capacity are the major limitations.

This soil is moderately suited to trees. Coves and north- and east-facing slopes are better suited than other areas because they are cooler and less subject to evapotranspiration. Seedling mortality, slope, and erosion are the main management concerns. Using seedlings that have been transplanted once and mulching around the seedlings reduce seedling mortality. The use of equipment, which is limited by the slope, increases the hazard of erosion. Building logging roads and skid trails on the contour helps to overcome the slope and control erosion.

This soil is generally unsuitable as a site for buildings or septic tank absorption fields. The slope and the depth to bedrock are the major limitations. Some areas are suitable for recreation, but paths and trails that are not on the contour or that are not seeded or covered with resistant material are subject to erosion.

The land capability classification is VIIe. The woodland ordination symbol is 4R on north aspects and 3R on south aspects.

BnD—Bethesda silty clay loam, 15 to 25 percent slopes. This soil is deep, moderately steep, and well drained. It is in areas of mine spoil, mainly on side slopes and on a few benches and narrow ridgetops. These areas have been surface-mined for coal and then reclaimed by grading and by blanketing the surface with a layer of material removed from other soils. Small gullies and hillside slips are in some areas. Most areas of this soil are irregularly shaped and range from 5 to 30 acres.

Typically, the surface layer is very dark brown, firm silty clay loam about 5 inches thick. The substratum to a depth of about 72 inches is variegated brown, dark grayish brown, gray, and yellowish brown, firm very shaly silty clay loam and very shaly clay loam.

Included with this soil in mapping are barren areas of soils that have a large amount of sulfates. These areas range from 1 to 5 acres. Also included are strips of steep and very steep soils on side slopes. Included soils make up about 10 percent of most mapped areas.

Permeability is moderately slow in the Bethesda soil. The depth of the root zone varies widely because of differences in the density of the soil material. The available water capacity is low. Runoff is very rapid. In the surface layer, the content of organic matter is very low and tilth is poor.

Most areas of this soil are used as grassland. Some areas are used for grass-legume hay or small grain.

This soil is generally unsuited to corn and small grain. It is poorly suited to hay because of the slope, droughtiness, and a very severe hazard of erosion. The soil is a poor medium for roots; puddles and crusting are common. No-till seeding reduces the hazard of erosion, but a permanent plant cover is especially effective in controlling erosion.

This soil is poorly suited to pasture. The slope interferes with the use of equipment. Proper stocking rates and rotation grazing help to prevent overgrazing and control erosion. Restricted grazing during wet periods helps to prevent surface compaction. Ground cover and surface mulch reduce the runoff rate and the hazard of erosion and increase the rate of water intake.

This soil is suited to acid- and drought-tolerant trees that have a shallow root system. Erosion is a hazard if equipment is used. It can be controlled by building logging roads and skid trails on the contour and by establishing water bars. Grasses and legumes provide ground cover during the establishment of trees.

Onsite investigation is needed to determine the suitability of the soil as a site for buildings, septic tank absorption fields, and local roads. After settling, the soil is poorly suited to small buildings and to septic tank absorption fields because of the slope, the moderately slow permeability, and the susceptibility to hillside slippage. The thickness of the soil over bedrock and the control of storm-water runoff are major concerns. The deeper areas usually require more time to settle. In a few places where the premining use was woodland, the hazard of subsidence is severe because of the buried trees and woody debris. Designing the buildings so that they conform to the natural slope of the land helps to control erosion. Increasing the width of trenches in leach fields and laying out the distribution lines on the contour help to prevent seepage of the effluent to the surface. Cutting and filling increase the hazard of slippage, but installing drains in areas where water concentrates reduces this hazard.

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

BoB—Bethesda very shaly silty clay loam, 0 to 8 percent slopes. This soil is deep, nearly level and gently sloping, and well drained. It is in areas of mine spoil, mainly on benches and ridges and in basin-shaped areas between ridges. These areas have been surface-mined for coal. Rock fragments 1 to 5 inches long are throughout the soil, and a few stones are in and on the soil. Rills and small gullies are on some ridges, and pools of water are in some of the basins. Most areas of this soil are irregularly shaped and range from 10 to 150 acres.

Typically, the surface layer is brown, friable very shaly silty clay loam about 4 inches thick. The substratum to a depth of about 60 inches is yellowish brown, brown, and dark brown, friable very shaly silt loam, extremely shaly silt loam, and very shaly silty clay loam.

Included with this soil in mapping are barren areas where coal was stockpiled. Also included, in depressions, are small ponded areas. Inclusions make up about 5 percent of most mapped areas.

Permeability is moderately slow in the Bethesda soil. The depth of the root zone varies widely because of differences in the density of the soil material. The available water capacity is low. Runoff is slow or medium. In the surface layer, the content of organic matter is very low and tilth is poor.

Most areas of this soil are used as wildlife habitat or grassland. Some areas are used for grass-legume hay and small grain. Planted black locust and pines and volunteer hardwoods are in most areas.

This soil is generally unsuited to corn and small grain. It is poorly suited to hay. The soil is a poor medium for roots; puddles and crusting are common, and the surface layer is shaly. The hazard of erosion is very severe. A permanent plant cover is especially effective in controlling erosion. Because of uneven grading and settling, a surface drainage system is needed in some areas.

This soil is poorly suited to pasture. Proper stocking rates and rotation grazing help to prevent overgrazing and control erosion. Restricted grazing during wet periods helps to prevent surface compaction. Ground cover, surface mulch, and no-till seeding reduce the runoff rate and the hazard of erosion and increase the rate of water intake.

This soil is suited to acid- and drought-tolerant trees that have a shallow root system. The rock fragments in the soil interfere with mechanical planting. Grasses and legumes provide ground cover during the establishment of trees. Black locust, eastern white pine, red pine, red maple, sweetgum, and autumn-olive are suitable species for establishing wildlife habitat.

Onsite investigation is needed to determine the suitability of the soil as a site for buildings and local roads. After settling, the soil is moderately suited to use as a site for small buildings. The thickness of the soil over bedrock and the control of storm-water runoff are major concerns. The deeper areas usually require more time to settle. In a few places where the premining use was woodland, the hazard of subsidence is severe because of the buried trees and woody debris. Maintaining or establishing a plant cover and mulching help to control erosion. Blanketing sites with a more suitable soil for lawns provides a favorable root zone, increases the available water capacity, and covers the stones in and on the soil.

The restricted permeability makes this soil poorly suited to septic tank absorption fields. Enlarging the field helps to overcome this limitation.

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

BoF—Bethesda very shaly silty clay loam, 25 to 70 percent slopes. This soil is deep, steep and very steep, and well drained. It is in areas of mine spoil, mainly on side slopes. These areas have been surface-mined for coal, shale, or limestone. Rock fragments 1 to 5 inches long are throughout the soil, and a few stones are in and on the soil. Hillside slips are in most areas. Pools of water are in some valleys between the piles of spoil and are at the base of high walls. Most areas of this soil are long and narrow and range from 20 to 200 acres.

Typically, the surface layer is dark brown, friable very shaly silty clay loam about 4 inches thick. The substratum to a depth of about 72 inches is yellowish brown, brown, dark grayish brown, and gray, firm very shaly silty clay loam and very shaly clay loam.

Included with this soil in mapping are small areas of gently sloping or strongly sloping soils on ridgetops. Also included are barren areas of soils that have a large amount of sulfates; nearly vertical, high walls of rock; and strips of soils at the base of slopes in the flood pool of the Senecaville Dam. Inclusions make up about 15 percent of most mapped areas.

Permeability is moderately slow in the Bethesda soil. The depth of the root zone varies widely because of differences in the density of the soil material. The available water capacity is low. Runoff is very rapid. In the surface layer, the content of organic matter is very low and tilth is poor.

Most areas of this soil are used as wildlife habitat.

This soil is generally unsuited to farming because of the slope, droughtiness, and a very severe hazard of erosion.

This soil is suited to acid- and drought-tolerant trees that have a shallow root system. Grasses and legumes provide ground cover during the establishment of trees. Black locust, eastern white pine, red pine, red maple, sweetgum, and autumn-olive are suitable species for establishing wildlife habitat.

This soil generally is unsuitable as a site for small buildings and for septic tank absorption fields because of the slope, the moderately slow permeability, the susceptibility to hillside slippage, and the instability of the mine spoil. Cutting and filling increase the hazard of slippage, but installing drains in wet areas reduces this hazard.

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

BsC2—Brookside silt loam, 8 to 15 percent slopes, eroded. This soil is deep, strongly sloping, and moderately well drained. It is on foot slopes in the uplands. Erosion has removed part of the original surface layer. Slips and seeps are in some areas. Most areas of this soil are long and narrow and range from 5 to 60 acres.

Typically, the surface layer is very dark grayish brown, friable silt loam about 5 inches thick. The subsoil is brown, firm silty clay loam and silty clay about 45 inches thick. It is mottled at a depth of more than 18 inches. The substratum to a depth of about 60 inches is brown, mottled, firm silty clay. Some areas have a thicker subsoil and a darker surface layer.

Included with this soil in mapping are small areas of the moderately deep Gilpin soils on the upper parts of slopes. Included soils make up about 5 percent of most mapped areas.

Permeability is moderately slow in the Brookside soil. The root zone is deep. The available water capacity is moderate, and runoff is rapid. The shrink-swell potential is high. A perched seasonal high water table is at a depth of 30 to 48 inches during extended wet periods. The organic matter content is moderately low in the surface layer.

This soil is used mainly as pasture and cropland. Some areas are wooded.

This soil is poorly suited to corn and small grain because of the hazard of erosion, the slope, and uneven slopes near slips. It is moderately suited to hay. Contour stripcropping and no-till planting help to control erosion. A thick plant cover slows runoff. Subsurface drains in seeps reduce seasonal wetness and the hazard of slippage. The surface layer is crusty after hard rains. Crop residue management improves tilth and reduces crusting. Tilling when the soil is wet causes compaction and cloddiness.

This soil is moderately suited to pasture. Rotation grazing helps to maintain tilth and reduces the hazard of erosion. No-till seeding also helps to control erosion. Subsurface drains remove excess water from seeps. Some seeps can be developed as a source of stock water.

This soil is well suited to woodland. No major hazards or limitations affect planting or harvesting.

This soil is poorly suited to building site development because of the seasonal wetness, the high shrink-swell potential, and the slope. Designing the buildings so that they conform to the natural slope of the land helps to control erosion. Designing walls to include pilasters, reinforced concrete, and large-spread footings and backfilling around foundations with material that has a low shrink-swell potential help to prevent the damage caused by shrinking and swelling. Drains at the base of footings help keep basements dry.

This soil is poorly suited to septic tank absorption fields because of the restricted permeability, the slope, and the seasonal wetness. Installing the distribution lines on the contour helps to prevent seepage of the effluent to the surface. Subsurface drains upslope from the absorption field intercept seepage water. Increasing the width of trenches in the absorption field increases the rate of absorption.

Using a suitable base material under local roads reduces the damage caused by low strength and by shrinking and swelling.

The land capability classification is IIIe. The woodland ordination symbol is 5A.

BsD2—Brookside silt loam, 15 to 25 percent slopes, eroded. This soil is deep, moderately steep, and moderately well drained. It is on foot slopes and the lower parts of side slopes in the uplands. Erosion has removed part of the original surface layer. Slips, springs, and seeps are in places. Most areas of this soil are long and narrow and range from 30 to 100 acres.

Typically, the surface layer is brown, friable silt loam about 6 inches thick. The subsoil is yellowish brown and brown, firm silty clay about 44 inches thick. It is mottled in the lower part. The substratum to a depth of about 78 inches is light olive brown and olive brown, mottled, firm silty clay. Some areas have a thicker, darker surface layer.

Included with this soil in mapping are strips of soils on the lower parts of some slopes in the flood pool of the Senecaville Dam. These soils are subject to flooding. They make up about 15 percent of most mapped areas.

Permeability is moderately slow in the Brookside soil. The root zone is deep. The available water capacity is moderate, and runoff is very rapid. The shrink-swell potential is high. A perched seasonal high water table is at a depth of 30 to 48 inches during extended wet periods. The organic matter content is moderately low in the surface layer.

This soil is used mainly as pasture and cropland. Some areas are wooded.

This soil is poorly suited to corn, hay, and small grain because of a very severe erosion hazard, the slope, and uneven slopes near slips. The surface layer crusts after hard rains. A system of conservation tillage that leaves crop residue on the surface and contour stripcropping, grassed waterways, and cover crops help to control erosion. A thick plant cover slows runoff. Subsurface drains in seeps reduce seasonal wetness and the hazard of slippage. Crop residue management improves tilth and reduces crusting. Tilling when the soil is wet causes compaction and cloddiness. The slope and hillside slips limit the use of some types of equipment.

This soil is moderately suited to pasture. If the soil is overgrazed or is plowed during seedbed preparation, the hazard of erosion is very severe. Rotation grazing and proper stocking rates help to maintain tilth and reduce the hazard of erosion. No-till seeding also reduces the hazard of erosion. Subsurface drains remove excess water from seeps.

This soil is well suited to woodland. Coves and north- and east-facing slopes are especially suitable because they are cooler and less susceptible to evapotranspiration. The use of equipment, which is limited by the slope, increases the hazard of erosion. Building logging roads and skid trails on the contour helps to overcome the slope and control erosion. Water bars and a plant cover also help to control erosion.

This soil is generally unsuitable as a site for buildings or septic tank absorption fields because of the restricted permeability, the seasonal wetness, the high shrink-swell potential, hillside slippage, and the slope. Cutting and filling increase the hazard of slippage.

A drainage system and a suitable base material under local roads reduce the damage caused by hillside slippage and by shrinking and swelling. Establishing the roads on the contour and seeding road cuts help to control erosion.

The land capability classification is IVe. The woodland ordination symbol is 5R on north aspects and 4R on south aspects.

BtD2—Brookside-Vandalia complex, 15 to 25 percent slopes, eroded. This unit consists of deep, moderately steep soils on upland foot slopes below steep and very steep soils. Erosion has removed part of the original surface layer of the soils, and landslips and seeps are common. Most areas of these soils are long and narrow and range from 10 to 90 acres. They are about 50 percent moderately well drained Brookside soil and 45 percent well drained Vandalia soil. The two soils are so mixed or in areas so small that it was not practical to map them separately.

Typically, the surface layer of the Brookside soil is brown, friable silt loam about 6 inches thick. The subsoil is about 46 inches thick. The upper part is yellowish brown, friable silty clay loam. The lower part is brown and yellowish brown, mottled, firm silty clay and shaly silty clay. The substratum to a depth of about 78 inches is light olive brown and grayish brown, firm silty clay. It is mottled in the upper part. Some places have a thinner subsoil.

Typically, the surface layer of the Vandalia soil is brown, friable silty clay loam about 9 inches thick. The subsoil is about 41 inches thick. The upper part is reddish brown and dark reddish brown, firm silty clay. The lower part is dark reddish brown and dusky red, firm channery silty clay. The substratum to a depth of about 70 inches is dark reddish brown, firm channery silty clay.

Included with these soils in mapping are small areas of the moderately deep Gilpin soils on the convex parts of slopes. Included soils make up about 5 percent of most mapped areas.

Permeability is moderately slow in the Brookside soil and moderately slow or slow in the Vandalia soil. The root zone is deep in both soils, and the available water capacity is moderate. Runoff is very rapid. The shrink-swell potential is high. A perched seasonal high water table is at a depth of 30 to 48 inches in the Brookside soil and 48 to 72 inches in the Vandalia soil. The organic matter content is moderately low in the surface layer of both soils.

Most areas of these soils are used for corn or small grain or as pasture or woodland.

These soils are poorly suited to corn, small grain, and hay. The erosion hazard and the slope are major limitations. If the soils are cultivated, the hazard of erosion is very severe. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour stripcropping, and cover crops help to maintain tilth, reduce runoff, and control erosion. In some areas the slope limits the use of equipment. Subsurface drains are needed in scattered seep areas.

These soils are moderately suited to pasture. If the pasture is overgrazed or is plowed during seedbed preparation, the hazard of erosion is very severe. Proper stocking rates and rotation grazing help to prevent overgrazing and thus help to control erosion. No-till seeding also helps to control erosion. Restricted grazing during wet periods helps to prevent surface compaction.

These soils are well suited to woodland. The use of equipment, which is limited by the slope, increases the hazard of erosion. Building logging roads and skid trails on the contour helps to overcome the slope and reduces the hazard of erosion. Water bars and a plant cover also help to control erosion. Planting techniques that spread the roots of seedlings and increase soil-root contact reduce seedling mortality. Removing vines and the less desirable trees and shrubs helps to control plant competition.

These soils are generally unsuitable as sites for buildings or septic tank absorption fields because of the slope, moderately slow or slow permeability, the high shrink-swell potential, seasonal wetness, and slippage hazard. Maintaining or establishing a plant cover and mulching help to control erosion on construction sites.

The shrink-swell potential, slippage hazard, and low strength cause damage to local roads. A suitable base material and a drainage system, however, help to prevent this damage.

The land capability classification is IVe. The woodland ordination symbol for the Brookside soil is 5R on north aspects and 4R on south aspects. For the Vandalia soil, it is 4R on north and south aspects.

BtE2—Brookside-Vandalia complex, 25 to 35 percent slopes, eroded. This unit consists of deep, steep soils on the lower parts of upland side slopes below steep and very steep soils. Erosion has removed part of the original surface layer of the soils, and landslips and seeps are common. Most areas of these soils are long and narrow and range from 15 to 80 acres. They are about 50 percent moderately well drained Brookside soil and 40 percent well drained Vandalia soil. The two soils are so mixed or in areas so small that it was not practical to map them separately.

Typically, the surface layer of the Brookside soil is very dark grayish brown, friable silt loam about 5 inches thick. The subsoil is brown, firm silty clay loam and silty clay about 45 inches thick. It is mottled in the lower part. The substratum to a depth of about 60 inches is brown, mottled, firm channery silty clay.

Typically, the surface layer of the Vandalia soil is brown, friable silty clay loam about 2 inches thick. The subsurface layer is reddish brown, friable silty clay loam about 3 inches thick. The subsoil is reddish brown and dark reddish brown, firm silty clay about 45 inches thick. The substratum to a depth of about 60 inches is dark reddish brown, firm channery silty clay.

Included with these soils in mapping are small areas of the moderately deep Berks soils on the convex parts of slopes. Also included are strips of soils on the lower parts of slopes that are in the flood pool of the Senecaville Dam. These soils are subject to flooding. Included soils make up about 10 percent of most mapped areas.

Permeability is moderately slow in the Brookside soil and moderately slow or slow in the Vandalia soil. The root zone is deep in both soils, and the available water capacity is moderate. Runoff is very rapid. The shrink-swell potential is high. A perched seasonal high water table is at a depth of 30 to 48 inches in the Brookside soil and 48 to 72 inches in the Vandalia soil. The organic matter content is moderately low in the surface layer of both soils.

Most areas of these soils are used as pasture or woodland.

These soils are generally unsuited to corn, small grain, and hay. They are poorly suited to pasture. Erosion and the slope are major limitations. The slope limits the use of equipment. If the pasture is overgrazed or is plowed during seedbed preparation, the hazard of erosion is very severe. Proper stocking rates and rotation grazing help to prevent overgrazing and thus help to control erosion. No-till seeding also helps to control erosion. Restricted grazing during wet periods helps to prevent surface compaction.

These soils are well suited to woodland. The use of equipment, which is limited by the slope, increases the hazard of erosion. Building logging roads and skid trails on the contour helps to overcome the slope and reduces the hazard of erosion. Water bars and a plant cover also help to control erosion. Planting techniques that spread the roots of seedlings and increase soil-root contact reduce seedling mortality. Removing vines and the less desirable trees and shrubs helps to overcome plant competition. Harvesting methods that do not leave the remaining trees widely spaced or isolated help to prevent windthrow in areas of the Vandalia soil.

These soils are generally unsuitable as sites for buildings or septic tank absorption fields because of the slope, moderately slow or slow permeability, the high shrink-swell potential, seasonal wetness, and the slippage hazard.

The land capability classification is VIe. The woodland ordination symbol for the Brookside soil is 5R on north aspects and 4R on south aspects. For the Vandalia soil, it is 4R on north and south aspects.

Ch—Chagrin silt loam, occasionally flooded. This soil is deep, nearly level, and well drained. It is on flood plains. Slope ranges from 0 to 3 percent. Most areas are long and narrow and range from 300 to 800 acres.

Typically, the surface layer is brown, friable silt loam about 10 inches thick. The subsoil is dark yellowish brown and brown, friable stratified silt loam and loam about 38 inches thick. The substratum to a depth of about 63 inches is dark grayish brown and brown, mottled, friable silt loam. Some areas have more clay in the substratum.

Included with this soil in mapping are small areas of the somewhat poorly drained Newark soils in shallow depressions and old meander channels. Also included are areas of soils in the flood pool of Senecaville Lake. These soils are subject to frequent flooding of long duration. Included soils make up about 15 percent of most mapped areas.

Permeability is moderate in the Chagrin soil. The root zone is deep. The available water capacity is high. Runoff is slow. A seasonal high water table is at a depth of 48 to 72 inches during extended wet periods. In the surface layer, the content of organic matter is moderate and tilth is good.

Most areas of this soil are used for corn, hay, or pasture. Some areas are wooded.

This soil is well suited to corn and hay, especially if the crops are planted after the normal period of flooding instead of early in spring. Row crops can be grown year after year if the soil is intensively managed and if flooding is controlled or the crops are planted after the normal period of flooding. The soil is well suited to no-till planting and to other conservation tillage systems that leave a protective amount of crop residue on the surface. Floodwater sometimes leaves sediment on hayland and pasture, making the hay unsuitable for forage.

This soil is well suited to pasture. Rotation grazing and restricted grazing during wet periods help to keep the pasture in good condition. Surface compaction, poor tilth, and a decreased rate of infiltration result from overgrazing and from grazing during wet periods when the soil is soft. Mowing during the growing season increases the palatability of the pasture plants and helps to control weeds.

This soil is well suited to trees. Removing vines and the less desirable trees and shrubs helps to overcome plant competition.

This soil generally is unsuitable as a site for small buildings or septic tank absorption fields because of the flooding. It is well suited, however, to some kinds of recreational development, such as picnic areas and paths and trails. Local roads and streets can be constructed on fill material above the level of flooding. Instability is a hazard in excavated areas.

The land capability classification is IIw. The woodland ordination symbol is 5A.

DkE—Dekalb channery loam, 25 to 40 percent slopes. This soil is moderately deep, steep, and well drained. It is on hillsides and narrow ridgetops in the uplands. Most areas are long and narrow or oblong and range from 10 to 400 acres.

Typically, the surface layer is very dark grayish brown, friable channery loam about 4 inches thick. The subsoil is yellowish brown, friable very channery loam and very channery sandy loam about 35 inches thick. Sandstone bedrock is at a depth of about 39 inches. In some small concave areas on side slopes, the soils are deep and moderately well drained.

Included with this soil in mapping are small areas of the deep, moderately well drained Guernsey soils on the concave parts of side slopes. A few seeps and slips are in these areas. Inclusions make up about 15 percent of most mapped areas.

Permeability is rapid in the Dekalb soil. The root zone is moderately deep. The available water capacity is low or very low. Runoff is very rapid. In the surface layer, the content of organic matter is moderately low and tilth is good. The depth to bedrock is 20 to 40 inches.

Most areas of this soil are wooded. Some areas are used as pasture.

This soil is generally unsuited to corn, small grain, and hay. The slope, the erosion hazard, and the low or very low available water capacity are the major limitations.

This soil is poorly suited to pasture. The erosion hazard, droughtiness, and the slope are the major limitations. If the pasture is plowed during seedbed preparation or overgrazed, the hazard of erosion is very severe. A permanent plant cover is especially effective in controlling erosion. Proper stocking rates, no-till seeding, and rotation grazing also help to control erosion.

This soil is moderately suited to woodland. Coves and north- and east-facing slopes are especially suitable because they are cooler and less subject to evapotranspiration. Seedling mortality is the main management concern. Mulching around the seedlings reduces seedling mortality. The use of equipment, which is limited by the slope, increases the hazard of erosion. Building logging roads and skid trails on the contour helps to overcome the slope and reduces the hazard of erosion.

This soil generally is unsuitable as a site for buildings and septic tank absorption fields because of the slope, the depth to bedrock, and a poor filtering capacity. Constructing local roads across the slope reduces the angle of incline and thus helps to control erosion.

The land capability classification is VIe. The woodland ordination symbol is 4R on north aspects and 3R on south aspects.

DkF—Dekalb channery loam, 40 to 70 percent slopes. This soil is moderately deep, very steep, and well drained. It is on hillsides in the uplands. In some areas it is dissected by deep drainageways. Most areas are long and narrow and range from 5 to 250 acres.

Typically, the surface layer is very dark grayish brown, friable channery loam about 3 inches thick. The subsoil is about 19 inches thick. It is yellowish brown, brown, dark yellowish brown, and friable. The upper part of the subsoil is channery and very channery loam, and the lower part is very channery sandy loam. The substratum is yellowish brown, very friable extremely channery sandy loam. Fractured, light yellowish brown, hard sandstone bedrock is at a depth of about 34 inches.

Included with this soil in mapping are small areas of Gilpin soils on the upper parts of hillsides. These soils have a higher content of clay and a lower content of sandstone fragments in the subsoil than the Dekalb soil. Included soils make up about 15 percent of most mapped areas.

Permeability is rapid in the Dekalb soil. The root zone is moderately deep. The available water capacity is low or very low. Runoff is very rapid. Bedrock is at a depth of 20 to 40 inches.

Almost all areas of this soil are wooded.

This soil is generally unsuited to corn, small grain, hay, and pasture. The slope, the erosion hazard, and the low or very low available water capacity are the major limitations.

This soil is moderately suited to woodland. Coves and north- and east-facing slopes are especially suitable because they are cooler and less subject to evapotranspiration. Seedling mortality is the main management concern. Mulching around the seedlings reduces seedling mortality. The use of equipment, which is limited by the slope, increases the hazard of erosion. Building logging roads and skid trails on the contour helps to overcome the slope and reduces the hazard of erosion. Water bars and a plant cover also help to control erosion.

This soil generally is unsuitable as a site for buildings and septic tank absorption fields because of the slope, the depth to bedrock, and a poor filtering capacity. Erosion can be controlled by building local roads on the contour and by seeding road cuts.

The land capability classification is VIIe. The woodland ordination symbol is 4R on north aspects and 3R on south aspects.

EbD2—Elba silty clay loam, 15 to 25 percent slopes, eroded. This soil is deep, moderately steep, and well drained. It is on ridgetops and side slopes in the uplands. Erosion has removed part of the original surface layer. Most areas are long and narrow and range from 10 to 30 acres.

Typically, the surface layer is brown, firm silty clay loam about 7 inches thick. The subsoil is about 41 inches thick. It is yellowish brown, firm silty clay in the upper part and light olive brown and yellowish brown, firm channery silty clay in the lower part. Light gray limestone bedrock is at a depth of about 48 inches.

Included with this soil in mapping, on shoulder slopes, are strips of soils that have limestone bedrock at a depth of less than 2 feet. Also included are small areas of Vandalia soils. Vandalia soils have redder colors in the subsoil than the Elba soil. Included soils make up about 10 percent of most mapped areas.

Permeability is slow in the Elba soil. The root zone is deep. The available water capacity is moderate. Runoff is very rapid. The shrink-swell potential is high. In the surface layer, the content of organic matter is moderately low or moderate and tilth is fair.

Most areas of this soil are used for corn, small grain, hay, or pasture. A few areas are wooded.

This soil is moderately suited to hay and pasture and poorly suited to corn, soybeans, and small grain. The erosion hazard is severe, and the soil can be worked only within a narrow range in moisture content. The surface is crusty, and puddles are common after hard rains. If plowed when wet and sticky, the soil becomes very cloddy. A system of conservation tillage that leaves crop residue on the surface, cover crops, and grassed waterways help to control runoff and erosion. Incorporating crop residue or other organic matter into the surface layer improves tilth, increases the rate of water infiltration, and helps to prevent surface crusting. Surface compaction, reduced growth, and increased runoff result from overgrazing or from grazing during wet periods when the soil is soft and sticky. Proper stocking rates, proper plant selection, rotation grazing, and timely deferment of grazing are needed.

This soil is well suited to woodland. Coves and north- and east-facing slopes are especially suitable because they are cooler and less subject to evapotranspiration. Seedling mortality is the main management concern. Mulching around the seedlings reduces seedling mortality. The use of equipment, which is limited by the slope, increases the hazard of erosion. Building logging roads and skid trails on the contour helps to overcome the slope and reduces the hazard of erosion. Water bars and a plant cover also help to control erosion. Harvesting methods that do not leave the remaining trees widely spaced or isolated help to prevent windthrow.

This soil generally is unsuitable as a site for buildings with basements and for septic tank absorption fields because of the slope, the depth to bedrock, the restricted permeability, and the shrink-swell potential. The soil is poorly suited as a site for buildings without basements. Designing walls to include pilasters, reinforced concrete, and large-spread footings and backfilling around foundations with material that has a low shrink-swell potential help to prevent the damage caused by shrinking and swelling.

Building local roads on the contour reduces the angle of incline and thus helps to control erosion. Providing a suitable base material reduces the damage caused by shrinking and swelling and by low strength.

The land capability classification is IVe. The woodland ordination symbol is 3R.

EbE2—Elba silty clay loam, 25 to 40 percent slopes, eroded. This soil is deep, steep, and well drained. It is on ridgetops and hillsides in the uplands. Erosion has removed part of the original surface layer. Hillside slips and gullies are in some areas. Most areas of this soil are long and narrow and range from 10 to 60 acres.

Typically, the surface layer is dark grayish brown, friable silty clay loam about 2 inches thick. The subsurface layer is brown, firm silty clay loam about 3 inches thick. The subsoil is about 43 inches thick. It is yellowish brown, firm silty clay and shaly silty clay in the upper part and light olive brown and yellowish brown, firm channery silty clay and very channery silty clay in the lower part. Light gray, fractured, hard limestone bedrock is at a depth of about 48 inches.

Included with this soil in mapping, on shoulder slopes, are strips of soils that have limestone bedrock at a depth of less than 2 feet. Also included are small areas of Vandalia soils. Vandalia soils have redder colors in the subsoil than the Elba soil. Included soils make up about 10 percent of most mapped areas.

Permeability is slow in the Elba soil. The root zone is deep. The available water capacity is moderate. Runoff is very rapid. The shrink-swell potential is high. The content of organic matter is moderately low or moderate in the surface layer.

Most areas of this soil are used as pasture or woodland.

This soil is generally unsuited to crops and poorly suited to pasture. The erosion hazard is very severe. Rotation grazing, proper stocking rates, and a thick plant cover help to control erosion. Mulching gullies and slips helps to prevent further erosion.

This soil is moderately suited to woodland. Coves and north- and east-facing slopes are especially suitable because they are cooler and less subject to evapotranspiration. Seedling mortality is the main management concern. Mulching around the seedlings and using planting methods that ensure adequate soil-root contact reduce seedling mortality. The use of equipment, which is limited by the slope, increases the hazard of erosion. Building logging roads and skid trails on the contour helps to overcome the slope and reduces the hazard of erosion. Water bars and a plant cover also help to control erosion. Frequent, light thinning and harvesting help to prevent windthrow.

This soil generally is unsuitable as a site for buildings or septic tank absorption fields because of the slope, the depth to bedrock, the slow permeability, and the shrink-swell potential. Establishing paths and trails on the contour and covering them with resistant material help to control erosion.

The land capability classification is VIe. The woodland ordination symbol is 3R.

EbF2—Elba silty clay loam, 40 to 70 percent slopes, eroded. This soil is deep, very steep, and well drained. It is on hillsides in the uplands. Erosion has removed part of the original surface layer. Hillside slips are in some areas. Most areas of this soil are long and wide and range from 50 to 100 acres.

Typically, the surface layer is brown, friable silty clay loam about 4 inches thick. The subsoil is yellowish brown and light olive brown, friable silty clay loam and firm channery clay about 41 inches thick. The substratum is olive brown, firm channery silty clay about 10 inches thick. Light gray, fractured limestone bedrock is at a depth of about 55 inches.

Included with this soil in mapping, on shoulder slopes, are small areas of soils that have limestone bedrock at a depth of less than 2 feet. Also included are small areas of Vandalia soils. Vandalia soils have redder colors in the subsoil than the Elba soil. Included soils make up about 15 percent of most mapped areas.

Permeability is slow in the Elba soil. The root zone is deep. The available water capacity is moderate. Runoff is very rapid. The shrink-swell potential is high.

Most areas of this soil are wooded.

This soil is generally unsuited to farming. It is moderately suited to woodland. Coves and north- and east-facing slopes are especially suitable because they are cooler and less subject to evapotranspiration. Seedling mortality is the main management concern. Mulching around the seedlings and using planting methods that ensure adequate soil-root contact reduce seedling mortality. The use of equipment, which is limited by the slope, increases the hazard of erosion. Building logging roads and skid trails on the contour helps to overcome the slope and reduces the hazard of erosion. Water bars and a plant cover also help to control erosion. Frequent, light thinning and harvesting help to prevent windthrow.

This soil generally is unsuitable as a site for buildings or septic tank absorption fields because of the slope, the depth to bedrock, the slow permeability, and the shrink-swell potential. Placing paths and trails on the contour and covering them with resistant material help to control erosion.

The land capability classification is VIIe. The woodland ordination symbol is 3R.

EdD2—Elba-Guernsey silty clay loams, 15 to 25 percent slopes, eroded. This unit consists of deep, moderately steep soils on hillsides in the uplands. Erosion has removed part of the original surface layer. Landslips with a few feet of microrelief are in most areas. Most areas of these soils are long and are 200 to 1,000 feet wide. They range from 80 to 200 acres. This unit is about 40 percent well drained Elba soil and 40 percent moderately well drained Guernsey soil. The two soils are so mixed or in areas so narrow that it was not practical to map them separately.

Typically, the surface layer of the Elba soil is brown, friable silty clay loam about 7 inches thick. The subsoil is about 41 inches thick. It is yellowish brown, firm silty clay in the upper part and brown, light olive brown, and yellowish brown, firm channery silty clay in the lower part. Light gray limestone bedrock is at a depth of about 48 inches.

Typically, the surface layer of the Guernsey soil is brown, friable silty clay loam about 5 inches thick. The subsoil is brown, firm silty clay about 49 inches thick. It is mottled in the lower part. The substratum is yellowish brown, mottled, firm clay about 26 inches thick. Clay shale is at a depth of about 80 inches.

Included with these soils in mapping are strips of soils on the lower parts of hillsides that are in the flood pool of Senecaville Lake. These soils are subject to flooding. Also included are small areas of the moderately deep Gilpin soils on the upper parts of slopes and strips of severely eroded soils that have a silty clay surface layer in which tilth is poor. Included soils make up about 20 percent of most mapped areas.

Permeability is slow in the Elba soil and slow or moderately slow in the Guernsey soil. The available water capacity is moderate in both soils. Runoff is very rapid. The shrink-swell potential is high in the subsoil of both soils. The Guernsey soil has a seasonal high water table between depths of 24 and 42 inches during extended wet periods. In the surface layer of both soils, the content of organic matter is moderately low and tilth is fair.

Most areas of these soils are used for corn, small grain, pasture, or woodland.

These soils are poorly suited to corn, small grain, and hay because of the slope and a very severe erosion hazard in cultivated areas. Row crops can be grown about once every 4 years. A conservation tillage system that leaves crop residue on the surface reduces the hazard of erosion and improves tilth. No-till farming also is effective on these soils. The slope and the hillside slips hinder the use of equipment. Land smoothing reduces surface microrelief in most areas, and subsurface drains are needed in seep areas.

These soils are moderately suited to pasture. This use helps to protect the soils and reduces the hazard of erosion. Unless they are smoothed, the slips hinder mowing. Ponding is common in gouges caused by the slips.

These soils are well suited to woodland. Seedling mortality is the main management concern. Mulching around the seedlings and using planting methods that ensure adequate soil-root contact reduce seedling mortality. The use of equipment, which is limited by the slope, increases the hazard of erosion. Building logging roads and skid trails on the contour helps to overcome the slope and reduces the hazard of erosion. Water bars and a plant cover also help to control erosion. Frequent, light thinning and harvesting help to prevent windthrow on the Elba soil. Removing vines and the less desirable trees and shrubs helps to control plant competition in areas of the Guernsey soil.

These soils are generally unsuitable as sites for buildings and septic tank absorption fields because of the slope, restricted permeability, the shrink-swell potential, and the seasonal wetness and slippage hazard in areas of the Guernsey soil.

The land capability classification is IVe. The woodland ordination symbol is 3R for the Elba soil and 4R for the Guernsey soil.

EdE2—Elba-Guernsey silty clay loams, 25 to 35 percent slopes, eroded. This unit consists of deep, steep soils on hillsides in the uplands. Erosion has removed part of the original surface layer. Landslips with a few feet of microrelief are in most areas. Most areas of these soils are long and are 200 to 1,000 feet wide. They range from 80 to 200 acres. This unit is about 50 percent well drained Elba soil and 40 percent moderately well drained Guernsey soil. The two soils are so mixed or in areas so narrow that it was not practical to map them separately.

Typically, the surface layer of the Elba soil is dark brown, friable silty clay loam about 4 inches thick. The subsoil is about 44 inches thick. It is dark yellowish brown and brown, firm silty clay and channery silty clay. Light gray, fractured limestone bedrock is at a depth of about 55 inches.

Typically, the surface layer of the Guernsey soil is brown, friable silty clay loam about 6 inches thick. The subsoil is yellowish brown, firm silty clay about 46 inches thick. It is mottled in the lower part. The substratum to a depth of about 72 inches is gray and light brownish gray, firm channery silty clay.

Included with these soils in mapping are strips of soils on the lower parts of hillsides that are in the flood pool of Senecaville Lake. These soils are subject to flooding. Also included are small areas of the moderately deep Gilpin soils on the upper parts of slopes, strips of severely eroded soils that have a silty clay surface layer in which tilth is poor, and small areas of somewhat poorly drained soils in seeps. Included soils make up about 10 percent of most mapped areas.

Permeability is slow in the Elba soil and slow or moderately slow in the Guernsey soil. The available water capacity is moderate in both soils. Runoff is very rapid. The shrink-swell potential is high in the subsoil of both soils. The Guernsey soil has a seasonal high water table between depths of 24 and 42 inches during extended wet periods. In the surface layer of both soils, the content of organic matter is moderately low and tilth is fair.

Most areas of this unit are used as pasture or woodland.

These soils are generally unsuited to crops and poorly suited to pasture because of the slope and a very severe erosion hazard if the soils are cultivated or overgrazed. Pasture grasses help to protect the soils and reduce the hazard of erosion. Unless they are smoothed, the slips hinder mowing. Ponding is common in gouges caused by the slips. The main pasture plants are bluegrass and ladino clover.

These soils are moderately suited to woodland. Seedling mortality is the main management concern. Mulching around the seedlings and using planting methods that ensure adequate soil-root contact reduce seedling mortality. The use of equipment, which is limited by the slope, increases the hazard of erosion. Building logging roads and skid trails on the contour helps to overcome the slope and reduces the hazard of erosion. Water bars and a plant cover also help to control erosion. Frequent, light thinning and harvesting help to prevent windthrow in areas of the Elba soil. Removing vines and the less desirable trees and shrubs helps to control plant competition in areas of the Guernsey soil.

These soils are generally unsuitable as sites for buildings and septic tank absorption fields because of the slope, restricted permeability, the shrink-swell potential, and the seasonal wetness and slippage hazard in areas of the Guernsey soil.

The land capability classification is VIe. The woodland ordination symbol is 3R for the Elba soil and 4R for the Guernsey soil.

EnB—Enoch shaly silty clay loam, 0 to 8 percent slopes, very stony. This soil is deep, nearly level and gently sloping, and well drained. It is mainly on mine-spoil benches and a few mine-spoil ridgetops. These areas have been surface-mined for coal. Stones cover from less than 1 percent to 3 percent of the surface. They are rounded or angular and range in diameter from 10 inches to almost 4 feet. They are about 5 to 30 feet apart. The soil is a mixture of rock fragments and partly weathered soil that was in or below the original soil. Slopes are dominantly smooth. Rills and small gullies are in some areas, and seeps from coal outcrops are in other areas. Most areas of this soil are long and narrow and range from 10 to 100 acres.

Typically, the surface layer is dark grayish brown, friable shaly silty clay loam about 7 inches thick. The substratum to a depth of about 60 inches is variegated gray, black, very dark gray, and yellowish brown, firm very shaly clay loam, very firm very shaly loam, and friable very channery loam.

Included with this soil in mapping are small areas of Bethesda soils near high walls. These soils are less acid throughout than the Enoch soil. Included soils make up about 5 percent of most mapped areas.

Permeability is moderately slow in the Enoch soil. The depth of the root zone varies widely because of differences in the density of the soil material, but it is generally very shallow. The available water capacity is low. Runoff is slow or medium. The risk of corrosion is high for uncoated steel and concrete. The organic matter content is very low in the surface layer. Natural fertility also is very low.

Most areas of this soil have a sparse plant cover.

This soil is generally unsuited to cropland, pasture, and woodland because of the hazard of erosion, droughtiness, stoniness, a limited root zone, and a high level of acidity. Lowering the acidity level, adding nutrients, and replacing the soil are the only practices that will make the unit suitable for plants and trees. Some acid-tolerant plants are suitable if large amounts of sewage sludge, manure, fly ash, and soil materials that were present before mining are incorporated into the soil. Reclaimed areas are suited to grasses, trees, and wildlife habitat, but careful management is needed. Establishing a plant cover as soon as possible after reclamation helps to control erosion.

Onsite investigation is needed to determine the suitability of the soil as a site for buildings and local roads. After settling, the soil is moderately suited or poorly suited to small buildings. The thickness of the soil over bedrock, surface stoniness, and the control of storm-water runoff are major management concerns. The deeper areas usually require more time to settle. In a few places where the premining use was woodland, the hazard of subsidence is severe because of the buried trees and woody debris. Maintaining or establishing a plant cover and mulching help to control erosion. Blanketing sites with a more suitable soil for lawns provides a favorable root zone, increases the available water capacity, and covers the stones in and on the soil.

The restricted permeability and the settling make this soil poorly suited to septic tank absorption fields. Installing the fields in suitable fill material improves the absorption of effluent.

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

EnD—Enoch shaly silty clay loam, 15 to 25 percent slopes, very stony. This soil is deep, moderately steep, and well drained. It is in areas of mine spoil, mainly on side slopes and on a few benches and narrow ridgetops. These areas have been surface-mined for coal. Stones cover from less than 1 percent to as much as 3 percent of the surface. They are rounded or angular and range in diameter from 10 inches to almost 4 feet. They are about 5 to 30 feet apart. The soil is a mixture of rock fragments and partly weathered soil that was in or below the original soil. The rock fragments are mainly shale, some medium- and coarse-grained sandstone, and smaller amounts of siltstone, coal, and fine-grained sandstone. Small gullies are in some areas. Most areas of this soil are irregularly shaped and range from 5 to 30 acres.

Typically, the surface layer is dark grayish brown, friable shaly silty clay loam about 7 inches thick. The substratum extends to a depth of about 60 inches. It is gray and black, firm and very firm very shaly clay loam and very shaly silty clay loam in the upper part and variegated yellowish brown, black, and gray, friable very channery loam in the lower part.

Included with this soil in mapping are small areas of Bethesda soils near high walls. These soils are less acid throughout than the Enoch soil. Included soils make up about 5 percent of most mapped areas.

Permeability is moderately slow in the Enoch soil. The depth of the root zone varies widely because of differences in the density of the soil material, but it is generally very shallow. The available water capacity is low. Runoff is very rapid. The risk of corrosion is high for uncoated steel and concrete. The organic matter content is very low in the surface layer. Natural fertility also is very low.

Most areas of this soil have a sparse plant cover.

This soil is generally unsuited to cropland, pasture, and woodland because of the slope, the hazard of erosion, droughtiness, stoniness, a limited root zone, and a high level of acidity. Lowering the acidity level, adding nutrients, and blanketing the soil with suitable soil material are the only practices that will make the unit suitable for plants and trees. Some acid-tolerant plants are suitable if large amounts of sewage sludge, manure, fly ash, and soil materials that were present before mining are incorporated into the soil. Reclaimed areas are suited to grasses, trees, and wildlife habitat, but careful management is needed. Establishing a plant cover as soon as possible after reclamation helps to control erosion.

This soil is generally unsuitable as a site for buildings and septic tank absorption fields because of the settlement of the mine spoil, the restricted permeability, the stoniness, the slope, and the risk of corrosion to uncoated steel and concrete.

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

EnF—Enoch shaly silty clay loam, 25 to 70 percent slopes, very stony. This soil is deep, steep and very steep, and well drained. It is in areas of mine spoil, mainly on side slopes and on a few ridges adjacent and parallel to high walls. These areas have been surface-mined for coal, and most have not been graded. Stones cover from less than 1 percent to as much as 3 percent of the surface. They are rounded or angular and range in diameter from 10 inches to almost 4 feet. They are about 5 to 10 feet apart. The soil is a mixture of rock fragments and partly weathered soil that was in or below the original soil. The rock fragments are mainly shale, some medium- and coarse-grained sandstone, and smaller amounts of siltstone, coal, and fine-grained sandstone. Hillside slips are in some areas, and seeps from coal outcrops are in other areas. Most areas of this soil are long and narrow and range from 10 to 300 acres.

Typically, the surface layer is dark grayish brown, friable shaly silty clay loam about 4 inches thick. The substratum extends to a depth of about 72 inches. It is variegated gray, black, and yellowish brown, firm and very firm very shaly clay loam, very shaly silty clay loam, and friable very channery loam.

Included with this soil in mapping are small areas of Bethesda soils near high walls. These soils are less acid throughout than the Enoch soil. Included soils make up about 5 percent of most mapped areas.

Permeability is moderately slow in the Enoch soil. The depth of the root zone varies widely because of differences in the density of the soil material, but it is generally very shallow. The available water capacity is low. Runoff is very rapid. The risk of corrosion is high for uncoated steel and concrete. The organic matter content is very low in the surface layer. Natural fertility also is very low.

Most areas of this soil have a sparse plant cover.

This soil is generally unsuited to cropland, pasture, and woodland because of the slope, the hazard of erosion, droughtiness, stoniness, a limited root zone, and a high level of acidity. Lowering the acidity level, adding nutrients, and blanketing the soil with suitable soil material are the only practices that will make the unit suitable for plants and trees. Establishing a plant cover as soon as possible after reclamation helps to control erosion. The stones on the surface interfere with the use of equipment.

This soil is generally unsuitable as a site for buildings and septic tank absorption fields because of the instability of the mine spoil, the restricted permeability, the stoniness, the slope, and the risk of corrosion to uncoated steel and concrete.

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

GdC—Gilpin silt loam, 8 to 15 percent slopes. This soil is moderately deep, strongly sloping, and well drained. It is on ridgetops in the uplands. Slopes are convex or plane. Rills are in some cultivated areas. Most areas of this soil are circular or long and narrow and range from 5 to 40 acres.

Typically, the surface layer is dark grayish brown and yellowish brown, friable silt loam about 4 inches thick. The subsoil is about 26 inches thick. It is yellowish brown and brown, friable silt loam and shaly silt loam. Fractured shale bedrock is at a depth of about 30 inches.

Included with this soil in mapping are narrow strips of Upshur and Berks soils near the edges of ridgetops. Upshur soils have redder colors than the Gilpin soil and are deep to bedrock. Berks soils have more coarse fragments in the subsoil than the Gilpin soil. Included soils make up about 15 percent of most mapped areas.

Permeability is moderate in the Gilpin soil, and the available water capacity is low. The root zone is moderately deep. Runoff is medium. In the surface layer, the content of organic matter is moderately low and tilth is good. Bedrock is at a depth of 20 to 40 inches.

Many areas of this soil are used as cropland or pasture. Corn, small grain, and hay are the principal crops. Some areas are wooded.

This soil is moderately suited to corn and small grain and well suited to hay. If the soil is cultivated, the hazard of erosion is severe and controlling erosion is the main management concern. The soil is well suited to no-till planting. A system of conservation tillage that leaves crop residue on the surface, contour stripcropping, and cover crops reduce the runoff rate and help to prevent the deterioration of tilth. Crusting of the surface layer is common, especially in tilled areas. It restricts moisture penetration and air movement. Shallow cultivation of intertilled crops breaks up the crust.

This soil is well suited to pasture. If the pasture is overgrazed or is plowed during seedbed preparation, however, the hazard of erosion is severe. Proper stocking rates and rotation grazing help to prevent overgrazing and control erosion. No-till seeding also helps to control erosion.

This soil is well suited to woodland. No major hazards or limitations affect planting or harvesting.

This soil is moderately suited to building site development. The slope and the depth to bedrock are limitations. Designing the buildings so that they conform to the natural slope of the land helps to overcome the slope, and constructing buildings without basements helps to overcome the limited depth to bedrock. Removing as little vegetation as possible, mulching, or establishing a temporary plant cover helps to control erosion on construction sites. Building local roads and streets on the contour and seeding road cuts also help to control erosion. The potential for frost action is a limitation on sites for local roads and streets. Providing suitable base material helps to prevent the road damage caused by frost action.

This soil is poorly suited to septic tank absorption fields because of the slope and the limited depth to bedrock. The soil above the bedrock is not thick enough to adequately filter the effluent in septic tank absorption fields. Effluent that seeps into cracks in the rock causes a hazard of ground-water pollution. Installing the absorption field in suitable fill material improves the filtering capacity. Laying out the distribution lines on the contour helps to prevent the seepage of effluent to the surface.

The land capability classification is IIIe. The woodland ordination symbol is 4A.

GdD—Gilpin silt loam, 15 to 25 percent slopes. This soil is moderately deep, moderately steep, and well drained. It is on ridgetops and hillsides in the uplands. Slopes are mainly smooth. Most areas are long and narrow and range from 5 to 40 acres.

Typically, the surface layer is dark grayish brown, friable silt loam about 3 inches thick. The subsoil is about 28 inches thick. It is yellowish brown, friable silt loam and shaly silt loam. Fractured, olive siltstone bedrock is at a depth of about 31 inches.

Included with this soil in mapping are small areas of Berks soils on the upper parts of slopes and narrow strips of Upshur soils on benches and across the lower parts of slopes. Berks soils have more coarse fragments in the subsoil than the Gilpin soil, and Upshur soils are redder in color. Seeps and springs are in some areas. Inclusions make up about 10 percent of most mapped areas.

Permeability is moderate in the Gilpin soil, and the available water capacity is low. The root zone is moderately deep. Runoff is rapid. In the surface layer, the content of organic matter is moderately low and tilth is good. Bedrock is at a depth of 20 to 40 inches.

Many areas of this soil are used as cropland or pasture. Some areas are wooded.

This soil is poorly suited to corn and small grain and moderately suited to hay. If the soil is cultivated, the hazard of erosion is severe and controlling erosion is the main management concern. Cultivated crops can be grown about once every 4 years. A system of conservation tillage that leaves crop residue on the surface, contour stripcropping, and cover crops reduce the runoff rate and help to prevent crusting and the deterioration of tilth. The slope limits the use of some types of farm machinery.

This soil is moderately suited to pasture. If the pasture is overgrazed or is plowed during seedbed preparation, however, the hazard of erosion is severe. Proper stocking rates and rotation grazing help to prevent overgrazing and control erosion. No-till seeding also helps to control erosion.

This soil is well suited to trees. Coves and north- and east-facing slopes are especially suitable because they are cooler and less subject to evapotranspiration. Seedling mortality is the main management concern. Mulching around the seedlings reduces seedling mortality on south aspects. The use of equipment, which is limited by the slope, increases the hazard of erosion. Building logging roads and skid trails on the contour helps to overcome the slope and reduces the hazard of erosion. Water bars and a plant cover also help to control erosion.

This soil is poorly suited to building site development. The slope and the depth to bedrock are limitations. Designing the buildings so that they conform to the natural slope of the land helps to overcome the slope, and constructing buildings without basements helps to overcome the limited depth to bedrock. Removing as little vegetation as possible, mulching, or establishing a temporary plant cover on construction sites helps to control erosion. Building local roads and streets on the contour and seeding road cuts also help to control erosion. The potential for frost action is a limitation on sites for local roads and streets. Providing suitable base material helps to prevent the road damage caused by frost action.

This soil is poorly suited to septic tank absorption fields because of the slope and the limited depth to bedrock. The soil above the bedrock is not thick enough to adequately filter the effluent in septic tank absorption fields. Effluent that seeps into cracks in the rock causes a hazard of ground-water pollution. Installing the absorption fields in suitable fill material improves the filtering capacity. Laying out the distribution lines on the contour helps to prevent the seepage of effluent to the surface.

The land capability classification is IVe. The woodland ordination symbol is 4R.

GdE—Gilpin silt loam, 25 to 35 percent slopes. This soil is moderately deep, steep, and well drained. It is on hillsides in the uplands. A few of the hillsides are benched, and gullies are in a few areas. Most areas of this soil are oblong and range from 20 to 150 acres.

Typically, the surface layer is dark grayish brown, friable silt loam about 4 inches thick. The subsoil is brown and friable and is about 20 inches thick. The upper part is silt loam and loam, and the lower part is channery silt loam. The substratum is brown, friable very channery loam about 4 inches thick. Sandstone bedrock is at a depth of about 28 inches.

Included with this soil in mapping are small areas of the deep Lowell soils and narrow strips of the deep Upshur soils. Lowell soils are on the upper parts of slopes, and Upshur soils are on hillsides. Included soils make up about 15 percent of most mapped areas.

Permeability is moderate in the Gilpin soil, and the available water capacity is low. The root zone is moderately deep. Runoff is very rapid. In the surface layer, the content of organic matter is moderately low and tilth is good. The depth to bedrock is 20 to 40 inches.

Most areas of this soil are used as woodland, but some areas are used as pasture.

This soil is generally unsuited to cultivated crops and hay and poorly suited to pasture. The slope and a very severe hazard of erosion are the major limitations. A permanent plant cover helps to control erosion. If the pasture is plowed during seedbed preparation or is overgrazed, the hazard of erosion is very severe. Proper stocking rates and rotation grazing help to prevent overgrazing and control erosion. No-till seeding and mulching and seeding the gullies reduce the hazard of erosion. The slope limits the use of equipment.

This soil is well suited to trees. Coves and north- and east-facing slopes are especially suitable because they are cooler and less subject to evapotranspiration. Seedling mortality is the main management concern. Mulching around the seedlings reduces seedling mortality on south aspects. The use of equipment, which is limited by the slope, increases the hazard of erosion. Building logging roads and skid trails on the contour helps to overcome the slope and reduces the hazard of erosion. Water bars and a plant cover also help to control erosion.

This soil generally is unsuitable as a site for buildings or septic tank absorption fields because of the slope and the depth to bedrock. Cutting and filling increase the hazard of hillside slippage in areas of the included Upshur soils. Installing subsurface drains in the seep areas, however, reduces this hazard. Building local roads and streets on the contour and seeding road cuts help to control erosion.

The land capability classification is VIe. The woodland ordination symbol is 4R.

GdF—Gilpin silt loam, 35 to 70 percent slopes. This soil is moderately deep, very steep, and well drained. It is on hillsides in the uplands. Deep ravines, slips, and benches are in some areas. Most areas of this soil are long and narrow or oblong and range from 30 to 200 acres.

Typically, the surface layer is dark grayish brown, friable silt loam about 3 inches thick. The subsoil is brown and friable and is about 23 inches thick. The upper part is silt loam and channery silt loam, and the lower part is very channery loam. Olive, fractured shale bedrock is at a depth of about 26 inches.

Included with this soil in mapping are small areas of the deep Lowell soils on the upper parts of slopes and narrow strips of the deep Upshur soils on hillsides marked by slips and gullies. Included soils make up about 15 percent of most mapped areas.

Permeability is moderate in the Gilpin soil, and the available water capacity is low. The root zone is moderately deep. Runoff is very rapid. Bedrock is at a depth of 20 to 40 inches.

Almost all areas of this soil are wooded.

This soil is generally unsuited to corn, small grain, hay, and pasture. The slope and the erosion hazard are the major limitations.

This soil is moderately suited to trees. Coves and north- and east-facing slopes are especially suitable because they are cooler and less subject to evapotranspiration. Seedling mortality is the main management concern. Using seedlings that have been transplanted once reduces seedling mortality on south aspects. The use of equipment, which is limited by the slope, increases the hazard of erosion. Building logging roads and skid trails on the contour helps to overcome the slope and reduces the hazard of erosion. Water bars and a plant cover also help to control erosion. Leaving large trees as den areas and piling brush and fallen trees improve the suitability of the soil for wildlife habitat.

This soil generally is unsuitable as a site for buildings or septic tank absorption fields because of the slope and the depth to bedrock. Cutting and filling increase the hazard of hillside slippage in areas of the included Upshur soils. Installing subsurface drains in the seep areas, however, reduces this hazard. Building local roads and streets on the contour and seeding road cuts help to control erosion. Establishing paths and trails on a safe gradient and seeding or surfacing them with resistant material also help to control erosion.

The land capability classification is VIIe. The woodland ordination symbol is 4R.

GkD2—Gilpin-Upshur complex, 15 to 25 percent slopes, eroded. This unit consists of moderately steep, well drained soils on ridgetops and side slopes in the uplands. The Gilpin soil is on the steeper parts of the side slopes, and the Upshur soil, which is subject to slippage, is in the less sloping areas and on benches. Erosion has removed part of the original surface layer of the soils. The present surface layer is a mixture of the original surface layer and the subsoil. Most areas of these soils are oblong and range from about 5 to 50 acres. They are about 50 percent moderately deep Gilpin soil and 40 percent deep Upshur soil. The two soils are so intermingled or in areas so small that it was not practical to separate them at the scale used in mapping.

Typically, the surface layer of the Gilpin soil is dark grayish brown and yellowish brown, friable silt loam about 4 inches thick. The subsoil is yellowish brown, friable silt loam about 26 inches thick. Olive, fractured siltstone bedrock is at a depth of about 30 inches.

Typically, the surface layer of the Upshur soil is reddish brown, firm silty clay loam about 5 inches thick. The subsoil is reddish brown and dark reddish brown, firm silty clay and shaly silty clay about 37 inches thick. The substratum to a depth of about 60 inches is dark reddish brown, firm shaly silty clay loam.

Included with these soils in mapping are small areas of Berks soils near slope breaks. Included soils make up about 10 percent of most mapped areas.

Permeability is moderate in the Gilpin soil and slow in the Upshur soil. The root zone is moderately deep in the Gilpin soil and deep in the Upshur soil. The available water capacity is low in the Gilpin soil and moderate in the Upshur soil. Runoff is rapid on the Gilpin soil and very rapid on the Upshur soil. The shrink-swell potential is high in the subsoil of the Upshur soil and low in the Gilpin soil. The organic matter content is moderately low in the surface layer of both soils. The depth to bedrock ranges from 20 to 40 inches in the Gilpin soil.

Most areas of these soils are used for corn, hay, pasture, or woodland.

These soils are poorly suited to cropland and moderately suited to hay. If cultivated, the soils are difficult to manage. The hazard of erosion is very severe in cultivated areas. Applying a conservation tillage system that leaves crop residue on the surface, using grassed waterways, mulching, and including grasses and legumes in the cropping system help to control erosion. Shaping, seeding, and mulching gullies help to control erosion in those areas.

These soils are moderately suited to pasture. The hazard of erosion is very severe if the soils are plowed or overgrazed. No-till planting and mulching of new seedings help to control erosion. Deferred grazing during wet periods helps to prevent surface compaction. Mowing at least twice during the growing season helps to control weeds and brush.

These soils are well suited to woodland. Seedling mortality is the main management concern. Mulching around the seedlings or using seedlings that have been transplanted once reduces seedling mortality. The use of equipment, which is limited by the slope, increases the hazard of erosion. Building logging roads and skid trails on the contour helps to overcome the slope and reduces the hazard of erosion. Water bars and a plant cover also help to control erosion. Removing vines and the less desirable trees helps to control plant competition in areas of the Upshur soil. Harvesting methods that do not leave the remaining trees widely spaced or isolated help to prevent windthrow.

These soils are poorly suited to building site development because of the slope, the depth to bedrock in the Gilpin soil, and the high shrink-swell potential and slippage hazard in the Upshur soil. The Gilpin soil generally is better suited as a site for buildings than the Upshur soil. Designing walls to include pilasters, reinforced concrete, and large-spread footings and backfilling around foundations with material that has a low shrink-swell potential help to prevent the damage to buildings caused by shrinking and swelling in areas of the Upshur soil. Landslips are difficult to stabilize. Cutting and filling increase the hazard of hillside slippage. Designing the buildings so that they conform to the natural slope of the land helps to control erosion.

These soils are poorly suited to septic tank absorption fields, but the Gilpin soil is better suited to this use than the Upshur soil. Installing distribution lines on the contour helps to prevent the seepage of effluent to the surface. Providing suitable fill material in absorption fields in areas of the Gilpin soil improves the filtering capacity. Increasing the width of trenches improves absorption in areas of the Upshur soil. Landslips should be avoided as sites for septic tank absorption fields.

The Gilpin soil also is more suitable than the Upshur soil as a site for local roads and streets. Landslips should be avoided as sites for this use. Low strength and the high shrink-swell potential in the Upshur soil are limitations. Providing a suitable base material helps to overcome these limitations. The slope is also a limitation. It can be overcome by building the roads across the slope.

The land capability classification is IVe. The woodland ordination symbol is 4R for the Gilpin soil. For the Upshur soil, it is 4R on north aspects and 3R on south aspects.

GkE2—Gilpin-Upshur complex, 25 to 35 percent slopes, eroded. This unit consists of steep, well drained soils on hillsides in the uplands. Slips and gullies are common. Erosion has removed part of the original surface layer. The present surface layer is a mixture of the original surface layer and the subsoil. Most areas of these soils are oblong and range from about 20 to 150 acres. They are about 50 percent moderately deep Gilpin soil and 40 percent deep Upshur soil. The two soils are so intermingled or in areas so small that it was not practical to separate them at the scale used in mapping.

Typically, the surface layer of the Gilpin soil is dark grayish brown, friable silt loam about 4 inches thick. The subsoil is brown, friable channery silt loam about 20 inches thick. The substratum is brown, friable extremely channery silt loam about 4 inches thick. Olive shale bedrock is at a depth of about 28 inches.

Typically, the surface layer of the Upshur soil is dark reddish brown, firm silty clay loam about 5 inches thick. The subsoil is reddish brown and red and is about 40 inches thick. It is firm silty clay in the upper part and firm channery silty clay in the lower part. The substratum is variegated light yellowish brown and reddish brown, firm very channery silty clay about 17 inches thick. Soft shale bedrock is at a depth of about 62 inches.

Included with these soils in mapping are small areas of Lowell soils in narrow strips underlain by limestone bedrock. A few springs are in these areas. Lowell soils have more clay in the subsoil than the Gilpin soil and are not as red in the subsoil as the Upshur soil. Included soils make up about 10 percent of most mapped areas.

Permeability is moderate in the Gilpin soil and slow in the Upshur soil. The root zone is moderately deep in the Gilpin soil and deep in the Upshur soil. The available water capacity is low in the Gilpin soil and moderate in the Upshur soil. Runoff is very rapid on both soils. The shrink-swell potential is high in the subsoil of the Upshur soil and low in the Gilpin soil. The organic matter content is moderately low in the surface layer of both soils. The depth to bedrock ranges from 20 to 40 inches in the Gilpin soil.

Most areas of these soils are used as pasture or woodland.

These soils are generally unsuited to cropland and poorly suited to pasture. The slope and a severe erosion hazard are the major limitations. No-till seeding of desirable forage species helps to control erosion. Mulching and seeding in gullies reduce the hazard of erosion in those areas. Preventing overgrazing, especially during dry periods or extended wet periods, helps to control erosion in areas of pasture. Mowing helps to control weeds and brush.

These soils are well suited to woodland. Seedling mortality is the main management concern. Mulching around the seedlings or using seedlings that have been transplanted once reduces seedling mortality. The use of equipment, which is limited by the slope, increases the hazard of erosion. Building logging roads and skid trails on the contour helps to overcome the slope and reduces the hazard of erosion. Water bars and a plant cover also help to control erosion. Removing vines and the less desirable trees helps to control plant competition in areas of the Upshur soil. Harvesting methods that do not leave the remaining trees widely spaced or isolated help to prevent windthrow.

These soils are generally unsuitable as sites for buildings and septic tank absorption fields because of the slope, the depth to bedrock in the Gilpin soil, and the high shrink-swell potential and slippage hazard in areas of the Upshur soil. Landslips are difficult to stabilize. Cutting and filling increase the hazard of hillside slippage. Establishing trails and paths on a safe gradient and covering them with resistant material help to control erosion.

The land capability classification is VIe. The woodland ordination symbol is 4R for the Gilpin soil. For the Upshur soil, it is 4R on north aspects and 3R on south aspects.

GkF2—Gilpin-Upshur complex, 35 to 70 percent slopes, eroded. This unit consists of very steep, well drained soils on hillsides in the uplands. Slips and landslides are common. Erosion has removed part of the original surface layer. The present surface layer is a mixture of the original surface layer and the subsoil. The Gilpin soil is on the steeper parts of the slope, and the Upshur soil is on the less sloping parts and on benches. Most areas of these soils are long and broad and range from about 30 to 200 acres. They are about 50 percent moderately deep Gilpin soil and 40 percent deep Upshur soil. The two soils are so intermingled or in areas so small that it was not practical to separate them at the scale used in mapping.

Typically, the surface layer of the Gilpin soil is dark grayish brown, friable silt loam about 4 inches thick. The subsoil is brown, friable channery silt loam about 20 inches thick. The substratum is brown, friable extremely channery silt loam about 2 inches thick. Olive shale bedrock is at a depth of about 26 inches.

Typically, the surface layer of the Upshur soil is dark reddish brown, firm silty clay loam about 5 inches thick. The subsoil is reddish brown and red and is about 41 inches thick. It is firm silty clay in the upper part and firm channery silty clay in the lower part. The substratum is variegated light yellowish brown and reddish brown, firm very channery silty clay about 14 inches thick. Soft shale bedrock is at a depth of about 60 inches.

Included with these soils in mapping are small areas of Lowell soils in narrow strips underlain by limestone bedrock. Lowell soils have more clay in the subsoil than the Gilpin soil and are not as red in the subsoil as the Upshur soil. Included soils make up about 10 percent of most mapped areas.

Permeability is moderate in the Gilpin soil and slow in the Upshur soil. The root zone is moderately deep in the Gilpin soil and deep in the Upshur soil. The available water capacity is low in the Gilpin soil and moderate in the Upshur soil. Runoff is very rapid on both soils. The shrink-swell potential is high in the subsoil of the Upshur soil and low in the Gilpin soil. The organic matter content is moderately low in the surface layer of both soils. The depth to bedrock ranges from 20 to 40 inches in the Gilpin soil.

Most areas of these soils are wooded. These soils are moderately suited to woodland. Coves and north- and east-facing slopes are especially suitable because they are cooler and less subject to evapotranspiration. Seedling mortality is the main management concern. Mulching around the seedlings or using seedlings that have been transplanted once reduces seedling mortality. The use of equipment, which is limited by the slope, increases the hazard of erosion. Building logging roads and skid trails on the contour helps to overcome the slope and reduces the hazard of erosion. Water bars and a plant cover also help to control erosion. Removing vines and the less desirable trees helps to control plant competition in areas of the Upshur soil. Harvesting methods that do not leave the remaining trees widely spaced or isolated help to prevent windthrow.

These soils are generally unsuitable as sites for buildings and septic tank absorption fields because of the slope, the depth to bedrock in the Gilpin soil, and the high shrink-swell potential and slippage hazard in areas of the Upshur soil. Landslips are difficult to stabilize. Cutting and filling increase the hazard of hillside slippage.

The land capability classification is VIIe. The woodland ordination symbol is 4R for the Gilpin soil. For the Upshur soil, it is 4R on north aspects and 3R on south aspects.

GuB—Guernsey silt loam, 1 to 6 percent slopes. This soil is deep, nearly level and gently sloping, and moderately well drained. It is on ridgetops in the uplands. Most areas are long and narrow and range from 5 to 30 acres.

Typically, the surface layer is dark grayish brown, friable silt loam about 7 inches thick. The subsoil is about 37 inches thick. It is yellowish brown, friable silt loam in the upper part and dark yellowish brown, mottled, firm silty clay in the lower part. The substratum is light brownish gray, mottled, firm clay about 16 inches thick. Weathered shale bedrock is at a depth of about 60 inches.

Included with this soil in mapping are small areas of the moderately deep Gilpin and Berks soils on the edges of ridges. Also included are small areas of somewhat poorly drained soils on the more nearly level parts of ridgetops. Included soils make up about 15 percent of most mapped areas.

Permeability is slow or moderately slow in the

Guernsey soil. The root zone is deep. The available water capacity is moderate. Runoff is slow or medium. The shrink-swell potential is high in the lower part of the subsoil and in the substratum. A perched seasonal high water table is at a depth of 24 to 42 inches during extended wet periods. In the surface layer, the content of organic matter is moderate and tilth is good.

Most areas of this soil are used as cropland or pasture. Some areas are wooded.

This soil is well suited to corn, small grain, hay, and pasture. Controlling erosion and maintaining tilth are the major management concerns. The hazard of erosion is especially severe if the soil is cultivated or plowed during seedbed preparation. The surface layer is crusty after hard rains, but shallow cultivation of intertilled crops breaks up the crust. Tilling when the soil is wet causes clodding and compaction of the surface layer. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour farming, and cover crops reduce the runoff rate, help to control erosion, and maintain tilth. Drainage generally is adequate, but subsurface drains are needed in scattered areas of the wetter included soils.

This soil is well suited to pasture. The hazard of erosion is severe if the pasture is overgrazed or plowed during seedbed preparation. Proper stocking rates, rotation grazing, and no-till seeding help to control erosion. Restricted grazing during wet periods helps to prevent surface compaction and to keep the pasture in good condition.

This soil is well suited to woodland. Removing vines and the less desirable trees and shrubs helps to control plant competition.

This soil is moderately suited to building site development. The seasonal wetness and the high shrink-swell potential are limitations, especially on sites for dwellings with basements. Waterproofing basement walls and installing drains at the base of footings help to keep basements dry. The damage caused by shrinking and swelling can be reduced by designing walls to include pilasters, reinforced concrete, and large-spread footings and backfilling around foundations with material that has a low shrink-swell potential. The shrink-swell potential and low strength are limitations on sites for local roads and streets. Providing suitable base material and installing a drainage system help to minimize the effects of these limitations.

Because of the seasonal wetness and the restricted permeability, this soil is poorly suited to septic tank absorption fields. Perimeter drains help to reduce the wetness, and enlarging the field helps to overcome the restricted permeability.

The land capability classification is IIe. The woodland ordination symbol is 4A.

GuC—Guernsey silt loam, 6 to 15 percent slopes. This soil is deep, strongly sloping, and moderately well drained. It is on ridgetops and benches on upland hillsides. Most slopes are uneven because of differential soil movement on the slope. Most areas of this soil are long and narrow or circular and range from 5 to 40 acres.

Typically, the surface layer is dark grayish brown, friable silt loam about 6 inches thick. The subsoil is about 38 inches thick. It is brown, firm silt loam in the upper part and yellowish brown, mottled, firm silty clay loam and silty clay in the lower part. The substratum to a depth of about 60 inches is light brownish gray, mottled, very firm silty clay. Gray, soft shale bedrock is at a depth of about 60 inches.

Included with this soil in mapping are small areas of Upshur soils on the lower parts of slopes and convex areas of Gilpin soils on the higher parts of ridges. Upshur soils have a redder subsoil than the Guernsey soil, and Gilpin soils have less clay in the subsoil. Also included are a few small seep areas on the lower parts of slopes and on benches and strips of soils on some lower parts of hillsides that are in the flood pool of Senecaville Lake. The soils along Senecaville Lake are subject to flooding. Inclusions make up about 15 percent of most mapped areas.

Permeability is slow or moderately slow in the Guernsey soil. The root zone is deep. The available water capacity is moderate. Runoff is medium or rapid. The shrink-swell potential is high in the lower part of the subsoil and in the substratum. A perched seasonal high water table is at a depth of 24 to 42 inches during extended wet periods. In the surface layer, the content of organic matter is moderate and tilth is good.

Many areas of this soil are used as cropland or pasture. Some areas are wooded.

This soil is moderately suited to corn, small grain, and hay. Controlling erosion and maintaining tilth are the major management concerns. The hazard of erosion is especially severe if the soil is cultivated or plowed during seedbed preparation. The surface layer is crusty after hard rains, but shallow cultivation of intertilled crops breaks up the crust. Tilling when the soil is wet causes clodding and compaction of the surface layer. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour farming, and cover crops reduce the runoff rate, help to control erosion, and maintain tilth. Drainage generally is adequate, but subsurface drains are needed in scattered areas of the wetter included soils.

This soil is well suited to pasture. The hazard of erosion is very severe if the pasture is overgrazed or plowed during seedbed preparation. Proper stocking rates, rotation grazing, and no-till seeding help to control erosion. Restricted grazing during wet periods helps to prevent surface compaction and to keep the pasture in good condition.

This soil is well suited to woodland. Removing vines and the less desirable trees and shrubs helps to control plant competition.

This soil is moderately suited to building site development. The seasonal wetness and the high shrink-swell potential are limitations, especially on sites for dwellings with basements, and the slope and the hazard of erosion are also concerns. Maintaining or establishing a plant cover and mulching help to control erosion. Waterproofing basement walls and installing drains at the base of footings help to keep basements dry. The damage caused by shrinking and swelling can be reduced by designing walls to include pilasters, reinforced concrete, and large-spread footers and by backfilling around foundations with material that has a low shrink-swell potential. Cutting and filling increase the hazard of hillside slippage, but drains in seep areas reduce this hazard.

The shrink-swell potential and low strength are limitations on sites for local roads and streets. Providing suitable base material and installing a drainage system help to minimize the effects of these limitations. Establishing the roads and streets on the contour helps to control erosion.

Because of the seasonal wetness, the slope, and the restricted permeability, this soil is poorly suited to septic tank absorption fields. Perimeter drains reduce the wetness, and upslope subsurface drainage intercepts seepage water. Enlarging the field helps to overcome the restricted permeability.

The land capability classification is IIIe. The woodland ordination symbol is 4A.

GuD—Guernsey silt loam, 15 to 25 percent slopes. This soil is deep, moderately steep, and moderately well drained. It is on ridgetops and side slopes in the uplands. Seeps, springs, and slips are common, and deep ravines are in some areas. Most areas of this soil are long and narrow and range from 5 to 200 acres. Some areas on ridgetops are oblong.

Typically, the surface layer is brown, friable silt loam about 8 inches thick. The subsoil is about 46 inches thick. It is yellowish brown and brown, friable and firm silt loam in the upper part and dark yellowish brown and grayish brown, mottled, firm silty clay and silty clay loam in the lower part. The substratum is gray and light olive brown, firm shaly silty clay loam about 6 inches thick. Shale bedrock is at a depth of about 60 inches.

Included with this soil in mapping are small, convex areas of the moderately deep Berks soils and areas of the well drained Upshur soils on the upper parts of side slopes. Included soils make up about 15 percent of most mapped areas.

Permeability is slow or moderately slow in the Guernsey soil. The root zone is deep. The available water capacity is moderate. Runoff is very rapid. The shrink-swell potential is high in the lower part of the subsoil and in the substratum. A perched seasonal high water table is at a depth of 24 to 42 inches during extended wet periods. In the surface layer, the content of organic matter is moderate and tilth is good.

Many areas of this soil are used as woodland. Some areas are used as pasture or cropland. Corn, small grain, and hay are the principal crops.

This soil is poorly suited to cultivated crops and moderately suited to hay. Controlling erosion is the major management concern. The hazard of erosion is especially severe if the soil is cultivated. The surface layer is crusty after hard rains. Tilling when the soil is wet causes clodding and compaction of the surface layer. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour farming, and cover crops reduce the runoff rate, help to control erosion, and maintain tilth. The slope and hillside slips limit the use of some types of equipment. Subsurface drains are needed in scattered areas of the wetter included soils.

This soil is moderately suited to pasture. If the pasture is overgrazed or is plowed during seedbed preparation, the hazard of erosion is very severe. Proper stocking rates and pasture rotation help to prevent overgrazing and thus help to control erosion. No-till seeding also helps to control erosion. Restricted grazing during wet periods helps to prevent surface compaction.

This soil is well suited to woodland. Coves and north- and east-facing slopes are especially suitable because they are cooler and less subject to evapotranspiration. Using seedlings that have been transplanted once reduces seedling mortality on south-facing slopes. The use of equipment, which is limited by the slope, increases the hazard of erosion. Building logging roads and skid trails on the contour helps to overcome the slope and reduces the hazard of erosion. Water bars and a plant cover also help to control erosion. Removing vines and the less desirable trees and shrubs helps to control plant competition.

This soil is poorly suited to building site development. The seasonal wetness and the high shrink-swell potential are limitations, especially on sites for dwellings with basements, and the slope and the hazard of erosion are also concerns. Maintaining or establishing a plant cover and mulching help to control erosion. Waterproofing basement walls and installing drains at the base of footings help to keep basements dry. The damage caused by shrinking and swelling can be reduced by designing walls to include pilasters, reinforced concrete, and large-spread footers and by backfilling around foundations with material that has a low shrink-swell potential. Cutting and filling increase the hazard of hillside slippage, but drains in seep areas reduce this hazard.

The seasonal wetness, the slope, and the restricted permeability make this soil generally unsuitable as a site for septic tank absorption fields.

The shrink-swell potential and low strength are limitations on sites for local roads and streets. Providing suitable base material and installing a drainage system help to minimize the effects of these limitations. Constructing the roads and streets on the contour helps to control erosion.

The land capability classification is IVe. The woodland ordination symbol is 4R.

GwD2—Guernsey-Upshur silty clay loams, 15 to 25 percent slopes, eroded. This unit consists of deep, moderately steep soils on side slopes in the uplands. Erosion has removed part of the original surface layer. The present surface layer is a mixture of the original surface layer and the subsoil. Landslips are in most areas, and seeps and springs are in a few areas. Most areas of these soils are long and wide and range from 25 to 100 acres. They are about 50 percent moderately well drained Guernsey soil and 40 percent well drained Upshur soil. The two soils are so intermingled or in areas so small that it was not practical to separate them at the scale used in mapping.

Typically, the surface layer of the Guernsey soil is brown, friable silty clay loam about 6 inches thick. The subsoil is yellowish brown, firm silty clay about 38 inches thick. It is mottled in the lower part. The substratum is yellowish brown, mottled, firm silty clay about 36 inches thick. Clay shale is at a depth of about 80 inches. Some areas are deeper than 80 inches to bedrock.

Typically, the surface layer of the Upshur soil is reddish brown, firm silty clay loam about 6 inches thick. The subsoil is red, reddish brown, weak red, and dark red, firm silty clay about 44 inches thick. The substratum to a depth of about 72 inches is dark red, firm silty clay.

Included with these soils in mapping are small areas of the moderately deep Berks soils on the upper parts of slopes. Included soils make up about 10 percent of most mapped areas.

Permeability is moderately slow or slow in the Guernsey soil and slow in the Upshur soil. The root zone of both soils is deep. The available water capacity is moderate in both soils. Runoff is rapid. The shrink-swell potential is high in the subsoil and substratum of the Guernsey soil, and it is high in the subsoil of the Upshur soil. A seasonal high water table is at a depth of 24 to 42 inches in the Guernsey soil. In the surface layer of both soils, the organic matter content is moderately low and tilth is fair.

Most areas of these soils are used as cropland, pasture, or woodland.

These soils are poorly suited to cultivated crops because of the slope and a very severe erosion hazard. They are moderately suited to hay. Row crops can be grown about once every 4 years. A conservation tillage system that leaves crop residue on the soil reduces the hazard of erosion and improves tilth. No-till farming also is effective for controlling erosion in areas of row crops and meadows, but it is not as effective as a permanent plant cover. The slope and hillside slips hinder the use of some types of farm machinery. Subsurface drains are needed in scattered seep areas.

These soils are moderately suited to pasture. The erosion hazard is very severe if the soils are plowed during reseeding or if they are overgrazed. Proper stocking rates and rotation grazing reduce the hazard of erosion. Some of the seeps and springs are suitable for livestock water. Smoothing the hillside slips makes mowing easier and reduces ponding.

These soils are moderately suited to woodland. Seedling mortality is the main management concern. Mulching around the seedlings and using planting methods that ensure adequate soil-root contact reduce seedling mortality. The use of equipment, which is limited by the slope, increases the hazard of erosion. Building logging roads and skid trails on the contour helps to overcome the slope and reduces the hazard of erosion. Water bars and a plant cover also help to control erosion. Removing vines and the less desirable vegetation helps to control plant competition. Frequent, light thinning and harvesting help to prevent windthrow in areas of the Upshur soil.

These soils are generally unsuitable as sites for septic tank absorption fields and buildings because of the slope, the restricted permeability, the high shrink-swell potential, the slippage hazard, and the seasonal high water table in the Guernsey soil. Local roads and streets are difficult to stabilize on these soils.

The land capability classification is IVe. The woodland ordination symbol is 4R for the Guernsey soil. For the Upshur soil, it is 4R on north aspects and 3R on south aspects.

LoC—Lowell silt loam, 8 to 15 percent slopes. This soil is deep, strongly sloping, and well drained. It is on ridgetops in the uplands. Most areas are oblong and range from 5 to 30 acres.

Typically, the surface layer is dark grayish brown and brown, friable silt loam about 7 inches thick. The subsoil is about 43 inches thick. It is dark yellowish brown, firm silty clay in the upper part and yellowish brown, mottled, firm clay and variegated light yellowish brown, brown, and dark brown, firm silty clay loam in the lower part. The substratum is light yellowish brown and brown, firm silty clay loam about 10 inches thick. Hard siltstone bedrock is at a depth of about 60 inches.

Included with this soil in mapping are small areas of the moderately deep Berks and Gilpin soils near the edges of ridgetops. These soils are more droughty than the Lowell soil. Also included are small areas of somewhat poorly drained soils. Included soils make up about 15 percent of most mapped areas.

Permeability is moderately slow in the Lowell soil. The root zone is deep. The available water capacity is moderate. Runoff is medium or rapid. In the surface layer, the content of organic matter is moderate or moderately low and tilth is good. Bedrock is at a depth of 40 to 80 inches.

Most areas of this soil are used as pasture or cropland.

This soil is moderately suited to corn, small grain, and hay. Controlling erosion is the major management concern. If the soil is cultivated, the hazard of erosion is severe. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour stripcropping, and cover crops reduce the runoff rate and help to prevent erosion and deterioration of tilth.

This soil is well suited to pasture. If the pasture is overgrazed or is plowed during seedbed preparation, the hazard of erosion is severe. Proper stocking rates and rotation grazing help to prevent overgrazing and thus help to control erosion. Restricted grazing during wet periods helps to prevent surface compaction. No-till seeding also helps to control erosion. Timely applications of lime and fertilizer are needed.

This soil is well suited to woodland. Removing vines and the less desirable trees and shrubs helps to control plant competition.

This soil is poorly suited to building site development. The suitability of the soil as a site for buildings with basements is especially limited because of the depth to bedrock. The slope and the hazard of erosion also are limitations. They can be overcome by designing the buildings so that they conform to the natural slope of the land. Designing walls to include pilasters, reinforced concrete, and large-spread footings and backfilling around foundations with material that has a low shrink-swell potential help to minimize the damage caused by shrinking and swelling. Maintaining or establishing a plant cover and mulching help to control erosion on construction sites.

This soil is poorly suited to septic tank absorption fields. The restricted permeability and the slope are the major limitations. Increasing the width of trenches in leach fields improves the absorption of effluent. Placing leach lines on the contour helps to prevent the seepage of effluent to the surface.

Low strength is a major limitation on sites for local roads and streets. Providing suitable base material helps to overcome this limitation. Building local roads and streets on the contour and seeding road cuts help to control erosion.

The land capability classification is IIIe. The woodland ordination symbol is 5A.

LoD—Lowell silt loam, 15 to 25 percent slopes. This soil is deep, moderately steep, and well drained. It is on side slopes and ridgetops in the uplands. Seeps are in some areas. Most areas of this soil are oblong and narrow and range from 5 to 100 acres.

Typically, the surface layer is dark grayish brown, friable silt loam about 7 inches thick. The subsoil is about 50 inches thick. It is dark brown, firm silty clay in the upper part and light yellowish brown and light olive brown, firm silty clay and variegated light yellowish brown, brown, and dark brown, firm silty clay loam in the lower part. Hard siltstone bedrock is at a depth of about 57 inches.

Included with this soil in mapping are narrow strips of the moderately deep Gilpin soils on the upper parts of side slopes and small areas of somewhat poorly drained soils. Included soils make up about 15 percent of most mapped areas.

Permeability is moderately slow in the Lowell soil. The root zone is deep. The available water capacity is moderate. Runoff is very rapid. In the surface layer, the content of organic matter is moderate or moderately low

Figure 3.—An area of Lowell silt loam, 15 to 25 percent slopes, used for pasture.

and tilth is good. The depth to bedrock is 40 to 80 inches.

Many areas of this soil are wooded. Some areas are used as cropland or pasture.

This soil is poorly suited to corn, small grain, and hay. Controlling erosion is the major management concern, and the slope is the major limitation. If the soil is cultivated, the hazard of erosion is very severe. The surface layer is crusty after hard rains. Cultivated crops can be grown about once every 4 years. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour stripcropping, and cover crops reduce the runoff rate and help to prevent erosion and crusting. A permanent plant cover is especially effective in controlling erosion. The slope hinders the use of some types of farm machinery. Subsurface drains are needed in scattered seep areas.

This soil is moderately suited to pasture (fig. 3). If the pasture is overgrazed or is plowed during seedbed preparation, the hazard of erosion is very severe. Proper stocking rates and rotation grazing help to prevent overgrazing and thus help to control erosion. Restricted grazing during wet periods helps to prevent surface compaction. No-till seeding also helps to control erosion. Timely applications of lime and fertilizer are needed.

This soil is well suited to woodland. The use of equipment, which is limited by the slope, increases the hazard of erosion. Placing logging roads and skid trails on the contour helps to overcome the slope and reduces the hazard of erosion. Water bars and a plant cover also help to control erosion. Removing vines and the less desirable trees and shrubs helps to control plant competition.

This soil is poorly suited to building site development. The suitability of the soil as a site for buildings with basements is especially limited because of the depth to bedrock. The slope and the hazard of erosion also are limitations. They can be overcome by designing the buildings so that they conform to the natural slope of the land. Designing walls to include pilasters, reinforced concrete, and large-spread footings and backfilling around foundations with material that has a low shrink-swell potential help to prevent the damage caused by shrinking and swelling. Maintaining or establishing a plant cover and mulching help to control erosion on construction sites.

This soil is poorly suited to septic tank absorption fields. The restricted permeability and the slope are the major limitations. Placing leach lines on the contour helps to prevent the seepage of effluent to the surface. Increasing the width of trenches in leach fields improves the absorption of effluent.

Low strength is a major limitation on sites for local roads and streets. Providing suitable base material helps to overcome this limitation. Building local roads and streets on the contour and seeding road cuts help to control erosion.

The land capability classification is IVe. The woodland ordination symbol is 5R.

LpE2—Lowell silty clay loam, 25 to 40 percent slopes, eroded. This soil is deep, steep, and well drained. It is on side slopes and ridgetops in the uplands. Erosion has removed part of the original surface layer. The present surface layer is a mixture of the original surface layer and the subsoil. Seeps are in some areas. Most areas of this soil are long and wide and range from 10 to 100 acres.

Typically, the surface layer is brown, friable silty clay loam about 7 inches thick. The subsoil is about 52 inches thick. It is dark brown, firm silty clay in the upper part and yellowish brown, firm clay and variegated light yellowish brown, brown, and dark brown, firm silty clay loam in the lower part. Hard siltstone bedrock is at a depth of about 59 inches. Some areas are moderately well drained.

Included with this soil in mapping are small areas of the moderately deep Berks and Gilpin soils on the shoulder slopes and the upper parts of side slopes. Included soils make up about 15 percent of most mapped areas.

Permeability is moderately slow in the Lowell soil. The root zone is deep. The available water capacity is moderate. Runoff is very rapid. The content of organic matter is moderately low in the surface layer. The depth to bedrock is 40 to 80 inches.

Most areas of this soil are used as woodland or pasture.

This soil is poorly suited to pasture and is generally unsuited to corn, small grain, and hay. The slope and the hazard of erosion are major limitations. If the pasture is overgrazed or is plowed during seedbed preparation, the hazard of erosion is very severe. A thick plant cover and no-till seeding reduce the hazard of erosion. Rotation grazing and proper stocking rates help to prevent overgrazing and thus help to control erosion. Seeding and mulching the gullies help to control erosion. Restricted grazing during wet periods helps to prevent surface compaction.

This soil is well suited to woodland. The use of equipment, which is limited by the slope, increases the hazard of erosion. Building logging roads and skid trails on the contour helps to overcome the slope and reduces the hazard of erosion. Water bars and a plant cover also help to control erosion. Removing vines and the less desirable trees and shrubs helps to control plant competition.

This soil is generally unsuited as a site for buildings and septic tank absorption fields because of the slope, a moderate shrink-swell potential, the restricted permeability, and the depth to bedrock. Slope and low strength are major limitations on sites for local roads and streets. Placing the roads on the contour helps to overcome the slope, and providing suitable base material helps to overcome the low strength.

The land capability classification is VIIe. The woodland ordination symbol is 4R.

LtE2—Lowell-Elba silty clay loams, 25 to 40 percent slopes, eroded. This unit consists of deep, steep, well drained soils on hillsides in the uplands. A bench or several benches are on some hillsides. Seeps and gullies are in some areas. Erosion has removed part of the original surface layer. The present surface layer is a mixture of the original surface layer and the subsoil. Most areas of these soils are 500 to 1,500 feet wide and about 1 mile long. They range from 50 to 100 acres. They are about 50 percent Lowell soil and 35 percent Elba soil. The two soils are so mixed or in areas so small that it was not practical to map them separately.

Typically, the surface layer of the Lowell soil is dark brown, friable silty clay loam about 6 inches thick. The subsoil is about 54 inches thick. It is dark brown, firm silty clay loam in the upper part; yellowish brown and light yellowish brown, firm silty clay in the middle part; and variegated strong brown, light olive brown, and dark brown, firm silty clay in the lower part. The substratum is dark brown firm channery silty clay about 12 inches thick. Hard limestone bedrock is at a depth of about 72 inches. Some areas are moderately well drained.

Typically, the surface layer of the Elba soil is brown, friable silty clay loam about 5 inches thick. The subsoil is yellowish brown and light olive brown, friable silty clay loam and firm channery clay about 43 inches thick. Fractured limestone bedrock is at a depth of about 48 inches.

Included with these soils in mapping are small areas of Berks soils near slope breaks and Vandalia soils that occur throughout the unit. Berks soils are moderately deep, and Vandalia soils have redder colors in the subsoil than the major soils. Included soils make up about 15 percent of most mapped areas.

Permeability is moderately slow in the Lowell soil and slow in the Elba soil. The root zone is deep in both soils, and the available water capacity is moderate. Runoff is very rapid. The shrink-swell potential is moderate in the Lowell soil and high in the Elba soil. The organic matter content is moderately low in the surface layer of both soils. Bedrock is at a depth of 40 to 80 inches.

Most areas of these soils are used as woodland or pasture.

These soils are generally unsuited to corn, small grain, and hay. They are poorly suited to pasture. The slope and the hazard of erosion are major limitations. If the pasture is overgrazed or is plowed during seedbed preparation, the hazard of erosion is very severe. A thick grass-legume cover reduces the hazard of erosion. Rotation grazing and proper stocking rates help to prevent overgrazing and control erosion. Restricted grazing during wet periods helps to prevent surface compaction.

These soils are well suited to woodland. The main management concerns are erosion, seedling mortality, and plant competition. The use of equipment, which is limited by the slope, increases the hazard of erosion. Building logging roads and skid trails on the contour helps to overcome the slope and reduces the hazard of erosion. Water bars and a plant cover also help to control erosion. Planting techniques that spread the roots of seedlings and increase soil-root contact reduce seedling mortality. Frequent, light thinning and harvesting increase stand vigor and reduce the windthrow hazard in areas of the Elba soil. Removing vines and the less desirable trees and shrubs reduces plant competition in areas of the Lowell soil.

These soils are generally unsuitable as sites for buildings and septic tank absorption fields because of the slope, the restricted permeability, the shrink-swell potential, and the depth to bedrock. Some areas are scenic and are suitable for recreation. Establishing paths and trails on the contour and covering them with resistant material help to control erosion.

The land capability classification is VIe. The woodland ordination symbol is 5R for the Lowell soil and 3R for the Elba soil.

LtF2—Lowell-Elba silty clay loams, 40 to 70 percent slopes, eroded. This unit consists of deep, very steep, well drained soils on hillsides in the uplands. Slopes are uneven, and a bench or several benches are on some hillsides. Erosion has removed part of the original surface layer. The present surface layer is a mixture of the original surface layer and the subsoil. Seeps and hillside slips are in some areas. Most areas of these soils generally are long and narrow and range from about 50 to 100 acres. They are about 50 percent Lowell soil and 35 percent Elba soil. The two soils are so intermingled or in areas so small that it was not practical to map them separately.

Typically, the surface layer of the Lowell soil is dark brown, friable silty clay loam about 5 inches thick. The subsoil is about 50 inches thick. It is dark brown, firm silty clay loam in the upper part; yellowish brown and light yellowish brown, firm silty clay in the middle part; and dark brown, firm silty clay in the lower part. The substratum is dark brown, firm channery silty clay about 17 inches thick. Hard limestone bedrock is at a depth of about 72 inches.

Typically, the surface layer of the Elba soil is brown, friable silty clay loam about 5 inches thick. The subsoil is yellowish brown and light olive brown, friable silty clay loam and firm channery clay about 45 inches thick. The substratum is light olive brown, firm channery silty clay loam about 10 inches thick. Fractured limestone bedrock is at a depth of about 60 inches.

Included with these soils in mapping are small areas of the moderately deep Berks soils near slope breaks and Vandalia soils that occur throughout the unit. Vandalia soils have redder colors in the subsoil than the major soils. Included soils make up about 15 percent of most mapped areas.

Permeability is moderately slow in the Lowell soil and slow in the Elba soil. The root zone is deep in both soils, and the available water capacity is moderate. Runoff is very rapid. The shrink-swell potential is moderate in the Lowell soil and high in the Elba soil. The organic matter content is moderately low in the surface layer of both soils. Bedrock is at a depth of 40 to 80 inches.

Most areas of these soils are used as woodland. The slope and a very severe hazard of erosion make these soils generally unsuited to farming.

These soils are moderately suited to woodland. The main management concerns are the erosion hazard, seedling mortality, and plant competition. The use of equipment, which is limited by the slope, increases the hazard of erosion. Building logging roads and skid trails on the contour helps to overcome the slope and reduces the hazard of erosion. Water bars and a plant cover also help to control erosion. Planting techniques that spread the roots of seedlings and increase soil-root contact reduce seedling mortality. Frequent, light thinning and harvesting increase stand vigor and reduce the windthrow hazard in areas of the Elba soil. Removing vines and the less desirable trees and shrubs reduces plant competition in areas of the Lowell soil.

These soils are generally unsuitable as sites for buildings and septic tank absorption fields because of the slope, the restricted permeability, the shrink-swell potential, and the depth to bedrock. Some areas are scenic and are suitable for recreation. Establishing paths and trails on the contour and covering them with resistant material help to control erosion.

The land capability classification is VIIe. The woodland ordination symbol is 5R for the Lowell soil and 3R for the Elba soil.

LuE—Lowell-Gilpin silt loams, 25 to 35 percent slopes. This unit consists of steep, well drained soils on side slopes and narrow ridgetops in the uplands. The Lowell soil is on the less sloping parts of the side slopes and on a few benches. The Gilpin soil is on the steeper parts of the side slopes. Landslips and gullies are in some areas. Most areas of these soils are long and wide and range from 30 to 600 acres. They are about 50 percent deep Lowell soil and 35 percent moderately deep Gilpin soil. The two soils are so intermingled or in areas so small that it was not practical to map them separately.

Typically, the surface layer of the Lowell soil is very dark grayish brown, friable silt loam about 3 inches thick. The subsoil is about 56 inches thick. It is yellowish brown, friable silt loam and firm silty clay and clay in the upper part and light yellowish brown, firm silty clay in the lower part. The substratum to a depth of about 64 inches is light yellowish brown, firm silty clay. In places carbonates are in the subsoil at a depth of less than 30 inches.

Typically, the surface layer of the Gilpin soil is dark brown, friable silt loam about 3 inches thick. The subsoil is yellowish brown, friable shaly silty clay loam about 26 inches thick. The substratum is yellowish brown, friable extremely shaly silt loam about 6 inches thick. Hard, light olive brown, fractured siltstone bedrock is at a depth of about 35 inches.

Included with these soils in mapping are small areas of Woodsfield soils on some of the wider benches. Woodsfield soils have redder colors in the lower part of the subsoil than the major soils. Included soils make up about 15 percent of most mapped areas.

Permeability is moderately slow in the Lowell soil and moderate in the Gilpin soil. The root zone is deep in the Lowell soil and moderately deep in the Gilpin soil. The available water capacity is moderate in the Lowell soil and low in the Gilpin soil. Runoff is very rapid on both soils. The organic matter content is moderately low in the surface layer of both soils. Bedrock is at a depth of 20 to 40 inches in the Gilpin soil.

Most areas of these soils are used as woodland or pasture.

The slope and the hazard of erosion make these soils generally unsuited to corn, small grain, and hay and poorly suited to pasture. If the pasture is overgrazed or is plowed during seedbed preparation, the hazard of erosion is very severe. A thick grass-legume cover reduces the hazard of erosion. Rotation grazing and proper stocking rates help to prevent overgrazing and thus help to control erosion. Filling, seeding, and mulching gullies also help to control erosion. Restricted grazing during wet periods helps to prevent surface compaction.

These soils are well suited to woodland. The use of equipment, which is limited by the slope, increases the hazard of erosion. Building logging roads and skid trails on the contour helps to overcome the slope and reduces the hazard of erosion. Water bars and a plant cover help to control erosion. Using seedlings that have been transplanted once reduces seedling mortality on south-facing slopes. Removing vines and the less desirable trees and shrubs helps to control plant competition.

These soils are generally unsuitable as sites for buildings and septic tank absorption fields because of the slope, the restricted permeability of the Lowell soil, and the depth to bedrock in the Gilpin soil. Some areas are scenic and are suitable for recreation. Establishing paths and trails on the contour and covering them with resistant material help to control erosion.

The land capability classification is VIe. The woodland ordination symbol is 5R for the Lowell soil and 4R for the Gilpin soil.

LuF—Lowell-Gilpin silt loams, 35 to 70 percent slopes. This unit consists of very steep, well drained soils on side slopes in the uplands. The Lowell soil is on the less sloping parts of the side slopes and on a few benches. The Gilpin soil is on the steeper parts of the side slopes. Landslips are in some areas. Most areas of these soils are long and wide and range from 30 to 300 acres. They are about 50 percent deep Lowell soil and 35 percent moderately deep Gilpin soil. The two soils are so intermingled or in areas so small that it was not practical to map them separately.

Typically, the surface layer of the Lowell soil is very dark grayish brown, friable silt loam about 4 inches thick. The subsoil is firm silty clay about 50 inches thick. The upper part is dark brown, the middle part is yellowish brown and light yellowish brown, and the lower part is variegated strong brown, olive brown, and brown. The substratum is brown, firm channery silty clay about 16 inches thick. Hard limestone bedrock is at a depth of about 70 inches.

Typically, the surface layer of the Gilpin soil is dark brown, friable silt loam about 4 inches thick. The subsoil is about 22 inches thick. It is brown, friable silt loam and channery silt loam in the upper part and yellowish brown, friable very channery silt loam in the lower part. Olive shale bedrock is at a depth of about 26 inches.

Included with these soils in mapping are areas of Woodsfield soils on benches. Woodsfield soils have redder colors in the lower part of the subsoil than the major soils. Included soils make up about 15 percent of most mapped areas.

Permeability is moderately slow in the Lowell soil and moderate in the Gilpin soil. The root zone is deep in the Lowell soil and moderately deep in the Gilpin soil. The available water capacity is moderate in the Lowell soil and low in the Gilpin soil. Runoff is very rapid on both soils. Bedrock is at a depth of 20 to 40 inches in the Gilpin soil.

Most areas of these soils are used as woodland. The slope and a very severe hazard of erosion make these soils generally unsuited to farming.

These soils are moderately suited to woodland. The use of equipment, which is limited by the slope, increases the hazard of erosion. Building logging roads and skid trails on the contour helps to overcome the slope and reduces the hazard of erosion. Water bars and a plant cover help to control erosion. Using seedlings that have been transplanted once reduces seedling mortality on south-facing slopes. Removing vines and the less desirable trees and shrubs helps to control plant competition.

These soils are generally unsuitable as sites for buildings and septic tank absorption fields because of the slope, the restricted permeability of the Lowell soil, and the depth to bedrock in the Gilpin soil. Some areas are scenic and are suitable for recreation.

The land capability classification is VIIe. The woodland ordination symbol is 5R for the Lowell soil and 4R for the Gilpin soil.

LvD2—Lowell-Upshur silty clay loams, 15 to 25 percent slopes, eroded. This unit consists of deep, moderately steep, well drained soils on side slopes in the uplands. Erosion has removed part of the original surface layer. The present surface layer is a mixture of the original surface layer and the subsoil. Landslips with hummocky relief of 2 to 6 feet are in most areas. Seeps are in some areas. Most areas of these soils are long and wide. They range from 25 to 100 acres. They are about 50 percent Lowell soil and 35 percent Upshur soil. The two soils are so mixed or in areas so small that it was not practical to map them separately.

Typically, the surface layer of the Lowell soil is dark brown, friable silty clay loam about 7 inches thick. The subsoil is firm silty clay about 48 inches thick. It is dark brown in the upper part, light yellowish brown and light olive brown in the middle part, and variegated light yellowish brown, brown, and dark brown in the lower part. Hard siltstone bedrock is at a depth of about 55 inches.

Typically, the surface layer of the Upshur soil is dark reddish brown, firm silty clay loam about 6 inches thick. The subsoil is dark reddish brown, reddish brown, and dusky red, firm silty clay about 44 inches thick. The substratum to a depth of about 72 inches is reddish brown, dusky red, and weak red, firm silty clay. Some areas are moderately alkaline in the upper part of the soil.

Included with these soils in mapping are small areas of the moderately deep Gilpin soils on the upper parts of slopes. Included soils make up about 15 percent of most mapped areas.

Permeability is moderately slow in the Lowell soil and slow in the Upshur soil. The root zone is deep in both soils, and the available water capacity is moderate. Runoff is very rapid. The shrink-swell potential is high in the subsoil of the Upshur soil and moderate in the subsoil of the Lowell soil. The organic matter content is moderately low in the surface layer of both soils.

Most areas of these soils are used as woodland. A few areas are used as pasture or cropland.

These soils are generally unsuited to corn, small grain, hay, and pasture. The slope and a very severe erosion hazard are the major limitations. Surface drains are needed in scattered seep areas.

These soils are well suited to woodland. The use of equipment, which is limited by the slope, increases the hazard of erosion. Building logging roads and skid trails on the contour helps to overcome the slope and reduces the hazard of erosion. Water bars and a plant cover also help to control erosion. Planting techniques that spread the roots of seedlings and increase soil-root contact reduce seedling mortality. Frequent, light thinning and harvesting increase stand vigor and reduce the windthrow hazard in areas of the Upshur soil. Removing vines and the less desirable trees and shrubs helps to control plant competition.

These soils are generally unsuitable as sites for buildings and septic tank absorption fields. The slope, the restricted permeability, and the high shrink-swell potential and slippage hazard in areas of the Upshur soil are the major limitations. Cutting and filling increase the hazard of hillside slippage. Designing walls to include pilasters, reinforced concrete, and large-spread footings and backfilling around foundations with material that has a low shrink-swell potential help to prevent the damage caused by shrinking and swelling. Maintaining or establishing a plant cover and mulching help to control erosion on construction sites. Establishing paths and trails on the contour and covering them with resistant material help to control erosion. Building local roads and streets on the contour and using suitable base material also help to control erosion and reduce the damage caused by shrinking and swelling.

The land capability classification is VIe. The woodland ordination symbol is 4R for the Lowell soil. For the Upshur soil, it is 4R on north aspects and 3R on south aspects.

LvE2—Lowell-Upshur silty clay loams, 25 to 40 percent slopes, eroded. This unit consists of deep, steep, well drained soils on side slopes in the uplands. Erosion has removed part of the original surface layer. The present surface layer is a mixture of the original surface layer and the subsoil. Landslips with hummocky relief of 2 to 6 feet are in most areas. Seeps are in some areas. Most areas of these soils are long and wide and range from 25 to 150 acres. They are about 50 percent Lowell soil and 35 percent Upshur soil. The two soils are so mixed or in areas so small that it was not practical to map them separately.

Typically, the surface layer of the Lowell soil is dark brown, friable silty clay loam about 7 inches thick. The subsoil is firm silty clay about 48 inches thick. It is dark brown in the upper part, light yellowish brown and light olive brown in the middle part, and variegated light yellowish brown, brown, and dark brown in the lower part. Hard siltstone bedrock is at a depth of about 55 inches.

Typically, the surface layer of the Upshur soil is dark reddish brown, firm silty clay loam about 6 inches thick. The subsoil is dark reddish brown, reddish brown, and dusky red, firm silty clay about 44 inches thick. The substratum to a depth of about 72 inches is reddish brown, dusky red, and weak red, firm silty clay. Some areas are moderately alkaline in the upper part.

Included with these soils in mapping are small areas of the moderately deep Gilpin soils on the upper parts of slopes. Included soils make up about 15 percent of most mapped areas.

Permeability is moderately slow in the Lowell soil and slow in the Upshur soil. The root zone is deep in both soils, and the available water capacity is moderate. Runoff is very rapid. The shrink-swell potential is high in the subsoil of the Upshur soil and moderate in the subsoil of the Lowell soil. The organic matter content is moderately low in the surface layer of both soils.

Most areas of these soils are used as woodland. A few areas are used as pasture.

These soils are generally unsuited to corn, small grain, hay, and pasture. The slope and a very severe erosion hazard are the major limitations.

These soils are moderately suited to woodland. The use of equipment, which is limited by the slope, increases the hazard of erosion. Building logging roads and skid trails on the contour helps to overcome the slope and reduces the hazard of erosion. Water bars and a plant cover also help to control erosion. Planting techniques that spread the roots of seedlings and increase soil-root contact reduce seedling mortality. Frequent, light thinning and harvesting increase stand vigor and reduce the windthrow hazard in areas of the Upshur soil. Removing vines and the less desirable trees and shrubs helps to control plant competition.

These soils are generally unsuitable as sites for buildings and septic tank absorption fields. The slope, the restricted permeability, and the high shrink-swell potential and slippage hazard in areas of the Upshur soil are the major limitations. Cutting and filling increase the hazard of hillside slippage. Establishing paths and trails on the contour and covering them with resistant material help to control erosion.

The land capability classification is VIIe. The woodland ordination symbol is 5R for the Lowell soil. For the Upshur soil, it is 4R on north aspects and 3R on south aspects.

LvF2—Lowell-Upshur silty clay loams, 40 to 70 percent slopes, eroded. This unit consists of deep, very steep, well drained soils on side slopes in the uplands. Erosion has removed part of the original surface layer. Landslips with hummocky relief of 2 to 6 feet are in most areas. Seeps are in some areas. Most areas of these soils are long and wide and range from 25 to 150 acres. They are about 50 percent Lowell soil and 35 percent Upshur soil. The two soils are so mixed or in areas so small that it was not practical to map them separately.

Typically, the surface layer of the Lowell soil is dark brown, friable silty clay loam about 6 inches thick. The subsoil is about 48 inches thick. It is dark brown, firm silty clay in the upper part; light yellowish brown and light olive brown, firm silty clay in the middle part; and variegated light yellowish brown, brown, and dark brown, firm silty clay loam in the lower part. Hard bedrock is at a depth of about 54 inches.

Typically, the surface layer of the Upshur soil is dark reddish brown, firm silty clay loam about 6 inches thick. The subsoil is dark reddish brown, reddish brown, and dusky red, firm silty clay about 28 inches thick. The substratum to a depth of about 72 inches is reddish brown, dusky red, and weak red, firm silty clay.

Included with these soils in mapping are small areas of the moderately deep Gilpin and Berks soils near slope breaks. Included soils make up about 15 percent of most mapped areas.

Permeability is moderately slow in the Lowell soil and slow in the Upshur soil. The root zone is deep in both soils, and the available water capacity is moderate. Runoff is very rapid. The shrink-swell potential is high in the subsoil of the Upshur soil and moderate in the subsoil of the Lowell soil.

Most areas of these soils are used as woodland.

These soils are generally unsuited to corn, small grain, hay, and pasture. The slope and a very severe erosion hazard are the major limitations.

These soils are moderately suited to woodland. The use of equipment, which is limited by the slope, increases the hazard of erosion. Building logging roads and skid trails on the contour helps to overcome the slope and reduces the hazard of erosion. Water bars and a plant cover also help to control erosion. Planting techniques that spread the roots of seedlings and increase soil-root contact reduce seedling mortality. Frequent, light thinning and harvesting increase stand vigor and reduce the windthrow hazard in areas of the Upshur soil. Removing vines and the less desirable trees and shrubs helps to control plant competition.

These soils are generally unsuitable as sites for buildings and septic tank absorption fields. The slope, the restricted permeability, and the high shrink-swell potential and slippage hazard in areas of the Upshur soil are the major limitations. Establishing paths and trails on the contour and covering them with resistant material help to control erosion.

The land capability classification is VIIe. The woodland ordination symbol is 5R for the Lowell soil. For the Upshur soil, it is 4R on north aspects and 3R on south aspects.

MoB—Morristown silty clay loam, 0 to 8 percent slopes. This soil is deep, nearly level and gently sloping, and well drained. It is on mine-spoil ridgetops in areas that have been surface-mined for coal. It has been reclaimed by grading and by blanketing the surface with a layer of material removed from areas of other soils. The substratum is a mixture of rock fragments and partly weathered fine earth material that was in or below the profile of the original soil. Most of the rock fragments in the soil are limestone and shale and smaller amounts of siltstone, sandstone, and coal. Slopes are smooth. Most areas of this soil are elongated or circular and range from 10 to 100 acres.

Typically, the surface layer is reddish brown, firm silty clay loam about 10 inches thick. The substratum to a depth of about 72 inches is olive gray, firm very channery silty clay loam and extremely channery silty clay loam.

Included with this soil in mapping are small unreclaimed areas of soils in which tilth is poor and that have a surface layer of channery silty clay loam. The channers in the surface layer interfere with tillage. Included soils make up about 15 percent of most mapped areas.

Permeability is moderately slow in the Morristown soil. The depth of the root zone varies widely because of differences in the density of the soil material. The available water capacity is low. Runoff is medium. Tilth is fair. The content of organic matter is low in the surface layer.

Most areas of this soil support grasses and legumes for hay and pasture. Some areas are used for small grain.

This soil is poorly suited to corn and moderately suited to hay. Erosion is a hazard, and the soil is droughty. If the soil is cultivated, the hazard of erosion is very severe. No-till farming is well suited to this soil. Including grasses and legumes and cover crops in the cropping sequence, mixing crop residue into the surface layer, tilling on the contour, and applying a system of conservation tillage that leaves crop residue on the surface will help to control erosion, conserve moisture, and increase the rate of water intake. Because of uneven grading or settling, surface drains are needed in some areas.

This soil is moderately suited to pasture. Erosion is a hazard, and the soil is droughty. If the pasture is overgrazed or is plowed during seedbed preparation, the hazard of erosion is very severe. Proper stocking rates and rotation grazing help to prevent overgrazing and thus help to control erosion. No-till seeding also helps to control erosion. Restricted grazing during wet periods helps to prevent surface compaction. A plant cover and surface mulch reduce runoff and the hazard of erosion and increase the rate of water intake.

This soil is suited to alkaline- and drought-tolerant trees. Grasses and legumes provide ground cover during the establishment of trees. Mechanical planting is practical on this soil.

Onsite investigation is needed to determine the suitability of the soil as a site for buildings, local roads, and septic tank absorption fields. Once the soil has settled, it is moderately suited to building site development and poorly suited to septic tank absorption fields. The thickness of the soil over bedrock and the control of storm-water runoff are major concerns. The areas that are deeper to bedrock usually take longer to settle. In a few places where the premining use was woodland, trees and woody debris are in the soil. These areas are especially susceptible to subsidence. A moderate shrink-swell potential is a limitation on sites for dwellings. This limitation can be overcome by backfilling around foundations with material that has a low shrink-swell potential and by supporting the walls with a large-spread footing. The restricted permeability is a limitation on sites for septic tank absorption fields. Enlarging the field improves the filtering capacity, and aeration systems or holding tanks help to overcome the restricted permeability. If the soil is used for lawns, droughtiness is a hazard during dry periods.

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

MoC—Morristown silty clay loam, 8 to 15 percent slopes. This soil is deep, strongly sloping, and well drained. It is on mine-spoil ridgetops and side slopes in areas that have been surface-mined for coal. It has been reclaimed by grading and by blanketing the surface with a layer of material removed from areas of other soils. The substratum is a mixture of rock fragments and partly weathered fine earth material that was in or below the profile of the original soil. Most of the rock fragments in the soil are limestone and shale and smaller amounts of siltstone, sandstone, and coal. Most areas of this soil are elongated or circular and range from 10 to 100 acres.

Typically, the surface layer is reddish brown, firm silty clay loam about 9 inches thick. The substratum to a depth of about 72 inches is olive gray, firm very channery silty clay loam and extremely channery silty clay loam.

Included with this soil in mapping are small unreclaimed areas of soils in which tilth is poor and that have a surface layer of channery silty clay loam. The channers in the surface layer interfere with tillage. Included soils make up about 15 percent of most mapped areas.

Permeability is moderately slow in the Morristown soil. The depth of the root zone varies widely because of differences in the density of the soil material. The available water capacity is low. Runoff is rapid. Tilth is fair. The content of organic matter is low in the surface layer.

Most areas of this soil support grasses and legumes for hay and pasture. Some areas are used for small grain or as woodland.

This soil is poorly suited to corn and moderately suited to hay and pasture. Erosion is a hazard, and the soil is droughty. If the soil is cultivated, the hazard of erosion is very severe. No-till farming is well suited to this soil. Including grasses and legumes and cover crops in the cropping sequence, mixing crop residue into the surface layer, tilling on the contour, and applying a system of conservation tillage that leaves crop residue on the surface help to control erosion, conserve moisture, and increase the rate of water intake. Because of uneven grading or settling, surface drains are needed in some areas. If the pasture is overgrazed or is plowed during seedbed preparation, the hazard of erosion is very severe. Proper stocking rates and rotation grazing help to prevent overgrazing and thus help to control erosion. Restricted grazing during wet periods helps to prevent surface compaction.

This soil is suited to alkaline- and drought-tolerant trees. Grasses and legumes provide ground cover during the establishment of trees. Mechanical planting is practical on this soil.

Onsite investigation is needed to determine the suitability of the soil as a site for buildings, local roads, and septic tank absorption fields. Once the soil has settled, it is moderately suited to building site development and poorly suited to septic tank absorption fields. The thickness of the soil over bedrock, the erosion hazard, and the control of storm-water runoff are major concerns. Mulching and establishing a temporary plant cover help to control erosion during construction. The areas that are deeper to bedrock usually take longer to settle. In a few places where the premining use was woodland, trees and woody debris are in the soil. These areas are especially susceptible to subsidence. The moderate shrink-swell potential is a limitation on sites for dwellings. This limitation can be overcome by backfilling around foundations with material that has a low shrink-swell potential and by supporting the walls with a large-spread footing. Land shaping is needed in some areas. The restricted permeability is a limitation on sites for septic tank absorption fields. Enlarging the absorption field improves the filtering capacity, and aeration systems or holding tanks help to overcome the restricted permeability. Installing distribution lines on the contour helps to prevent seepage. If the soil is used for lawns, droughtiness is a hazard during dry periods. Building local roads on the contour helps to control erosion.

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

MoD—Morristown silty clay loam, 15 to 25 percent slopes. This soil is deep, moderately steep, and well drained. It is on mine-spoil ridgetops and side slopes in areas that have been surface-mined for coal. It has been reclaimed by grading and by blanketing the surface with a layer of material removed from areas of other soils. A few stones are on the surface. The substratum is a mixture of rock fragments and partly weathered fine earth material that was in or below the profile of the original soil. Most of the rock fragments are limestone and shale and smaller amounts of siltstone, sandstone, and coal. Most areas of this soil are oblong and range from 5 to 100 acres. Deep gullies dissect some areas.

Typically, the surface layer is brown, firm silty clay loam about 10 inches thick. The substratum to a depth of about 72 inches is variegated olive gray, light olive gray, and pale olive, firm very channery silty clay loam and extremely channery silty clay loam.

Included with this soil in mapping are small unreclaimed areas of soils in which tilth is poor and that have a surface layer of channery silty clay loam. The channers in the surface layer interfere with tillage. Included soils make up about 15 percent of most mapped areas.

Permeability is moderately slow in the Morristown soil. The depth of the root zone varies widely because of differences in the density of the soil material. The available water capacity is low. Runoff is very rapid. Tilth is fair. The content of organic matter is low in the surface layer.

Most of the acreage of this soil is grassland. Some areas are used as pasture.

This soil is generally unsuited to corn and small grain and poorly suited to hay and pasture. Erosion is a very severe hazard, and the soil is droughty. Overgrazing the pasture or plowing during seedbed preparation increases the hazard of erosion. Proper stocking rates and rotation grazing help to prevent overgrazing and thus help to control erosion. No-till seeding also helps to control erosion. The slope limits the use of some types of equipment.

This soil is suited to alkaline- and drought-tolerant trees, though growth generally is slow. Grasses and legumes provide ground cover during the establishment of trees. Water bars and logging roads and skid trails built on the contour help to control erosion.

Even after the soil has settled, it is generally unsuitable as a site for buildings and septic tank absorption fields. The moderately slow permeability and a susceptibility to hillside slippage are major limitations. Cutting and filling increase the hazard of slippage, but installing drains reduces this hazard.

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

MrB—Morristown channery silty clay loam, 0 to 8 percent slopes. This soil is deep, nearly level and gently sloping, and well drained. It is on mine-spoil ridgetops in areas that have been surface-mined for coal. It has been reclaimed by grading and by blanketing the surface with a layer of material removed from areas of other soils, and most areas have been smoothed. A few stones are on the surface of some areas. The substratum is a mixture of rock fragments and partly weathered fine earth material that was in or below the profile of the original soil. Most of the rock fragments are limestone and shale and smaller amounts of siltstone, sandstone, and coal. Slopes mainly are smooth, but small, shallow gullies are in some areas. Most areas of this soil are elongated or circular and range from 5 to 100 acres.

Typically, the surface layer is reddish brown, friable channery silty clay loam about 8 inches thick. The substratum to a depth of about 72 inches is olive gray, firm very channery silty clay loam and extremely channery silty clay loam. Some areas have a surface layer of silty clay loam.

Included with this soil in mapping are small areas of Bethesda soils and soils that have a surface layer and substratum of very channery sandy loam or very channery loamy sand. Bethesda soils are more acid than the Morristown soil. Included soils make up about 15 percent of most mapped areas.

Permeability is moderately slow in the Morristown soil. The depth of the root zone varies widely because of differences in the density of the soil material. The available water capacity is low. Runoff is medium. Tilth is poor. The content of organic matter is very low in the surface layer.

Most of the acreage of this soil supports grasses and legumes for hay and pasture. Some areas are used for small grain.

This soil is generally unsuited to corn and poorly suited to hay and pasture. Erosion is a hazard, and the soil is droughty. If the soil is cultivated, the hazard of erosion is very severe. No-till farming is well suited to this soil. Including grasses and legumes and cover crops in the cropping sequence, mixing crop residue into the surface layer, tilling on the contour, and applying a system of conservation tillage that leaves crop residue on the surface help to control erosion, conserve moisture, and increase the rate of water intake. Because of uneven grading or settling, surface drains are needed in some areas.

This soil is suited to alkaline- and drought-tolerant trees. Grasses and legumes provide ground cover during the establishment of trees. Mechanical planting is practical on this soil.

Onsite investigation is needed to determine the suitability of the soil as a site for buildings, local roads, and septic tank absorption fields. Once the soil has settled, it is moderately suited to building site development and poorly suited to septic tank absorption fields. The thickness of the soil over bedrock and the control of storm-water runoff are major concerns. The areas that are deeper to bedrock usually take longer to settle. In a few places where the premining use was woodland, trees and woody debris are in the soil. These areas are especially susceptible to subsidence. The moderate shrink-swell potential is a limitation on sites for dwellings. This limitation can be overcome by backfilling around foundations with material that has a low shrink-swell potential and by supporting the walls with a large-spread footing. The restricted permeability is a limitation on sites for septic tank absorption fields. Enlarging the absorption field improves the filtering capacity, and aeration systems or holding tanks help to overcome the restricted permeability. Covering the areas with a soil that has a better available water capacity and fewer stones increases the suitability of the soil for lawns.

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

MrD—Morristown channery silty clay loam, 8 to 25 percent slopes. This soil is deep, strongly sloping and moderately steep, and well drained. It is on mine-spoil ridgetops and side slopes in areas that have been surface-mined for coal. The substratum is a mixture of rock fragments and partly weathered fine earth material that was in or below the profile of the original soil. Most of the rock fragments are limestone and shale and smaller amounts of siltstone, sandstone, and coal. A few stones are on the surface of some areas, and deep gullies dissect some areas. Most areas of this soil are oblong and range from 5 to 80 acres.

Typically, the surface layer is reddish brown, friable channery silty clay loam about 8 inches thick. The substratum to a depth of about 72 inches is olive gray, firm very channery silty clay loam. In some areas the surface layer is silty clay loam.

Included with this soil in mapping are small areas of Bethesda soils. These soils are more acid than the Morristown soil. Included soils make up about 15 percent of most mapped areas.

Permeability is moderately slow in the Morristown soil. The depth of the root zone varies widely because of differences in the density of the soil material. The available water capacity is low. Runoff is very rapid. Tilth is poor. The content of organic matter is very low in the surface layer.

Most of the acreage of this soil is grassland. Some areas are used for pasture, small grain, or woodland.

This soil is generally unsuited to corn and small grain, poorly suited to pasture, and poorly suited or unsuited to hay. Erosion is a very severe hazard, and the soil is droughty. Proper stocking rates and rotation grazing help to prevent overgrazing and thus help to control erosion. No-till seeding also helps to control erosion. The slope limits the use of some types of equipment.

This soil is suited to alkaline- and drought-tolerant trees, though growth generally is slow. Grasses and legumes provide ground cover during the establishment of trees.

Onsite investigation is needed to determine the suitability of the soil as a site for buildings, local roads, and septic tank absorption fields. Once the soil has settled, it is moderately suited to building site development and poorly suited to septic tank absorption fields. The thickness of the soil over bedrock, the slope, the erosion hazard, a susceptibility to hillside slippage, and the control of storm-water runoff are major concerns. The areas that are deeper to bedrock usually take longer to settle. In a few places where the premining use was woodland, trees and woody debris are in the soil. These areas are especially susceptible to subsidence. The moderate shrink-swell potential is a limitation on sites for dwellings. This limitation can be overcome by backfilling around foundations with material that has a low shrink-swell potential and by supporting the walls with a large-spread footing. Shaping the land and designing the buildings so that they conform to the natural slope of the land help to control erosion. The slope also is a major limitation on sites for local roads and streets.

The restricted permeability is a limitation on sites for septic tank absorption fields. Enlarging the field improves the filtering capacity, and aeration systems or holding tanks help to overcome the restricted permeability. Installing distribution lines on the contour helps to prevent seepage. Covering the areas with a soil that has a better available water capacity and fewer stones increases the suitability of the soil for lawns.

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

MrF—Morristown channery silty clay loam, 25 to 70 percent slopes. This soil is deep, steep and very steep, and well drained. It is on graded mine-spoil side slopes in areas that have been surface-mined for coal. The substratum is a mixture of rock fragments and partly weathered fine earth material that was in or below the profile of the original soil. Most of the rock fragments are limestone and shale and smaller amounts of siltstone, sandstone, and coal. A few stones are on the surface. Deep gullies are in some areas, and water is in some small V-shaped valleys between piles of spoil and at the base of high walls. Most areas of this soil are long and narrow and range from 10 to 300 acres.

Typically, the surface layer is yellowish brown, friable channery silty clay loam about 8 inches thick. The substratum to a depth of about 72 inches is dark gray and gray, firm very channery silty clay loam, extremely channery silty clay loam, extremely channery clay loam, and very channery clay loam.

Included with this soil in mapping are small areas of Bethesda soils. These soils are more acid than the Morristown soil. Included soils make up about 15 percent of most mapped areas.

Permeability is moderately slow in the Morristown soil. The depth of the root zone varies widely because of differences in the density of the soil material. The available water capacity is low. Runoff is very rapid. The content of organic matter is very low in the surface layer.

Most areas of this soil support grasses and legumes. Planted black locust is in some areas, and volunteer trees and briars are in some other areas.

This soil is generally unsuited to cultivated crops, hay, and pasture because of the slope, a very severe erosion hazard, and droughtiness. A dense plant cover increases the infiltration rate in the soil by slowing runoff.

This soil is suited to alkaline- and drought-tolerant trees, though growth generally is slow. Grasses and legumes provide ground cover during the establishment of trees.

This soil generally is unsuitable as a site for buildings or septic tank absorption fields because of the slope, the restricted permeability, the settling, and a hazard of hillside slippage. Cutting and filling increase the hazard of hillside slippage, but installing drains in areas where water concentrates reduces this hazard.

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

Ne—Newark silt loam, occasionally flooded. This soil is deep, nearly level, and somewhat poorly drained. It is in shallow depressions on flood plains. Slope ranges from 0 to 3 percent. Most areas of this soil are long and narrow and range from 50 acres to several hundred acres.

Typically, the surface layer is brown, friable silt loam about 7 inches thick. The subsoil is brown and dark grayish brown, mottled, friable silt loam about 28 inches thick. The substratum to a depth of about 63 inches is grayish brown, mottled, friable silty clay loam and gravelly loam.

Included with this soil in mapping are small areas of the well drained Nolin soils on the slightly higher parts of flood plains. Also included are areas of soils in the flood pool of Senecaville Lake. These soils are subject to frequent flooding of long duration. Included soils make up about 15 percent of most mapped areas.

Permeability is moderate in the Newark soil. The root zone is deep. The available water capacity is high. Runoff is slow. A seasonal high water table is at a depth of 6 to 18 inches during extended wet periods. In the surface layer, the content of organic matter is moderate and tilth is good.

Most areas of this soil are used for corn, small grain, and hay. Some irregularly shaped areas are used as pasture or woodland.

If drained, this soil is well suited to corn, hay, and pasture. Row crops can be grown year after year if the soil is adequately drained and if the flooding is controlled or the crops are planted after the normal period of flooding. Subsurface drains are suitable where drainage outlets are available. Grassed waterways help to divert runoff from the adjacent uplands to natural drainageways or ditches. A surface crust forms after periods of heavy rainfall, especially in tilled areas. Shallow cultivation of intertilled crops breaks up the crust. The floodwater deposits sediment on hay and pasture, commonly making the forage unsuitable for hay. Restricted grazing during wet periods helps to prevent surface compaction.

This soil is well suited to woodland. Many of the wooded areas are old stream channels. Frequent, light thinning and harvesting increase stand vigor and reduce the windthrow hazard. Removing vines and the less desirable trees and shrubs helps to control plant competition.

This soil generally is unsuitable as a site for small buildings and for septic tank absorption fields. Building local roads and streets on fill material helps to overcome the flooding. Providing artificial drainage and suitable base material help to prevent the road damage caused by low strength and by seasonal wetness.

The land capability classification is IIw. The woodland ordination symbol is 4A.

Ng—Newark silt loam, frequently flooded. This soil is deep, nearly level, and somewhat poorly drained. It is on flood plains of small streams. Slope ranges from 0 to 3 percent. Most areas of this soil are long and narrow and range from 10 to 50 acres.

Typically, the surface layer is brown, friable silt loam about 10 inches thick. The subsoil is about 34 inches thick. It is brown, mottled, friable silt loam and silty clay loam in the upper part and grayish brown, mottled, firm silty clay in the lower part. The substratum to a depth of about 72 inches is brown, mottled, firm silty clay. Some areas are poorly drained.

Included with this soil in mapping are small areas of soils that are ponded after flooding. Included soils make up about 10 percent of most mapped areas.

Permeability is moderate in the upper part of the Newark soil and slow in the lower part. The root zone is deep. The available water capacity is high. Runoff is slow. A seasonal high water table is at a depth of 6 to 18 inches during extended wet periods. In the surface layer, the content of organic matter is moderate and tilth is good.

Most areas of this soil are used as pasture or woodland. Some areas are used for hay.

If drained, this soil is moderately suited to corn and hay and well suited to pasture. Subsurface and surface drains are suitable on this soil, but drainage outlets for subsurface drains generally are not available. Flooding and seasonal wetness delay planting in most years, and flooding damages small grain. The floodwater deposits sediment on hay and pasture, commonly making the forage unsuitable for hay. Restricted grazing during wet periods helps to prevent surface compaction.

This soil is moderately suited to woodland. Flooding and seasonal wetness are the main limitations. Frequent, light thinning and harvesting increase stand vigor and reduce the windthrow hazard. Removing vines and the less desirable trees and shrubs helps to control plant competition.

This soil generally is unsuitable as a site for small buildings and for septic tank absorption fields. The seasonal wetness, the flooding, and the permeability are the major limitations. Building local roads and streets on fill material helps to overcome the flooding. Providing artificial drainage and suitable base material help to prevent the road damage caused by low strength and by seasonal wetness.

The land capability classification is IIIw. The woodland ordination symbol is 4A.

No—Nolin silt loam, frequently flooded. This soil is deep, nearly level, and well drained. It is on flood plains. Narrow meander channels are in many areas. Slope ranges from 0 to 3 percent. Most areas of this soil are long and narrow and range from 10 to 100 acres.

Typically, the surface layer is brown, friable silt loam about 8 inches thick. The subsoil is dark yellowish brown and dark brown, friable silt loam about 40 inches thick. The substratum to a depth of about 72 inches is dark brown, friable silt loam.

Included with this soil in mapping are areas of the somewhat poorly drained Newark soils in shallow depressions. Also included are areas of soils in the flood pool of Senecaville Lake. These soils are subject to flooding of long duration. Included soils make up about 15 percent of most mapped areas.

Permeability is moderate in the Nolin soil. The root zone is deep. The available water capacity is high. Runoff is slow. A seasonal high water table is at a depth of 36 to 72 inches during extended wet periods.

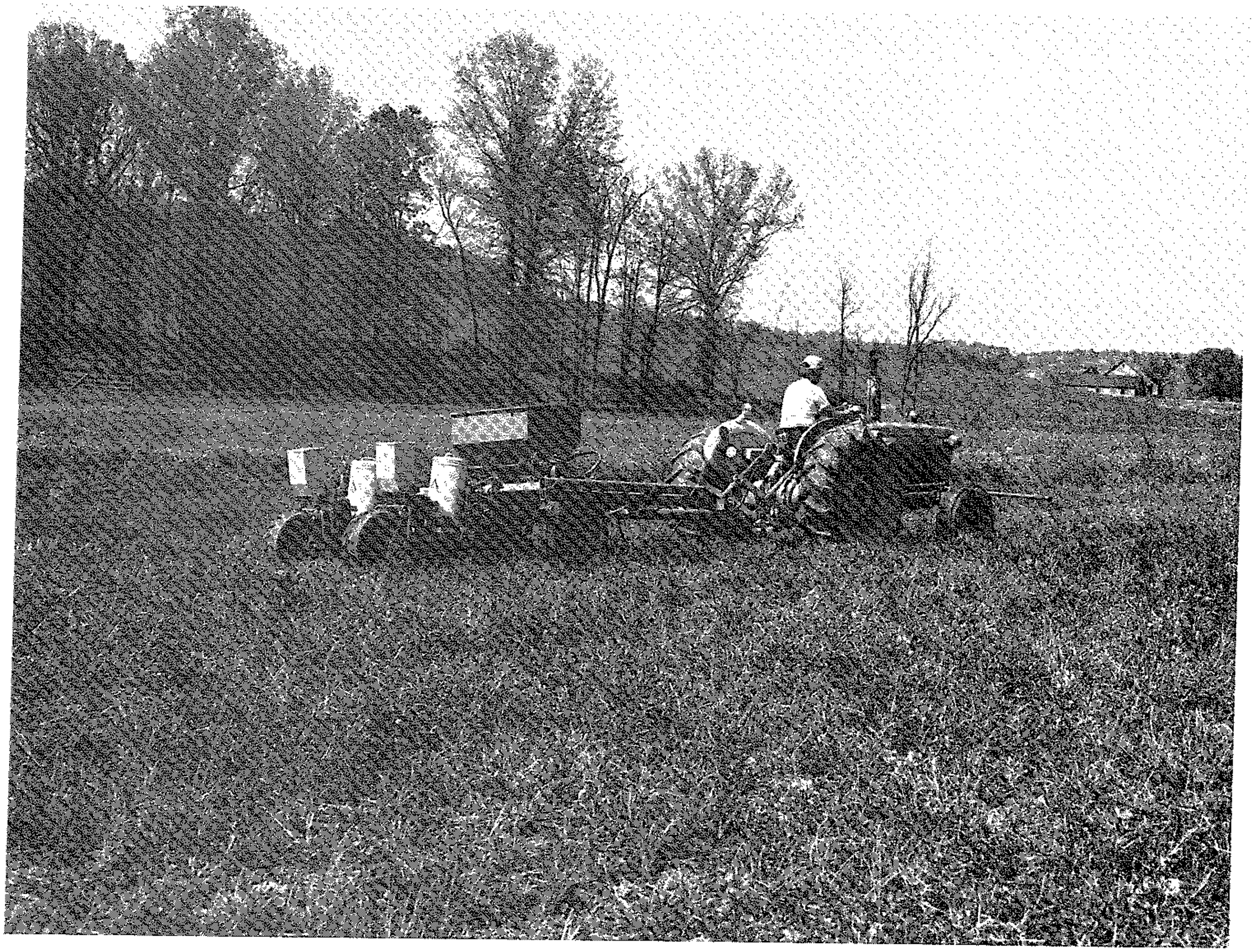

Figure 4.—Planting no-till corn in an area of Nolin silt loam, frequently flooded.

In the surface layer, the content of organic matter is moderate and tilth is good.

Most of the acreage of this soil is farmland.

This soil is well suited to corn and soybeans, but flooding is a limitation if winter grain is grown. The soil is better suited to crops that can be planted after the normal period of flooding than to crops that are planted early in spring. The surface layer is crusty after hard rains. No-till planting or other kinds of conservation tillage that leave crop residue on the surface help to prevent erosion and crusting (fig. 4). Floodwater sometimes deposits sediment on hay and pasture, commonly making the forage unsuitable for hay. Rotation grazing and restricted grazing during wet periods help to keep the pasture in good condition.

This soil is well suited to woodland. Flooding is a hazard to seedlings. Removing vines and the less desirable trees and shrubs helps to control plant competition.

This soil generally is unsuitable as a site for buildings and septic tank absorption fields because of the flooding. It is well suited, however, to some recreational uses, such as picnic areas and paths and trails, during seasons when flooding is rare. The soil is a good source of topsoil. Constructing local roads and streets on fill material helps to overcome the flooding, and using a suitable base material reduces the road damage caused by low strength and by frost action.

The land capability classification is IIw. The woodland ordination symbol is 5A.

OmB—Omulga silt loam, 1 to 6 percent slopes. This soil is deep, nearly level and gently sloping, and moderately well drained. It is on high terraces along streams. Slopes are mainly smooth but are slightly convex near the heads of drainageways. Most areas of this soil are roughly square or irregular in shape and range from 5 to 100 acres.

Typically, the surface layer is brown, friable silt loam about 10 inches thick. The subsoil is about 48 inches thick and is mottled at a depth of more than 28 inches. The upper part of the subsoil is brown, strong brown, and yellowish brown, friable and firm silt loam; the middle part is a fragipan of yellowish brown, very firm and brittle silty clay loam; and the lower part is yellowish brown, friable silt loam. The substratum to a depth of about 68 inches is reddish brown, mottled, firm silty clay. Bedrock is at a depth of less than 5 feet in some areas.

Included with this soil in mapping are small areas of somewhat poorly drained, less sloping soils. Some areas of soils are in the flood pool of Senecaville Lake and are subject to flooding. Included soils make up about 15 percent of most mapped areas.

Permeability is moderate above the fragipan in the Omulga soil and slow in the fragipan. The root zone is mainly restricted to a depth of 20 to 36 inches, which is the zone above the fragipan. The available water capacity of this zone is moderate. Runoff is slow or medium. A perched seasonal high water table is at a depth of 24 to 42 inches during extended wet periods. In the surface layer, the content of organic matter is moderate and tilth is good.

Most areas of this soil are used for row crops or for hay and pasture. Some areas are wooded.

This soil is well suited to corn, soybeans, small grain, hay, and pasture. Controlling erosion and maintaining tilth are the main management concerns. If the soil is cultivated or is plowed during seedbed preparation or if the pasture is overgrazed, erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour farming, and cover crops reduce the runoff rate and help to prevent erosion and deterioration of tilth. Natural drainage generally is adequate, but subsurface drains are needed in scattered areas of the wetter included soils. The surface layer of this soil is crusty after periods of heavy rainfall, especially in tilled areas. Shallow cultivation of intertilled crops breaks up the crust. Restricted grazing during wet periods helps to keep the pasture in good condition. Proper stocking rates and rotation grazing help to prevent overgrazing and thus help to control erosion.

This soil is well suited to woodland. No major hazards or limitations affect planting or harvesting.

This soil is moderately suited to building site development. The seasonal wetness and the shrink-swell potential are the main limitations. Waterproofing basement walls, using a sump pump, and installing drains at the base of footings help keep basements dry. Designing walls to include pilasters, reinforced concrete, and large-spread footings and backfilling around foundations with material that has a low shrink-swell potential help to prevent the structural damage caused by shrinking and swelling.

Low strength and the potential for frost action are limitations on sites for local roads and streets. Installing a drainage system and providing suitable base material help to reduce the effects of these limitations.

This soil is poorly suited to septic tank absorption fields. The seasonal wetness and the slow permeability are limitations. Installing perimeter drains around the absorption field reduces the seasonal wetness. Widening the bottom of the trench will help to overcome the restricted permeability.

The land capability classification is IIe. The woodland ordination symbol is 4A.

OmC—Omulga silt loam, 6 to 15 percent slopes. This soil is deep, strongly sloping, and moderately well drained. It is on high terraces along streams and is in broad interfluves between shallow drainageways (fig. 5). Most areas are long and narrow or irregularly shaped and range from 5 to 50 acres.

Typically, the surface layer is brown, friable silt loam about 10 inches thick. The subsoil is about 48 inches thick. The upper part is strong brown and yellowish brown, friable and firm silt loam; the middle part is a fragipan of yellowish brown, mottled, very firm and brittle silty clay loam; and the lower part is yellowish brown, mottled, friable silt loam. The substratum to a depth of about 68 inches is reddish brown, mottled, firm silty clay. Bedrock is at a depth of less than 5 feet in some areas.

Included with this soil in mapping are small seeps at the base of slopes. Some areas of soils are in the flood pool of Senecaville Lake and are subject to flooding. Included soils make up about 10 percent of most mapped areas.

Permeability is moderate above the fragipan in the

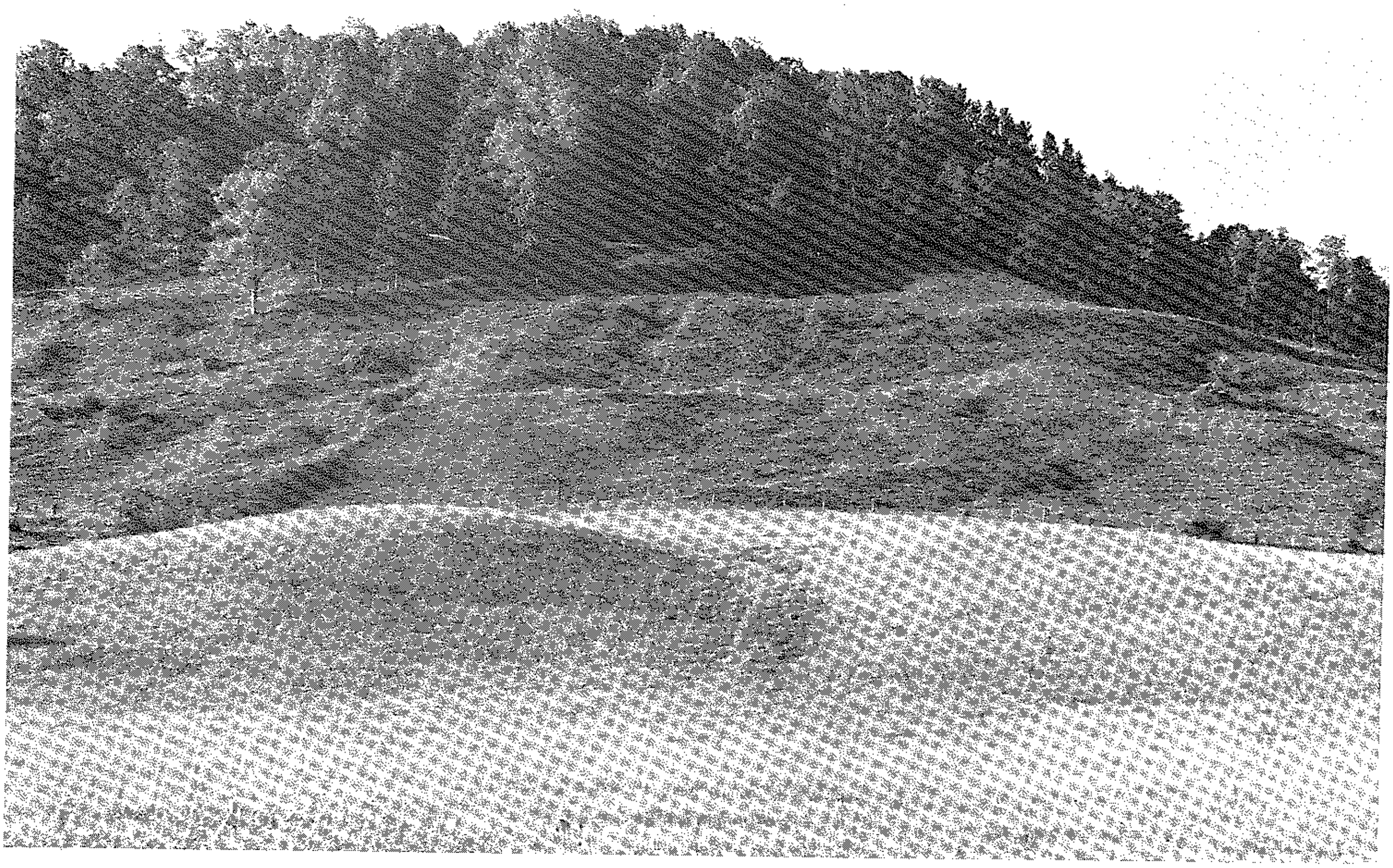

Figure 5.—An area of Omulga silt loam, 6 to 15 percent slopes, on high terraces along streams. Vandalia and Guernsey soils are on the hummocky foot slope in the background.

Omulga soil and slow in the fragipan. The root zone is mainly restricted to a depth of 20 to 36 inches, which is the zone above the fragipan. The available water capacity of this zone is moderate. Runoff is medium or rapid. A perched seasonal high water table is at a depth of 24 to 42 inches during extended wet periods. In the surface layer, the content of organic matter is moderate and tilth is good.

Most areas of this soil are used for row crops or for hay and pasture. Some areas are wooded.

This soil is moderately suited to corn, soybeans, and small grain and well suited to hay. The slope and the hazard of erosion are the major management concerns. If the soil is cultivated, the hazard of erosion is severe. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour stripcropping, and cover crops reduce the runoff rate and help to prevent erosion and deterioration of tilth. Natural drainage generally is adequate, but subsurface drains are needed in scattered seepy areas. The surface layer is crusty after periods of heavy rainfall, especially in tilled areas. Shallow cultivation of intertilled crops breaks up the crust.

This soil is well suited to pasture. If the pasture is overgrazed or is plowed during seedbed preparation, the hazard of erosion is severe. Proper stocking rates and rotation grazing help to prevent overgrazing and thus help to control erosion. No-till seeding also helps to control erosion. Mowing helps to control weeds. Timely applications of lime and fertilizer are needed.

This soil is well suited to woodland. No major hazards or limitations affect planting or harvesting.

This soil is moderately suited to building site development. The seasonal wetness, the slope, and the shrink-swell potential are the main limitations. Waterproofing basement walls, using a sump pump, and installing drains at the base of footings help keep basements dry. Designing the buildings so that they conform to the natural slope of the land and removing as little vegetation as possible help to control erosion. Designing walls to include pilasters, reinforced concrete, and large-spread footings and backfilling around foundations with material that has a low shrink-swell potential help to prevent the structural damage caused by shrinking and swelling.

Low strength and the potential for frost action are limitations on sites for local roads and streets. Installing a drainage system and providing suitable base material help to reduce the effects of these limitations. Building the roads and streets on the contour and seeding road cuts help to control erosion.

This soil is poorly suited to septic tank absorption fields. The seasonal wetness, the slope, and the slow permeability are limitations. Installing distribution lines on the contour helps to prevent seepage of the effluent to the surface, and upslope subsurface drains intercept seepage water. Widening the bottom of the trench in the absorption field helps to overcome the restricted permeability.

The land capability classification is IIIe. The woodland ordination symbol is 4A.

Sa—Sarahsville silty clay, frequently flooded. This soil is deep, nearly level, and somewhat poorly drained. It is on low slackwater terraces and on flood plains. Slopes range from 0 to 3 percent. Most areas of this soil are oblong and range from 10 to 50 acres.

Typically, the surface layer is brown, friable silty clay about 8 inches thick. The subsoil to a depth of about 68 inches is brown and strong brown, mottled, firm silty clay and silty clay loam. The substratum to a depth of about 80 inches is reddish brown, firm silty clay. Some areas are poorly drained.

Included with this soil in mapping are small areas of the somewhat poorly drained Newark soils. These soils are in the slightly higher positions on the landscape. Also included are areas of soils in the flood pool of Senecaville Lake. These soils are subject to flooding of long duration. Included soils make up about 15 percent of most mapped areas.

Permeability is very slow in the Sarahsville soil. The root zone is deep in drained areas. The available water capacity is moderate. The shrink-swell potential is high. Runoff is slow. A seasonal high water table is at a depth of 12 to 30 inches during extended wet periods. In the surface layer, the content of organic matter is moderate and tilth is fair.

Most areas of this soil are used for corn and hay. Some areas are used as pasture or woodland.

This soil is poorly suited to corn and moderately suited to hay. The seasonal wetness and the flooding are the major management concerns. Surface drains help to remove excess surface water. Because of the very slow permeability, subsurface drains should be closely spaced and their trenches should be backfilled with gravel or crushed stone. The soil becomes compacted and cloddy if worked when wet and sticky. Cover crops and a system of conservation tillage that leaves crop residue on the surface improve tilth, increase the water infiltration rate, and help to prevent surface crusting.

If drained, this soil is moderately suited to pasture. Overgrazing or grazing during wet periods, when the soil is soft and sticky, results in surface compaction, poor tilth, a decreased infiltration rate, and reduced plant growth. Proper stocking rates, proper plant selection, rotation grazing, and timely deferment of grazing help to keep the pasture in good condition.

This soil is moderately suited to woodland. Planting techniques that spread the roots of seedlings and increase soil-root contact reduce seedling mortality. Harvesting procedures that do not leave the remaining trees widely spaced or isolated reduce the windthrow hazard. Removing vines and the less desirable trees and shrubs helps to control plant competition.

This soil is generally unsuitable as a site for septic tank absorption fields and small buildings because of seasonal wetness, the shrink-swell potential, the restricted permeability, and the hazard of flooding. Paths and trails covered with gravel, bark, or wood chips are less sticky when wet. Surface drains help to remove excess water.

The land capability classification is IVw. The woodland ordination symbol is 5C.

Uc—Udorthents-Pits complex. This map unit consists mostly of areas that have been surface-mined for coal or limestone. These areas are about 70 percent Udorthents and about 20 percent pits. They are so intermingled or in areas so small that it was not practical to map them separately. The Udorthents are gently sloping to very steep and mainly are around the pits or near the edges of the pits. Some areas are long, narrow piles of soil material that was used for reclamation after the completion of mining.

Typically, Udorthents are a mixture of rock fragments and unweathered fine material in ridges and cone-shaped piles 30 to 100 feet high. The pits typically are nearly level areas between piles of Udorthents or between vertical high walls and Udorthents.

Included with this unit in mapping are small areas of Berks and Vandalia soils near the edges of the pits. Berks soils are moderately deep to bedrock, and Vandalia soils have more clay throughout than the Udorthents. Included soils make up about 10 percent of most areas.

In unprotected areas of Udorthents, the erosion hazard is severe. Suitable plant cover is needed to control erosion. Reclaiming by grading to a desirable slope and covering with adequate topsoil before seeding with a suitable plant cover help to control erosion. Grasses, legumes, and trees planted in reclaimed areas near where sandstone was dominant should be tolerant of a very low available water capacity. Plants seeded in areas where limestone was dominant should be alkaline tolerant.

Onsite investigation is needed to determine the suitability and limitations of the unit for any use.

This unit is not assigned to a land capability classification or a woodland ordination symbol.

UpB—Upshur silt loam, 3 to 8 percent slopes. This soil is deep, gently sloping, and well drained. It is on ridgetops in the uplands. Slopes are smooth and convex and are less than 100 feet in length. Most areas of this soil are oval and range from 2 to 10 acres.

Typically, the surface layer is reddish brown, friable silt loam about 7 inches thick. The subsoil is reddish brown and dark reddish brown, firm silty clay about 43 inches thick. The substratum to a depth of about 72 inches is dark reddish brown, firm shaly silty clay. Some areas have a thicker silty layer in the upper part of the soil.

Included with this soil in mapping are small areas of the moderately deep Gilpin soils on the higher parts of ridgetops. Included soils make up about 15 percent of most mapped areas.

Permeability is slow in the Upshur soil. The root zone is deep. The available water capacity is moderate. Runoff is medium. The shrink-swell potential is high in the subsoil. In the surface layer, the content of organic matter is moderate or moderately low and tilth is good.

This soil is used as cropland, pasture, or woodland.

This soil is moderately suited to corn, small grain, and hay. Erosion control is the main management concern. If this soil is cultivated, the hazard of erosion is severe. The surface layer is crusty after hard rains. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour stripcropping, and cover crops reduce the runoff rate and help to prevent erosion and surface crusting. Tilling when the soil is wet causes surface compaction and cloddiness.

This soil is well suited to pasture. Erosion control is the main management concern. If the pasture is overgrazed or is plowed during seedbed preparation, the hazard of erosion is severe. Rotation grazing and proper stocking rates help to maintain a thick, protective plant cover. Delayed grazing during wet periods reduces soil compaction.

This soil is well suited to woodland. The surface layer is sticky when wet, which limits the use of equipment, but logging can be done when the soil is dry or frozen. Using seedlings that have been transplanted once reduces seedling mortality. Frequent, light thinning and harvesting increase stand vigor and reduce the windthrow hazard. Removing vines and the less desirable trees and shrubs helps to control plant competition.

This soil is moderately suitable as a site for dwellings. The shrink-swell potential is the main limitation. Designing walls to include pilasters, reinforced concrete, and large-spread footings and backfilling around foundations with material that has a low shrink-swell potential help to prevent the damage to buildings caused by shrinking and swelling. Sediment basins and a permanent plant cover help to control erosion and reduce runoff from construction sites.

This soil is poorly suited to septic tank absorption fields because of the slow permeability. Increasing the width of trenches in the field improves the absorption of effluent.

The shrink-swell potential and low strength are limitations on sites for local roads and streets. Providing a suitable base material helps to prevent the road damage caused by shrinking and swelling and by low strength.

The land capability classification is IIIe. The woodland ordination symbol is 3C.

UpC—Upshur silt loam, 8 to 15 percent slopes. This soil is deep, gently sloping, and well drained. It is on ridgetops, on the upper parts of side slopes, and on benches on side slopes, all in the uplands. Most areas are long and narrow and range from 5 to 30 acres.

Typically, the surface layer is reddish brown, friable silt loam about 7 inches thick. The subsoil is reddish brown and dark reddish brown silty clay about 43 inches thick. The substratum to a depth of about 72 inches is dark reddish brown silty clay.

Included with this soil in mapping are small areas of the moderately deep Gilpin soils on shoulder slopes. Also included are eroded areas of soils that have fair tilth and a surface layer of silty clay loam. Included soils make up about 10 percent of most mapped areas.

Permeability is slow in the Upshur soil. The root zone is deep. The available water capacity is moderate. Runoff is medium or rapid. The shrink-swell potential is high in the subsoil. In the surface layer, the content of organic matter is moderate or moderately low and tilth is good.

This soil is used mainly for pasture and hay. Some areas are used as woodland. A few areas are used for corn and small grain.

This soil is poorly suited to corn and small grain and moderately suited to hay. Erosion control is the main management concern. If this soil is cultivated, the hazard of erosion is severe. The surface layer is crusty after hard rains. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour stripcropping, and cover crops reduce the runoff rate and help to prevent erosion and surface crusting. The soil dries slowly after extended wet periods. Tilling when the soil is wet causes surface compaction and cloddiness.

This soil is moderately suited to pasture. Erosion control is the main management concern. If the pasture is overgrazed or is plowed during seedbed preparation, the hazard of erosion is severe. Rotation grazing and proper stocking rates help to maintain a thick, protective plant cover. No-till seeding helps to control erosion. Delayed grazing during wet periods reduces soil compaction.

This soil is well suited to woodland. Using seedlings that have been transplanted once reduces seedling mortality. Frequent, light thinning and harvesting increase stand vigor and reduce the windthrow hazard. Removing vines and the less desirable trees and shrubs helps to control plant competition.

This soil is poorly suited to use as a site for dwellings. The shrink-swell potential and the slope are the main limitations. Designing walls to include pilasters, reinforced concrete, and large-spread footings and backfilling around foundations with material that has a low shrink-swell potential help to prevent the damage to buildings caused by shrinking and swelling. Designing the buildings so that they conform to the natural slope of the land helps to control erosion. A plant cover and mulch help to control erosion and reduce runoff from construction sites. Cutting and filling increase the hazard of hillside slippage. Installing drains in areas where water collects reduces this hazard.

This soil is poorly suited to septic tank absorption fields because of the slow permeability and the slope. Increasing the width of trenches in the field improves the absorption of effluent.

The shrink-swell potential and low strength are limitations on sites for local roads and streets. Providing a suitable base material helps to prevent the road damage caused by shrinking and swelling and by low strength. Building roads and streets on the contour helps to reduce the hazard of erosion.

The land capability classification is IVe. The woodland ordination symbol is 3C.

UrC3—Upshur silty clay, 8 to 15 percent slopes, severely eroded. This soil is deep, strongly sloping, and well drained. It is on ridgetops and on the upper parts of side slopes, all in the uplands. Erosion has removed most of the original surface layer. Most areas of this soil are long and narrow and range from 5 to 30 acres.

Typically, the surface layer is reddish brown, firm silty clay about 4 inches thick. The subsoil is red, reddish brown, and dark reddish brown, sticky silty clay about 29 inches thick. The substratum is light yellowish brown, firm silty clay loam about 15 inches thick. Soft shale bedrock is at a depth of about 48 inches.

Included with this soil in mapping are small areas of the moderately deep Gilpin soils on shoulder slopes. Included soils make up about 10 percent of most mapped areas.

Permeability is slow in the Upshur soil. The root zone is deep. The available water capacity is low or moderate. Runoff is rapid. The shrink-swell potential is high in the surface layer and the subsoil. The content of organic matter is low in the surface layer.

This soil is used mainly for pasture, hay, or woodland. A few areas are used for corn and small grain.

This soil is generally unsuited to corn and small grain and poorly suited to hay and pasture. If this soil is cultivated, the hazard of erosion is very severe. The surface layer is crusty after hard rains. Tilling when the soil is wet causes surface compaction and cloddiness. Rotation grazing and proper stocking rates help to prevent overgrazing and thus help to control erosion. Filling and seeding shallow rills and gullies also helps to control erosion.

This soil is moderately suited to woodland. The surface layer is sticky when wet, which limits the use of equipment, but logging and planting can be done when the soil is dry or frozen. Using seedlings that have been transplanted once reduces seedling mortality. Frequent, light thinning and harvesting increase stand vigor and reduce the windthrow hazard. Removing vines and the less desirable trees and shrubs helps to control plant competition.

This soil is poorly suited to use as a site for dwellings. The high shrink-swell potential, the silty clay surface layer, and the slope are the main limitations. Designing walls to include pilasters, reinforced concrete, and large-spread footings and backfilling around foundations with material that has a low shrink-swell potential help to prevent the damage to buildings caused by shrinking and swelling. Designing the buildings so that they conform to the natural slope of the land helps to control erosion. A plant cover and mulch help to control erosion and reduce runoff from construction sites. Cutting and filling increase the hazard of hillside slippage. Installing drains in areas where water collects reduces this hazard.

This soil is poorly suited to septic tank absorption fields because of the slow permeability and the slope. Installing distribution lines on the contour helps to prevent seepage of the effluent to the surface. Enlarging the field improves the absorption of effluent.

The shrink-swell potential and low strength are limitations on sites for local roads and streets. Providing a suitable base material helps to prevent the road damage caused by shrinking and swelling and by low strength. The slope and the hazard of erosion also are limitations on sites for local roads and streets. Building the roads on the contour and seeding road cuts help to control erosion.

The land capability classification is VIe. The woodland ordination symbol is 3C.

UrD3—Upshur silty clay, 15 to 25 percent slopes, severely eroded. This soil is deep, moderately steep, and well drained. It is on ridgetops and side slopes. Erosion has removed most of the original surface layer. The present surface layer is a mixture of the original surface layer and the subsoil. The larger areas are roughly square, and the smaller areas on ridgetops are long and narrow. Most areas of this soil range from 5 to 50 acres.

Typically, the surface layer is reddish brown, firm silty clay about 6 inches thick. The subsoil is red, reddish brown, weak red, and dark red, firm silty clay about 40 inches thick. The substratum to a depth of about 60 inches is dark red, firm silty clay.

Included with this soil in mapping are small areas of the moderately deep Berks soils on shoulder slopes. Included soils make up about 15 percent of most mapped areas.

Permeability is slow in the Upshur soil. The root zone is deep, but root growth is restricted by clay in the subsoil. The available water capacity is low or moderate. Runoff is rapid. The shrink-swell potential is high in the surface layer and the subsoil. The content of organic matter is low in the surface layer.

Most areas of this soil are used as pasture or woodland.

This soil is generally unsuited to farming because of the slope, the texture of the surface layer, and a very severe erosion hazard.

This soil is moderately suited to woodland. Coves and north- and east-facing slopes are especially suitable because they are cooler and less subject to evapotranspiration. The surface layer of this soil is sticky when wet, which limits the use of equipment, but logging and planting can be done when the soil is dry or frozen. The use of equipment, which is limited by the slope, increases the hazard of erosion. Building logging roads and skid trails on the contour helps to overcome the slope and reduces the hazard of erosion. Water bars and a plant cover also help to control erosion. Using seedlings that have been transplanted once reduces seedling mortality. Frequent, light thinning and harvesting increase stand vigor and reduce the windthrow hazard. Removing vines and the less desirable trees and shrubs helps to control plant competition.

This soil is generally unsuitable as a site for dwellings or septic tank absorption fields. The slope, the high shrink-swell potential, the restricted permeability, and a slippage hazard are the major limitations. A plant cover and mulch help to control erosion on construction sites. Cutting and filling increase the hazard of hillside slippage.

The land capability classification is VIIe. The woodland ordination symbol is 4R on north aspects and 3R on south aspects.

UrE3—Upshur silty clay, 25 to 40 percent slopes, severely eroded. This soil is deep, steep, and well drained. It is on ridgetops and side slopes. Slopes are mostly convex. Erosion has removed most of the original surface layer. The present surface layer is a mixture of the original surface layer and the subsoil. Drainageways cross the soil at intervals of 200 to 300 feet. Most areas of this soil are long and winding, but some of the larger areas are irregularly shaped or roughly square. Most areas range from 10 to 100 acres.

Typically, the surface layer is dark reddish brown, firm silty clay about 2 inches thick. The subsoil is reddish brown and red, firm silty clay about 48 inches thick. The substratum is variegated light yellowish brown and reddish brown, firm extremely shaly silty clay about 22 inches thick. Soft shale bedrock is at a depth of about 72 inches.

Included with this soil in mapping are small areas of the moderately deep Berks soils on narrow ridgetops. Included soils make up about 15 percent of most mapped areas.

Permeability is slow in the Upshur soil. The root zone is deep, but root growth is somewhat restricted by clay in the subsoil. The available water capacity is low or moderate. Runoff is very rapid. The shrink-swell potential is high in the surface layer and the subsoil. The content of organic matter is low in the surface layer.

Most areas of this soil are used as pasture or woodland.

This soil is generally unsuited to farming because of the slope, the texture of the surface layer, and a very severe erosion hazard.

This soil is moderately suited to woodland. Coves and north- and east-facing slopes are especially suitable because they are cooler and less subject to evapotranspiration. The silty clay surface layer of this soil is sticky when wet, which limits the use of equipment, but logging and planting can be done when the soil is dry or frozen. The use of equipment, which is limited by the slope, increases the hazard of erosion. Building logging roads and skid trails on the contour helps to overcome the slope and reduces the hazard of erosion. Water bars and a plant cover also help to control erosion. Using seedlings that have been transplanted once reduces seedling mortality. Frequent, light thinning and harvesting increase stand vigor and reduce the windthrow hazard. Removing vines and the less desirable trees and shrubs helps to control plant competition.

This soil is generally unsuitable as a site for dwellings or septic tank absorption fields. The slope, the high shrink-swell potential, the restricted permeability, and a slippage hazard are the major limitations. A plant cover and mulch help to control erosion on construction sites. Cutting and filling increase the hazard of hillside slippage. Paths and trails are sticky when wet. Establishing the paths and trails on the contour and covering them with gravel, bark, or wood chips help to control erosion and prevent stickiness.

The land capability classification is VIIe. The woodland ordination symbol is 4R on north aspects and 3R on south aspects.

VaD2—Vandalia silty clay loam, 15 to 25 percent slopes, eroded. This soil is deep, moderately steep, and well drained. It is on foot slopes in the uplands. Erosion has removed part of the original surface layer. Landslips, seeps, and springs are in many areas. Most areas of this soil are long and narrow or oblong and range from 5 to 60 acres.

Typically, the surface layer is dark reddish brown, friable silty clay loam about 5 inches thick. The subsoil is about 42 inches thick. It is reddish brown and yellowish red, friable and firm silty clay loam in the upper part and reddish brown, firm channery silty clay in the lower part. The substratum to a depth of about 72 inches is weak red, firm shaly clay.

Included with this soil in mapping are small areas of the moderately well drained Guernsey soils in seeps. Also included are strips of soils on the lower parts of some hillsides that are in the flood pool of Senecaville Lake. They are subject to flooding. Included soils make up about 15 percent of most mapped areas.

Permeability is moderately slow or slow in the Vandalia soil. The root zone is deep. The available water capacity is moderate. Runoff is very rapid. The shrink-swell potential is high in the subsoil and the substratum. A perched seasonal high water table is at a depth of 48 to 72 inches during extended wet periods. The content of organic matter is moderately low in the surface layer.

Most areas of this soil are used for corn, hay, pasture, or woodland.

This soil is poorly suited to corn, small grain, and hay. The slope and the hazard of erosion are major management concerns. If the soil is cultivated, the hazard of erosion is very severe. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour stripcropping, and cover crops help to maintain tilth, reduce the runoff rate, and help to control erosion. Uneven slopes in some areas limit the use of equipment. Subsurface drains are needed in scattered seep areas.

This soil is moderately suited to pasture. If the pasture is overgrazed or is plowed during seedbed preparation, the hazard of erosion is very severe. Proper stocking rates and rotation grazing help to prevent overgrazing and thus help to control erosion. No-till seeding also helps to control erosion. Restricted grazing during wet periods helps to prevent surface compaction.

This soil is well suited to woodland. The use of equipment, which is limited by the slope, increases the hazard of erosion. Building logging roads and skid trails on the contour helps to overcome the slope and reduces the hazard of erosion. Water bars and a plant cover also help to control erosion. Removing vines and the less desirable trees and shrubs helps to control plant competition. Planting techniques that spread the roots and increase soil-root contact reduce seedling mortality. Harvesting methods that do not leave the remaining trees isolated or widely spaced help to prevent windthrow.

This soil is generally unsuitable as a site for buildings or septic tank absorption fields because of the slope, the restricted permeability, the high shrink-swell potential, and a slippage hazard. Cutting and filling increase the slippage hazard. Erosion can be controlled by removing as little vegetation as possible, mulching, and establishing a temporary plant cover on construction sites. Building local roads and streets on the contour and seeding road cuts help to control erosion. Because of the slippage hazard, low strength, and the shrink-swell potential, roads need special design.

The land capability classification is IVe. The woodland ordination symbol is 4R.

VaE2—Vandalia silty clay loam, 25 to 40 percent slopes, eroded. This soil is deep, steep, and well drained. It is on foot slopes in the uplands. Erosion has removed part of the original surface layer. Landslips, seeps, and springs are in many areas. Most areas of this soil are long and narrow and range from 5 to 60 acres.

Typically, the surface layer is dark reddish brown, friable silty clay loam about 3 inches thick. The subsoil is about 40 inches thick. It is reddish brown and yellowish red, friable and firm silty clay loam in the upper part and reddish brown, firm channery silty clay in the lower part. The substratum to a depth of about 72 inches is weak red, firm shaly clay.

Included with this soil in mapping are small areas of the moderately well drained Guernsey soils in seeps. Also included are strips of soils on the lower parts of some hillsides that are in the flood pool of Senecaville Lake. These soils are subject to flooding. Included soils make up about 15 percent of most mapped areas.

Permeability is moderately slow or slow in the Vandalia soil. The root zone is deep. The available water capacity is moderate. Runoff is very rapid. The shrink-swell potential is high in the subsoil and the substratum. A perched seasonal high water table is at a depth of 48 to 72 inches during extended wet periods. The content of organic matter is moderately low in the surface layer.

Most areas of this soil are used as pasture or woodland.

This soil is generally unsuited to corn, small grain, and hay. The slope and the hazard of erosion are the major limitations.

This soil is poorly suited to pasture. The slope, the hazard of erosion, and a slippage hazard are the major limitations. If the pasture is overgrazed or is plowed during seedbed preparation, the hazard of erosion is very severe. Proper stocking rates and rotation grazing help to prevent overgrazing and thus help to control erosion. No-till seeding also helps to control erosion, but a permanent plant cover is more effective. Irregular slopes caused by slippage limit the use of equipment in many areas.

This soil is well suited to woodland. The use of equipment, which is limited by the slope, increases the hazard of erosion. Building logging roads and skid trails on the contour helps to overcome the slope and reduces the hazard of erosion. Water bars and a plant cover also help to control erosion. Removing vines and the less desirable trees and shrubs helps to control plant competition. Planting techniques that spread the roots and increase soil-root contact reduce seedling mortality. Harvesting methods that do not leave the remaining trees isolated or widely spaced help to prevent windthrow.

This soil is generally unsuitable as a site for buildings or septic tank absorption fields because of the slope, the restricted permeability, the high shrink-swell potential, and a slippage hazard. Cutting and filling increase the slippage hazard. Erosion can be controlled by removing as little vegetation as possible, mulching, and establishing a temporary plant cover on construction sites. Because of the slope, the slippage hazard, low strength, and the shrink-swell potential, roads and streets need special design.

The land capability classification is VIe. The woodland ordination symbol is 4R.

VcC2—Vandalia-Guernsey silty clay loams, 8 to 15 percent slopes, eroded. This unit consists of deep, strongly sloping soils on foot slopes and on side-slope benches in the uplands. Erosion has removed part of the original surface layer of both soils. Slopes are hummocky and have slips. Most areas of these soils are long and narrow and range from 10 to 60 acres. They are about 50 percent well drained Vandalia soil and 35 percent moderately well drained Guernsey soil.

The two soils are so intermingled that it was not practical to map them separately.

Typically, the surface layer of the Vandalia soil is dark reddish brown, firm silty clay loam about 5 inches thick. The subsoil is dark reddish brown, reddish brown, and dusky red, firm silty clay about 43 inches thick. The substratum to a depth of about 72 inches is weak red, firm silty clay.

Typically, the surface layer of the Guernsey soil is brown, friable silty clay loam about 7 inches thick. The subsoil is yellowish brown, firm silty clay about 44 inches thick. It is mottled in the lower part. The substratum to a depth of about 80 inches is yellowish brown, mottled, firm silty clay.

Included with these soils in mapping are narrow strips on the lower parts of some hillsides that are in the flood pool of the Senecaville Dam and are subject to flooding. Also included are narrow strips of the moderately deep Gilpin soils on shoulder slopes. Included soils make up about 15 percent of most mapped areas.

Permeability is moderately slow or slow in the Vandalia and Guernsey soils. The root zone is deep in both soils, and the available water capacity is moderate. Runoff is rapid. The shrink-swell potential is high in the subsoil and the substratum. A perched seasonal high water table is at a depth of 48 to 72 inches in the Vandalia soil and 24 to 42 inches in the Guernsey soil. In the surface layer of both soils, the organic matter content is moderately low and tilth is fair.

These soils are used for corn, small grain, woodland, pasture, or hay.

These soils are poorly suited to corn, small grain, and hay because of an erosion hazard, the slope, and the hummocky shape of the land. If the soils are cultivated, the hazard of erosion is severe. Contour stripcropping and a system of conservation tillage that leaves crop residue on the surface reduce the hazard of erosion and improve tilth. Subsurface drains in seeps reduce seasonal wetness. Tilling when the soils are wet causes compaction and cloddiness.

These soils are moderately suited to pasture. The erosion hazard is severe if the soils are overgrazed or are cultivated during seedbed preparation. No-till seeding and rotation grazing help to control erosion. Proper stocking rates help to prevent overgrazing and thus help to control erosion. Some seeps are suitable sources of stock water. Smoothing the slips reduces ponding and prevents additional slippage.

These soils are well suited to woodland. The use of equipment, which is limited by the slope, increases the hazard of erosion. Building logging roads and skid trails on the contour helps to overcome the slope and reduces the hazard of erosion. Providing a suitable base material reduces the damage caused by low strength and by shrinking and swelling. Removing vines and the less desirable trees and shrubs helps to control plant competition. Planting techniques that spread the roots and increase soil-root contact reduce seedling mortality in areas of the Vandalia soil. Harvesting methods that do not leave the remaining trees isolated or widely spaced help to prevent windthrow in areas of the Vandalia soil.

These soils are poorly suited to building site development because of the high shrink-swell potential, the slope, seasonal wetness, and the slippage hazard. Drains at the base of footings and gravel backfill help keep basements dry and reduce the damage caused by shrinking and swelling. Designing the buildings so that they conform to the natural slope of the land helps to control erosion. Cutting and filling increase the hazard of slippage. Drains in wet areas help to reduce this hazard.

Seasonal wetness, the slope, and the restricted permeability make these soils poorly suited to septic tank absorption fields. Increasing the width of trenches in the field improves the absorption of effluent. Installing distribution lines on the contour helps to prevent seepage of effluent to the surface. Upslope subsurface drains intercept seepage water.

The land capability classification is IIIe. The woodland ordination symbol is 4C for the Vandalia soil and 4A for the Guernsey soil.

VcD2—Vandalia-Guernsey silty clay loams, 15 to 25 percent slopes, eroded. This unit consists of deep, moderately steep soils on the lower parts of side slopes and on side-slope benches in the uplands. Erosion has removed part of the original surface layer of both soils. The present surface layer is a mixture of the original surface layer and the subsoil. Slopes are hummocky and have slips. Most areas of this soil are long and narrow and range from 25 to 300 acres. They are about 50 percent well drained Vandalia soil and 35 percent moderately well drained Guernsey soil. The two soils are so intermingled or in areas so small that it was not practical to map them separately.

Typically, the surface layer of the Vandalia soil is dark reddish brown, firm silty clay loam about 3 inches thick. The subsoil is dark reddish brown and reddish brown, firm silty clay about 34 inches thick. The substratum to a depth of about 72 inches is dusky red, reddish brown, and weak red, firm silty clay.

Typically, the surface layer of the Guernsey soil is brown, friable silty clay loam about 7 inches thick. The subsoil is yellowish brown, firm silty clay about 44 inches thick. It is mottled in the lower part. The substratum to a depth of about 80 inches is yellowish brown, mottled, firm silty clay.

Included with these soils in mapping are narrow strips on the lower parts of some hillsides that are in the flood pool of the Senecaville Dam and are subject to flooding. Also included are strips of the moderately deep Gilpin soils on shoulder slopes. Included soils make up about 15 percent of most mapped areas.

Permeability is moderately slow or slow in the Vandalia and Guernsey soils. The root zone is deep in both soils, and the available water capacity is moderate. Runoff is very rapid. The shrink-swell potential is high in the subsoil and the substratum. A perched seasonal high water table is at a depth of 48 to 72 inches in the Vandalia soil and 24 to 42 inches in the Guernsey soil. In the surface layer of both soils, the organic matter content is moderately low and tilth is fair.

These soils are used mainly for pasture. A few areas are wooded.

These soils are generally unsuited to corn and small grain and poorly suited to hay because of a very severe erosion hazard, the slope, and the hummocky shape of the land. The soils are moderately suited to pasture. The erosion hazard is very severe if the soils are overgrazed or are cultivated during seedbed preparation. No-till seeding and rotation grazing help to control erosion. Proper stocking rates help to prevent overgrazing and thus help to control erosion. Some seeps are suitable sources of stock water. Subsurface drains in seep areas reduce seasonal wetness and slippage. Smoothing and seeding the slips and gullies reduce ponding and help to prevent additional slippage.

These soils are well suited to woodland. The use of equipment, which is limited by the slope, increases the hazard of erosion. Building logging roads and skid trails on the contour helps to overcome the slope and reduces the hazard of erosion. Water bars and a plant cover also help to control erosion. Removing vines and the less desirable trees and shrubs helps to control plant competition. Planting techniques that spread the roots and increase soil-root contact reduce seedling mortality. Harvesting methods that do not leave the remaining trees isolated or widely spaced help to prevent windthrow in areas of the Vandalia soil.

These soils are generally unsuitable as sites for buildings and septic tank absorption fields because of the high shrink-swell potential, the slope, seasonal wetness, and the slippage hazard. Cutting and filling increase the hazard of slippage.

The land capability classification is IVe. The woodland ordination symbol is 4R.

VcE2—Vandalia-Guernsey silty clay loams, 25 to 35 percent slopes, eroded. This unit consists of deep, steep soils on the lower parts of side slopes and on side-slope benches in the uplands. Erosion has removed part of the original surface layer of both soils. The present surface layer is a mixture of the original surface layer and the subsoil. Slopes are hummocky and have slips. Most areas of this soil are long and wide and range from 40 to 100 acres. They are about 50 percent well drained Vandalia soil and 35 percent moderately well drained Guernsey soil. The two soils are so intermingled or in areas so small that it was not practical to map them separately.

Typically, the surface layer of the Vandalia soil is dark reddish brown, firm silty clay loam about 3 inches thick. The subsoil is dusky red, firm silty clay about 42 inches thick. The substratum to a depth of about 72 inches is reddish brown and weak red, firm silty clay.

Typically, the surface layer of the Guernsey soil is brown, friable silty clay loam about 5 inches thick. The subsoil is yellowish brown, firm silty clay about 44 inches thick. It is mottled in the lower part. The substratum to a depth of about 80 inches is yellowish brown, mottled, firm silty clay.

Included with these soils in mapping are narrow strips of the moderately deep Gilpin soils on shoulder slopes. Also included, on shoulder slopes, are narrow strips of soils that are less than 24 inches deep to limestone bedrock. Included soils make up about 15 percent of most mapped areas.

Permeability is moderately slow or slow in the Vandalia and Guernsey soils. The root zone is deep in both soils, and the available water capacity is moderate. Runoff is very rapid. The shrink-swell potential is high in the subsoil and the substratum. A perched seasonal high water table is at a depth of 48 to 72 inches in the Vandalia soil and 24 to 42 inches in the Guernsey soil. In the surface layer of both soils, the organic matter content is moderately low.

Most areas of these soils are wooded.

These soils are generally unsuited to farming. A very severe erosion hazard, the slope, a slippage hazard, and the hummocky shape of the land are the major limitations.

These soils are well suited to woodland. The use of equipment, which is limited by the slope, increases the hazard of erosion. Building logging roads and skid trails on the contour helps to overcome the slope and reduces the hazard of erosion. Water bars and a plant cover also help to control erosion. Removing vines and the less desirable trees and shrubs helps to control plant competition. Planting techniques that spread the roots and increase soil-root contact reduce seedling mortality. Harvesting methods that do not leave the remaining trees isolated or widely spaced help to prevent windthrow in areas of the Vandalia soil.

These soils are generally unsuitable as sites for buildings and septic tank absorption fields because of the shrink-swell potential, the slope, seasonal wetness, and the slippage hazard. Cutting and filling increase the hazard of slippage.

The land capability classification is VIe. The woodland ordination symbol is 4R.

WoB—Woodsfield silt loam, 1 to 6 percent slopes. This soil is deep, nearly level and gently sloping, and well drained. It is on ridgetops in the uplands. Most areas are oval or oblong and range from 5 to 20 acres.

Typically, the surface layer is brown, friable silt loam about 8 inches thick. The subsoil is about 48 inches thick. It is dark brown, friable silt loam and reddish brown, friable silty clay loam in the upper part and reddish brown, dark reddish brown, and dusky red, firm clay in the lower part. The substratum is variegated yellowish brown and light yellowish brown, firm clay about 14 inches thick. Olive brown, soft, calcareous shale is at a depth of about 70 inches.

Included with this soil in mapping are narrow areas of the moderately deep Gilpin soils on shoulder slopes. Included soils make up about 15 percent of most mapped areas.

Permeability is moderate in the upper part of the Woodsfield soil and slow in the lower part. The root zone is deep. The available water capacity is moderate. Runoff is slow or medium. The shrink-swell potential is high in the lower part of the subsoil. In the surface layer, the content of organic matter is moderate and tilth is good.

This soil is used for corn, hay, pasture, or woodland.

This soil is well suited to corn, small grain, and hay. Controlling erosion and maintaining tilth are the main management concerns. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour stripcropping, and cover crops reduce the runoff rate, help to control erosion, and maintain tilth. Tilling when the soil is wet causes surface compaction and cloddiness.

This soil is well suited to pasture. If the pasture is overgrazed or is plowed during seedbed preparation, however, erosion is a hazard. Proper stocking rates and rotation grazing help to prevent overgrazing and thus help to control erosion. No-till seeding also helps to control erosion. Restricted grazing during wet periods helps to prevent surface compaction.

This soil is well suited to woodland. Frequent, light thinning and harvesting increase stand vigor and reduce the windthrow hazard. Using seedlings that have been transplanted once reduces seedling mortality.

This soil is moderately suited to building site development. The shrink-swell potential is the main limitation. Designing walls to include pilasters, reinforced concrete, and large-spread footings and backfilling around foundations with material that has a low shrink-swell potential help to prevent the structural damage caused by shrinking and swelling.

This soil is poorly suited to septic tank absorption fields. The slow permeability is the main limitation. Widening the bottom of the trenches in the absorption field helps to overcome the restricted permeability.

The shrink-swell potential and low strength are limitations on sites for local roads and streets. Providing a suitable base material helps to prevent the road damage caused by shrinking and swelling and by low strength.

The land capability classification is IIe. The woodland ordination symbol is 4C.

WoC—Woodsfield silt loam, 6 to 15 percent slopes. This soil is deep, strongly sloping, and well drained. It is on ridgetops in the uplands. Most areas are oval or oblong and range from 5 to 20 acres.

Typically, the surface layer is brown, friable silt loam about 7 inches thick. The subsoil is about 46 inches thick. It is dark brown and reddish brown, friable silty clay loam in the upper part; reddish brown, dark reddish brown, and dusky red, firm clay in the middle part; and variegated reddish brown, dark reddish brown, and dusky red, firm clay in the lower part. The substratum is variegated yellowish brown, light brownish gray, and light yellowish brown, firm silty clay about 13 inches thick. Olive brown, soft, calcareous shale is at a depth of about 66 inches. Some areas have a thinner or thicker silt mantle.

Included with this soil in mapping are narrow areas of the moderately deep Gilpin soils on shoulder slopes. Included soils make up about 15 percent of most mapped areas.

Permeability is moderate in the upper part of the Woodsfield soil and slow in the lower part. The root zone is deep. The available water capacity is moderate. Runoff is medium or rapid. The shrink-swell potential is high in the lower part of the subsoil. In the surface layer, the content of organic matter is moderate and tilth is good.

This soil is used for corn, hay, pasture, or woodland.

This soil is moderately well suited to corn and small grain and well suited to hay. Overcoming the slope, controlling erosion, and maintaining tilth are the main management concerns. Erosion is a severe hazard in cultivated areas. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour stripcropping, no-till farming, and cover crops reduce the runoff rate, help to control erosion, and maintain tilth. Tilling when the soil is wet causes surface compaction and cloddiness.

This soil is well suited to pasture. If the pasture is overgrazed or is plowed during seedbed preparation, however, erosion is a hazard. Proper stocking rates and rotation grazing help to prevent overgrazing and thus help to control erosion. No-till seeding also helps to control erosion. Restricted grazing during wet periods helps to prevent surface compaction.

This soil is well suited to woodland. Frequent, light thinning and harvesting increase stand vigor and reduce the windthrow hazard. Using seedlings that have been transplanted once reduces seedling mortality.

This soil is moderately suited to building site development. The shrink-swell potential and the slope are the main limitations. Designing the buildings so that they conform to the natural slope of the land helps to control erosion. Designing walls to include pilasters, reinforced concrete, and large-spread footings and backfilling around foundations with material that has a low shrink-swell potential help to prevent the damage caused by shrinking and swelling.

This soil is poorly suited to septic tank absorption fields. The slow permeability and the slope are the main limitations. Widening the bottom of the trenches in the absorption fields helps to overcome the restricted permeability. Installing distribution lines on the contour helps to prevent seepage of the effluent to the surface.

The shrink-swell potential and low strength are limitations on sites for local roads and streets. Providing a suitable base material helps to prevent the road damage caused by shrinking and swelling and by low strength. Building the roads and streets on the contour and seeding the road cuts help to control erosion.

The land capability classification is IIIe. The woodland ordination symbol is 4C.

WoD—Woodsfield silt loam, 15 to 25 percent slopes. This soil is deep, moderately steep, and well drained. It is on ridgetops and hillsides in the uplands. Most areas are oval or oblong and range from 5 to 20 acres.

Typically, the surface layer is brown, friable silt loam about 7 inches thick. The subsoil is about 42 inches thick. It is dark brown, friable silt loam and reddish brown, friable silty clay loam in the upper part and reddish brown, dark reddish brown, and dusky red, firm clay in the lower part. The substratum is variegated yellowish brown and light yellowish brown, firm clay about 15 inches thick. Olive brown, soft, calcareous shale is at a depth of about 64 inches. Some areas have a thinner or thicker silt mantle.

Included with this soil in mapping are narrow areas of the moderately deep Gilpin soils on shoulder slopes. Included soils make up about 15 percent of most mapped areas.

Permeability is moderate in the upper part of the Woodsfield soil and slow in the lower part. The root zone is deep. The available water capacity is moderate. Runoff is rapid. The shrink-swell potential is high in the lower part of the subsoil. In the surface layer, the content of organic matter is moderate and tilth is good.

This soil is used for corn, hay, pasture, or woodland.

This soil is poorly suited to corn and small grain and moderately well suited to hay. Overcoming the slope, controlling erosion, and maintaining tilth are the main management concerns. Erosion is a severe hazard in cultivated areas. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour stripcropping, no-till farming, and cover crops reduce the runoff rate, help to control erosion, and maintain tilth. Tilling when the soil is wet causes surface compaction and cloddiness.

This soil is well suited to pasture. If the pasture is overgrazed or is plowed during seedbed preparation, however, erosion is a severe hazard. Proper stocking rates and rotation grazing help to prevent overgrazing and thus help to control erosion. No-till seeding also helps to control erosion. Restricted grazing during wet periods helps to prevent surface compaction.

This soil is well suited to woodland. Coves and north- and east-facing slopes are especially suitable because they are cooler and less subject to evapotranspiration. The use of equipment, which is limited by the slope, increases the hazard of erosion. Building logging roads and skid trails on the contour helps to overcome the slope and reduces the hazard of erosion. Water bars and a plant cover also help to control erosion. Frequent, light thinning and harvesting increase stand vigor and reduce the windthrow hazard. Using seedlings that have been transplanted once reduces seedling mortality.

This soil is poorly suited to building site development.

The shrink-swell potential and the slope are the main limitations. Designing the buildings so that they conform to the natural slope of the land helps to control erosion. Designing walls to include pilasters, reinforced concrete, and large-spread footings and backfilling around foundations with material that has a low shrink-swell potential help to prevent the structural damage caused by shrinking and swelling. Maintaining or establishing a plant cover and mulching help to control erosion on construction sites.

This soil is generally unsuited to septic tank absorption fields. The slow permeability and the slope are the main limitations.

The slope, the shrink-swell potential, and low strength are limitations on sites for local roads and streets. Providing a suitable base material helps to prevent the road damage caused by low strength and by shrinking and swelling. Building the roads and streets on the contour and seeding the road cuts help to control erosion.

The land capability classification is IVe. The woodland ordination symbol is 4R on north aspects and 3R on south aspects.

ZaB—Zanesville silt loam, 1 to 6 percent slopes. This soil is deep, nearly level and gently sloping, and moderately well drained and well drained. It is on ridgetops in the uplands. Slopes are mainly smooth but are slightly convex near the heads of drainageways. Most areas of this soil are as much as 1 mile long and range from 5 to 80 acres.

Typically, the surface layer is brown, friable silt loam about 9 inches thick. The subsoil is about 38 inches thick. The upper part is yellowish brown and brown, friable silt loam and silty clay loam. The lower part is a fragipan of brown, mottled, very firm and brittle silty clay loam. The substratum is brown, firm silty clay loam about 7 inches thick. Soft shale and siltstone bedrock is at a depth of about 54 inches.

Included with this soil in mapping are small areas of somewhat poorly drained soils in the less sloping areas. Also included are soils underlain by mildly alkaline, soft bedrock. Included soils make up about 15 percent of most mapped areas.

Permeability is moderate above the fragipan in the Zanesville soil and moderately slow or slow in the fragipan. The root zone is mainly restricted to the 20- to 32-inch zone above the fragipan. The available water capacity in this zone is low. Runoff is slow or medium. A perched seasonal high water table is at a depth of 24 to 36 inches during extended wet periods. In the surface layer, the content of organic matter is moderate and tilth is good.

Most of the acreage of this soil is cropland. This soil is well suited to corn, small grain, and hay. Controlling erosion and maintaining tilth are the main management concerns. The seasonal wetness delays planting in spring. Contour stripcropping, a cropping sequence that includes meadow crops, and winter cover crops help to control erosion and maintain tilth. No-till planting or other kinds of conservation tillage that leave crop residue on the surface also help to control erosion. The surface layer is crusty after hard rains. Shallow cultivation of intertilled crops breaks up the crust. Randomly spaced subsurface drains are needed in areas of the wetter included soils.

This soil is well suited to pasture. Because of the limited available water capacity, pasture plants grow better during the early part of the growing season than during the latter part. Proper stocking rates, rotation grazing, and weed control help to keep the pasture in good condition.

This soil is well suited to trees. No major hazards or limitations affect planting or harvesting.

This soil is moderately suited to building site development. Seasonal wetness is the main limitation. Water moves downslope along the top of the fragipan and can cause wetness in basements and around foundations and walls. Installing drains at the base of footings and coating the exterior of basement walls help keep basements dry. Landscaping and using diversions and drainage ditches help to divert runoff from the higher adjacent soils.

Installing drains and providing suitable base material help to prevent the damage to local roads and streets caused by frost action and by low strength.

This soil is poorly suited to septic tank absorption fields. The seasonal wetness and the restricted permeability in the fragipan are the major limitations. Installing perimeter drains around the absorption field helps to lower the seasonal high water table. Increasing the size of the absorption area helps to overcome the restricted permeability.

The land capability classification is IIe. The woodland ordination symbol is 4A.

ZaC—Zanesville silt loam, 6 to 15 percent slopes. This soil is deep, strongly sloping, and moderately well drained and well drained. It is on ridgetops in the uplands. Most areas are long and narrow and range from 20 to 50 acres. Some areas are as much as ½ mile long.

Typically, the surface layer is brown, friable silt loam about 8 inches thick. The subsoil is about 54 inches thick. The upper part is yellowish brown and strong brown, mottled, friable silt loam. The lower part is a fragipan of yellowish brown, mottled, very firm and brittle silt loam and silty clay loam. Soft shale and siltstone bedrock is at a depth of about 62 inches.

Included with this soil in mapping are small areas of Woodsfield soils on the upper parts of slopes and some soils that are in the flood pool of Senecaville Lake. Woodsfield soils do not have a fragipan. The soils along Senecaville Lake are subject to flooding. Also included are soils underlain by mildly alkaline, soft bedrock. Included soils make up about 15 percent of most mapped areas.

Permeability is moderate above the fragipan in the Zanesville soil and moderately slow or slow in the fragipan. The root zone is mainly restricted to the 20- to 32-inch zone above the fragipan. The available water capacity in this zone is low. Runoff is medium or rapid. A perched seasonal high water table is at a depth of 24 to 36 inches during extended wet periods. In the surface layer, the content of organic matter is moderate and tilth is good.

Most areas of this soil are used as cropland or pasture. Some areas are wooded.

This soil is moderately suited to corn and small grain and well suited to hay and pasture. The slope, the hazard of erosion, and a crusty surface are the main management concerns. Contour stripcropping, a cropping sequence that includes meadow crops, and winter cover crops help to control erosion and maintain tilth. No-till planting or other kinds of conservation tillage that leave crop residue on the surface also help to control erosion. Shallow cultivation of intertilled crops breaks up the crust on the surface. Proper stocking rates, rotation grazing, and weed control help to keep the pasture plants in good condition.

This soil is well suited to trees. No major hazards or limitations affect planting or harvesting.

This soil is moderately suited to building site development. The slope and the seasonal wetness are the main limitations. Water moves downslope along the top of the fragipan and can cause wetness in basements and around foundations and walls. Installing drains at the base of footings and coating the exterior of basement walls help keep basements dry. Landscaping and using diversions and drainage ditches help to divert runoff from the higher adjacent soils. Designing the buildings so that they conform to the natural slope of the land helps to control erosion.

Installing drains and providing suitable base material help to prevent the damage to local roads and streets caused by frost action and by low strength.

This soil is poorly suited to septic tank absorption fields. The seasonal wetness, the slope, and the restricted permeability in the fragipan are the major limitations. Installing perimeter drains around the absorption field helps to lower the seasonal high water table, and subsurface drains upslope from the field intercept seepage water. Increasing the size of the absorption area helps to overcome the restricted permeability.

The land capability classification is IIIe. The woodland ordination symbol is 4A.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

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

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

About 21,340 acres in the survey area, or about 8 percent of the total acreage, meets the soil requirements for prime farmland. Scattered areas of this land are throughout the county, but most are in the northern and southwestern parts, mainly in associations 7, 8, and 9, which are described under the heading "General Soil Map Units."

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

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

Some soils that have a seasonal high water table and all soils that are frequently flooded during the growing season qualify for prime farmland only in areas where these limitations have been overcome by drainage measures or flood control. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not these limitations have been overcome by corrective measures. About half of the acreage of prime farmland in Noble County is frequently flooded, and about 1,750 acres consists of somewhat poorly drained soils that need artificial drainage.

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 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.

The soils in the survey area are assigned to various interpretive groups at the end of each map unit description and in some of the tables. The groups for each map unit also are shown in the section "Interpretive Groups," which follows the tables at the back of this survey.

Crops and Pasture

Carl G. Stone, district conservationist, Soil Conservation Service, helped prepare this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the 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 "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

In 1982, about 31,100 acres, or 12 percent of the acreage in Noble County, was used for cropland (including hayland) and 74,000 acres, or 29 percent, was used for pasture *(18)*. The rest of the acreage was in woodland, urban areas, and other uses. The acreage in cultivated crops fluctuates significantly from year to year. The acreage in hay, which was about 22,000 acres in 1982, is about the same each year.

Nearly all of the cropland supports livestock enterprises consisting mostly of raising cattle and sheep. The major cultivated crop is corn, which is grown for grain and silage. The forage plants are of mixed species. Small grain is grown on a limited basis for cover crops and grain.

The main management concerns on the cropland in the county are erosion, drainage, fertility, slippage, and droughtiness.

Erosion is a major hazard on the cropland in the county, especially on some of the steeper slopes. Productivity decreases as topsoil is lost and the less fertile subsoil is mixed into the plow layer. The results of erosion are especially severe in soils with a clayey subsoil and in soils that have a restricted root zone or are droughty. Erosion also results in sedimentation of streams and in pollution of water supplies by chemicals and nutrients.

The main erosion-control practices are designed to provide a protective cover of growing plants or crop residue and reduce the runoff rate. A cropping system that keeps a plant cover or adequate amounts of crop residue on the soil year-round can often hold soil losses to a level which does not affect long-term productivity. Conservation tillage, mainly by no-till farming, leaves crop residue on the soil, which increases the rate of water infiltration and protects the soil while a new crop is being established.

Contour stripcropping, an effective erosion-control method, generally is not used in the county because of irregular slopes and the small size of the fields. Cover crops, which protect the soil surface, and grassed waterways also are effective erosion-control practices. Grassed waterways are natural or constructed channels that remove surface water at a nonerosive velocity. Natural drainageways are the best sites for grassed waterways, mainly because a good channel commonly can be established with a minimum of shaping. The waterway can be designed so that it can be crossed by farm machinery.

Pastures in the county also are subject to erosion. Most of the pastures are continually grazed, which keeps the plants short and results in shallow root systems and bare areas. The growth of plants with a shallow root system is very limited during the dry part of the summer. As the desirable species of grasses and legumes are weakened and overcome by weeds, more unprotected areas form and erosion is more severe. Using rotation grazing and maintaining proper stocking rates allow the grasses and legumes to reach several inches in height, which allows the root system to develop.

Drainage is a major management concern on many of the less sloping soils in the county. Such soils are saturated well into the growing season. Some of these soils have a clayey subsoil. Wetness commonly prevents root growth into that layer. Those soils also stay wet longer in the spring, which can delay the use of farm machinery. The Sarahsville and Newark soils are the common bottom-land soils that often require drainage. Subsurface drainage, also called tile drainage, is usually most effective on level soils if an outlet can be established. A pattern of subsurface drains can lower the water table in whole fields or parts of a field. A random or interceptor line can remove water from wet spots or seeps.

Surface drainage and blind drainage have been used in the county. Surface drainage ditches are effective for removing surface water but usually do little to change the water table in the soil. They are difficult to maintain, and they limit the use of equipment. Blind ditches, which are less common than surface ditches, are backfilled with field stones, pole-sized trees, or other material that leaves voids through which water moves. The effectiveness of blind ditches is often short term because the voids usually become blocked by soil.

On the steeper slopes, drainage of rapidly moving surface runoff and subsurface water is a concern. Subsurface drains remove water from seeps and wet spots, while diversion ditches move surface water safely away from a field.

Slippage of soils is a major concern in all areas of the county and for all uses of the soil. Slips on cropland and pasture, for example, make the use of equipment difficult and hazardous. The use of machinery for mowing, planting, or harvesting commonly is precluded in areas where slippage has resulted in a broken or undulating landscape.

The main soils in the county that are susceptible to slippage are the Upshur, Vandalia, Brookside, and Guernsey soils. The hazard is especially severe if the soils are disturbed, particularly on foot slopes, and if water is allowed to infiltrate the soil. The high content of clay in these soils makes them swell when wet. The swelling, combined with gravity and the slippery nature of the wet soil, causes the unstable soil to slide downslope in sheets or blocky masses. Installing surface and subsurface drains above the slip helps to reduce ponding and intercept the water that causes the swelling and makes the soil slippery, but this is difficult to accomplish and is only moderately effective. Grading the soils after they are drained improves surface drainage and helps to prevent subsequent slips.

Droughtiness is a severe limitation for crops on the Berks, Barkcamp, Enoch, Bethesda, Morristown, and Gilpin soils. Four of these—the Barkcamp, Enoch, Bethesda, and Morristown soils—are in surface-mined areas that have a poor moisture-holding capacity because of the many rock fragments in the soil and the poor structure of the subsoil. Maintaining sod, leaf litter, or plant residue on the droughty soils conserves moisture. Increasing the content of organic matter in these soils increases moisture retention. Overgrazing increases moisture stress in pastures by weakening the forage plants.

Maintaining fertility for crops and pasture is a concern on all the soils in the county. The fertility of an individual area depends upon how the area has been used and managed and on the types and amounts of fertilizer that have been applied. Because these factors differ widely from farm to farm, onsite testing is necessary.

While the amount and kind of fertilizer needed to build up fertility can differ widely even within soils of the same type, the ability of a soil to store and release plant nutrients is a fairly constant property. Soils that have large amounts of clay and organic matter also have a capacity for storing and releasing plant nutrients; soils that have less clay and organic matter have less capacity. Among soils of the same type, the eroded soils generally have less organic matter than the uneroded soils.

If a large amount of fertilizer and lime is applied to steep or very porous soils, much of it is likely to be lost through runoff or leaching before it is held by the soil in a form that can be used by plants. For this reason, frequent, light applications of fertilizer and lime are more effective on such soils than a single, large application.

Most crops grown in the area require a pH value of not more than 5.5 in the root zone for best growth. Alfalfa, however, grows best at a pH of 6.5 or more. The availability of phosphorus is closely dependent on pH values. Much of the phosphate fertilizer applied to very acid soils combines with iron and aluminum and is not available to plants. Earthworms, which incorporate plant residue into the soil, are most active at pH values near neutral. Their activity results in better soil structure.

As it breaks down, the organic matter in the soil releases considerable amounts of nitrogen and phosphorus and some micronutrients. It improves soil structure and makes the soil easier to work. A soil that has a high content of organic matter also has a large capacity for storing and releasing plant nutrients. Additions of crop residue and barnyard manure are especially beneficial in restoring productivity to severely eroded Upshur soils, for example.

Use and Management of Disturbed Land

In 1985, the county contained nearly 26,000 acres of surface-mined soils. Most of these areas were mined before 1972 and consisted of graded and ungraded ridges and piles of spoil with little or no soil material. Most of these unreclaimed areas are Barkcamp, Bethesda, Morristown, and Enoch soils and Udorthents-Pits complex. About 3,200 acres of the Bethesda and Morristown soils have been reclaimed by blanketing the surface with topsoil and restoring the original contours of the land. Most of the other mined areas that are undergoing reclamation are covered with a minimum of 6 inches of soil.

The reclaimed soils are suitable for farming but have special limitations. The organic matter content is much lower in mined soils than in most other soils. A high bulk density is common in the replacement soil on the surface and in the underlying graded mine spoil. This is caused by compaction from (1) heavy machinery, especially vehicles used during reclamation; (2) improper handling of the topsoil used during reclamation; (3) mining and reclamation performed when the soil was wet; and (4) insufficient time for the processes of soil formation to lower the bulk density. Soils with a high bulk density have a low available water capacity for plants.

Mine spoil typically is 35 to 60 percent rock fragments; the content of rock fragments in most other soils is 0 to 15 percent. A high content of rock fragments in a soil restricts the root zone and the available water capacity for plants.

Suitable forage crops on mine soils increase the organic matter content of the soil, improve soil structure, reduce compaction, and increase water infiltration, pore space, and the root zone. Planting forage crops also reduces runoff and helps to control erosion on those soils. Reseeding when stands are thin and planting companion crops or using no-till or trash-mulch methods reduce the hazard of erosion. Frequent, light applications of fertilizers are better than a single, large application because many of the nutrients are lost during runoff and most of the root systems are near the surface.

Compaction, plant damage, and erosion are hazards if the mine soils are grazed in winter when they are wet.

Yields Per Acre

Carl G. Stone, district conservationist, Soil Conservation Service, and Ray Wells, county agricultural extension agent, helped prepare this section.

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

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

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

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

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive land forming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for woodland and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit *(15)*. Only class and subclass are used in this survey.

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

Class I soils have few limitations 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 hazard is the risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

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

The acreage of soils in each capability class and subclass is shown in table 7. The capability classification of each map unit is given in the section "Detailed Soil Map Units" and in the yields table.

Woodland Management and Productivity

Woodland covers about 46 percent of the county. Most of it is in privately owned stands and farm lots, and the largest areas are in the southeastern part of the county. Mixed hardwoods, mainly oak and hickory, make up most of the stands. The main limitations for woodland management in the county are slope, wetness, rock fragments or clay in the subsoil, aspect, and restricted rooting. The degree of erosion, the acidity of the soil, and the level of fertility also are woodland management concerns.

Aspect, the compass direction toward which the slope faces *(5)*, affects the suitability of a soil for woodland. The soils on north and east aspects generally are more moist and are less exposed to the sun and wind than are soils on south and west aspects. Thus, the soils on north and east aspects generally have better potential productivity for trees.

The position of the soil commonly determines the amount of moisture available for trees. The moisture content of a soil decreases as the elevation of the soil increases, and soils on the lower parts of the slope generally are deeper, more moist, and cooler than those on the upper parts.

Slope restricts the use of equipment for managing woodland. Further, as the slope increases, the rate of water infiltration decreases and the rate of runoff and the hazard of erosion increase.

Erosion reduces the amount of soil available for holding moisture. In severe instances it strips away the surface layer, exposing the less porous and less fertile subsoil. An eroded soil thus limits the growth and reseeding of trees.

The reaction and level of fertility of a soil determine to a great extent the suitability of the soil for different trees. For example, the reaction and fertility level of the Chagrin and Nolin soils make them suitable for black walnut.

Table 8 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for an indicator tree species. The number indicates the volume, in cubic meters per hectare per year, which the indicator species can produce. The number 1 indicates low potential productivity; 2 and 3, moderate; 4 and 5, moderately high; 6 to 8, high; 9 to 11, very high; and 12 to 39, extremely high. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *R* indicates steep slopes; *X*, stoniness or rockiness; *W*, excess water in or on the soil; *T*, toxic substances in the soil; *D*, restricted rooting depth; *C*, clay in the upper part of the soil; *S*, sandy texture; *F*, a high content of rock fragments in the soil; and *L*, low strength. The letter *A* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: R, X, W, T, D, C, S, F, and L.

In table 8, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

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

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

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

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

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

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

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

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

Windbreaks and Environmental Plantings

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

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

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

Table 9 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 9 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service, from a commercial nursery, or from the Ohio Department of Natural Resources, Division of Forestry.

Recreation

The soils of the survey area are rated in table 10 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 sewer lines. 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 10, 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 10 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 13 and interpretations for dwellings without basements and for local roads and streets in table 12.

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

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

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

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

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

Wildlife Habitat

Sally Griffith, wildlife biologist, Soil Conservation Service, helped prepare this section.

The major wildlife species in the county are deer, fox, squirrel, rabbit, raccoon, beaver, muskrat, grouse, mallard, and wood duck.

Nearly 21,000 acres of unreclaimed surface-mined Bethesda, Barkcamp, Enoch, and Morristown soils is used primarily for wildlife habitat. These soils are droughty, have poor tilth, contain many rock fragments, and have a limited root zone. The suitable plants for wildlife habitat on these soils are black locust, eastern white pine, red pine, red maple, sweetgum, Tatarian honeysuckle, and autumn-olive.

In many areas of woodland, the types of soils are a major factor in determining which trees are suitable for wildlife habitat. Black walnut, for example, is suitable for deep, well drained soils, such as Chagrin and Nolin soils.

Guernsey and Lowell soils are good sites for ponds. Many areas of wet Sarahsville soils are undrained and are suitable as habitat for woodcock and raccoon, for instance. Some woody plants that tolerate wet conditions and are beneficial to wildlife are pin oak, black alder, silky dogwood, gray dogwood, and elderberry.

Additional information or assistance on improving wildlife habitat can be obtained from the Ohio Department of Natural Resources, Division of Wildlife; the Cooperative Extension Service; or the Soil Conservation Service.

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

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

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and 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, timothy, 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 foxtail, goldenrod, smartweed, ragweed, and fescue.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, sweetgum, apple, hawthorn, dogwood, hickory, blackberry, and sumac. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are shrub honeysuckle, autumn-olive, and crabapple.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, 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, duckweed, reed canarygrass, 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, groundhog, 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. The 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 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (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 12 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 dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, 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, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered. Some of the moderately steep, steep, and very steep soils in the county are subject to hillside slippage. Buildings can be damaged by this slippage.

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

Table 13 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 filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

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

Table 13 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 groundwater pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 13 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 revegetation. 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 14 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

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

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

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

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

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 14, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

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

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

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

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

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

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

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal 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 15 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed excavated ponds. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

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

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

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

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

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. 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 water 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 soil blowing 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 soil blowing, 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. These results are reported in table 19.

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 classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 16 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 Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay

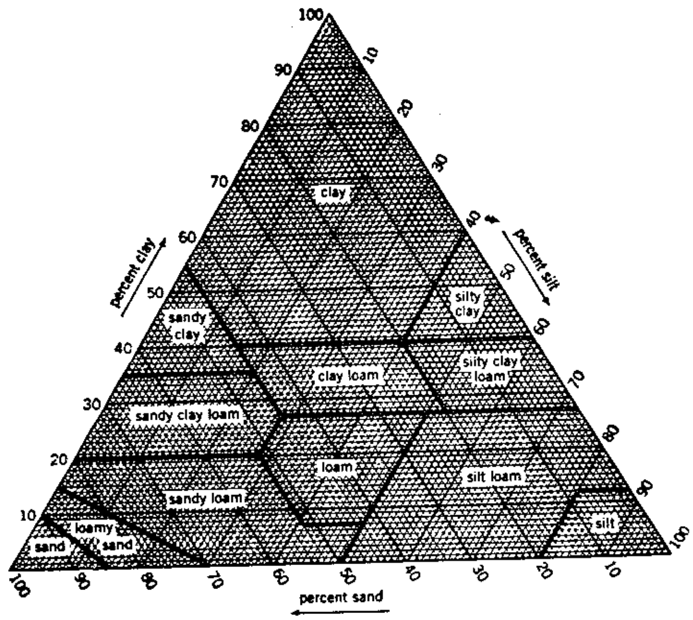

Figure 6.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

in the fraction of the soil that is less than 2 millimeters in diameter (fig. 6). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system *(4)* and the system adopted by the American Association of State Highway and Transportation Officials *(3)*.

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

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

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

Rock fragments 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 ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

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

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

Physical and Chemical Properties

Table 17 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

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

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

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at ⅓ bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

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

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 17, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 18 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the infiltration of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

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 is not considered flooding, nor is water in swamps and marshes.

Table 18 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs, on the average, once or less in 2 years; and *frequent* that it occurs, on the average, 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.

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 are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The 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 18 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 18. Only saturated zones within a depth of about 6 feet are indicated.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors 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.

Physical and Chemical Analyses of Selected Soils

Many of the soils in Noble County were sampled by the Soil Characterization Laboratory, Department of Agronomy, Ohio State University, Columbus, Ohio. The physical and chemical data obtained from the samples include particle-size distribution, reaction, organic matter content, calcium carbonate equivalent, and extractable cations.

These data were used in classifying and correlating the soils and in evaluating their behavior under various land uses. Seven pedons were selected as representative of their respective series and are described in the section "Soil Series and Their Morphology." These series and their laboratory identification numbers are Barkcamp series (NB-15), Enoch series (NB-16), Guernsey series (NB-S13), Sarahsville series (NB-18), Vandalia series (NB-49), Woodsfield series (NB-23), and Zanesville series (NB-48).

In addition to the data from Noble County, laboratory data are also available from nearby counties that have many of the same soils. These data and the data from Noble County are on file at the Department of Agronomy, Ohio State University, Columbus, Ohio; the Ohio Department of Natural Resources, Division of Soil and Water Conservation, Columbus, Ohio; and the Soil Conservation Service, State Office, Columbus, Ohio.

Engineering Index Test Data

Table 19 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are representative of the series described in the section "Soil Series and Their Morphology." The soil samples were tested by the Ohio Department of Transportation, Division of Highways, Bureau of Testing, Soils and Foundation Section.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); and Moisture density, Method A—T 99 (AASHTO), D 698 (ASTM).

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(16)*. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 20 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Eleven soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol.* An example is Alfisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Udalf (*Ud*, meaning humid, plus *alf*, from Alfisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Hapludalfs (*Hapl*, meaning minimal horizonation, plus *udalf*, the suborder of the Alfisols that has a udic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Hapludalfs.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine, mixed, mesic Typic Hapludalfs.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. 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 (14)*. Many of the technical terms used in the descriptions are defined in *Soil Taxonomy (16)*. Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Barkcamp Series

The Barkcamp series consists of deep, well drained soils in surface-mined areas. These soils formed in ultra acid, partly weathered fine earth and fragments of rock dominated by medium- and coarse-grained sandstone and a small amount of siltstone and shale. Permeability is moderately rapid or rapid. Slope ranges from 0 to 70 percent.

Barkcamp soils are similar to Enoch soils and are commonly adjacent to Berks, Enoch, Guernsey, Lowell, and Upshur soils. Enoch soils have more silt and clay throughout the profile than the Barkcamp soils. Berks, Guernsey, Lowell, and Upshur soils are in unmined areas. They have a subsoil.

Typical pedon of Barkcamp channery sandy loam, 0 to 8 percent slopes, very stony, about 2 miles southwest of Fulda, in Enoch Township; 50 feet north and 2,480 feet east of the southwest corner of sec. 17, T. 6 N., R. 8 W.

Ap—0 to 7 inches; variegated brown (10YR 4/3) and light gray (10YR 6/1) channery sandy loam; massive; very friable; 20 percent coarse fragments; ultra acid; clear smooth boundary.

C1—7 to 13 inches; variegated brown (10YR 4/3) and strong brown (7.5YR 5/6) very channery sandy loam; massive; friable; 40 percent coarse fragments, 5 percent coal fragments; ultra acid; clear smooth boundary.

C2—13 to 36 inches; variegated yellowish brown (10YR 5/4), brown (10YR 5/3), and strong brown (7.5YR 5/6) very channery sandy loam; massive; friable; 40 percent coarse fragments; ultra acid; clear smooth boundary.

C3—36 to 50 inches; variegated yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) extremely channery sandy loam; massive; friable; 75 percent coarse fragments; ultra acid; clear wavy boundary.

C4—50 to 72 inches; yellowish brown (10YR 5/4) extremely channery sandy loam; massive; friable; 65 percent coarse fragments; ultra acid.

The content of coarse fragments ranges from 35 to 75 percent in the C horizon. The Ap horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 0 to 8. It typically is channery sandy loam but is cobbly sandy loam in some pedons. The C horizon has hue of 2.5YR to 2.5Y, value of 4 to 6, and chroma of 0 to 8. It is the very channery, extremely channery, or very cobbly analog of loam, sandy loam, or loamy sand.

Berks Series

The Berks series consists of moderately deep, well drained soils on ridgetops and hillsides in the uplands. These soils formed in residuum weathered from shale and siltstone and smaller amounts of sandstone. Permeability is moderately rapid. Slope ranges from 8 to 70 percent.

Berks soils are similar to Dekalb soils and are commonly adjacent to Elba, Guernsey, Lowell, and Upshur soils. Berks soils and Elba, Guernsey, Lowell, and Upshur soils are in similar landscape positions. Dekalb soils have more sand in the subsoil than the Berks soils. Elba, Guernsey, Lowell, and Upshur soils are deep to bedrock.

Typical pedon of Berks shaly silt loam, 35 to 70 percent slopes, about 2 miles southeast of Belle Valley, in Noble Township; 530 feet east and 1,585 feet south of the center of sec. 22, T. 7 N., R. 9 W.

Oe—1 inch to 0; partly decomposed leaf litter.

A—0 to 3 inches; brown (10YR 4/3) shaly silt loam, pale brown (10YR 6/3) dry; weak fine granular structure; friable; common fine roots; 20 percent shale fragments; strongly acid; clear wavy boundary.

Bw1—3 to 8 inches; yellowish brown (10YR 5/4) very shaly silt loam; weak fine subangular blocky structure; friable; common fine roots; 50 percent shale fragments; strongly acid; clear wavy boundary.

Bw2—8 to 15 inches; yellowish brown (10YR 5/4) extremely shaly silt loam; weak fine subangular blocky structure; friable; common fine roots; 65 percent shale fragments; strongly acid; clear wavy boundary.

Bw3—15 to 29 inches; yellowish brown (10YR 5/4) extremely shaly silt loam; weak fine subangular blocky structure; friable; few fine roots; 75 percent shale fragments; strongly acid; clear wavy boundary.

C—29 to 35 inches; yellowish brown (10YR 5/4) extremely shaly silt loam; massive; friable; 85 percent shale fragments; strongly acid; clear wavy boundary.

R—35 to 42 inches; light olive brown (2.5Y 5/4), fractured shale and siltstone.

The thickness of the solum ranges from 18 to 37 inches. The depth to bedrock ranges from 20 to 40 inches. The content of coarse fragments ranges from 15 to 35 percent in the A horizon and from 15 to 75 percent in individual subhorizons of the Bw horizon.

The A horizon has value of 3 to 5 and chroma of 2 to 4. It commonly is shaly silt loam but is shaly loam in some pedons. The Bw and C horizons have value of 4 to 6 and chroma of 3 to 6. They are the channery, very channery, extremely channery, shaly, very shaly, or extremely shaly analog of silt loam.

Bethesda Series

The Bethesda series consists of deep, well drained, moderately slowly permeable soils in surface-mined areas. These soils formed in a mixture of partly weathered fine earth material and fragments of sandstone, siltstone, and shale. Slope ranges from 0 to 70 percent.

Bethesda soils are commonly adjacent to Berks, Elba, Guernsey, Lowell, and Vandalia soils in unmined areas. These adjacent soils have a subsoil.

Typical pedon of Bethesda very shaly silty clay loam, 0 to 8 percent slopes, about 2 miles northwest of Batesville, in Beaver Township; 2,190 feet north and 130 feet east of the southwest corner of sec. 23, T. 8 N., R. 7 W.

Ap—0 to 4 inches; brown (10YR 4/3) very shaly silty clay loam, light brownish gray (2.5Y 6/2) dry; weak medium granular structure; friable; many fine roots; 55 percent coarse fragments; very strongly acid; abrupt smooth boundary.

C1—4 to 14 inches; brown (10YR 4/3) very shaly silt loam; massive; friable; many fine roots; 55 percent coarse fragments; very strongly acid; clear wavy boundary.

C2—14 to 26 inches; dark brown (10YR 3/3) extremely shaly silt loam; massive; friable; common fine roots; 65 percent coarse fragments; very strongly acid; clear wavy boundary.

C3—26 to 40 inches; yellowish brown (10YR 5/4) very shaly silty clay loam; massive; friable; common fine roots; 55 percent coarse fragments; extremely acid in the upper part and very strongly acid in the lower part; clear wavy boundary.

C4—40 to 60 inches; brown (10YR 4/3) very shaly silty clay loam; massive; friable; few fine roots; 55 percent coarse fragments; very strongly acid.

The coarse fragments consist of shale, sandstone, siltstone, and coal. They typically are as much as 10 inches in diameter, but some are stones and boulders. The content of coarse fragments in the C horizon ranges from 40 to 75 percent.

The Ap horizon has hue of 10YR or 2.5Y or is neutral. It has value of 3 to 5 and chroma of 0 to 4. It is typically very shaly silty clay loam or silty clay loam but in some pedons is shaly, channery, or very channery silty clay loam, clay loam, silt loam, or loam. The C horizon has hue of 10YR or 2.5Y or is neutral. It has value of 3 to 6 and chroma of 0 to 4. It is the very shaly, extremely shaly, very channery, or extremely channery analog of silty clay loam, clay loam, silt loam, or loam.

Brookside Series

The Brookside series consists of deep, moderately well drained, moderately slowly permeable soils on foot slopes and the lower parts of side slopes in the uplands. These soils formed in colluvium derived from limestone, shale, siltstone, and thin layers of sandstone. Slope ranges from 8 to 35 percent.

Brookside soils are similar to and are commonly adjacent to the well drained Elba and Lowell soils. Elba and Lowell soils are in the higher positions on hillsides and ridgetops. Brookside soils are also adjacent to the redder Vandalia soils.

Typical pedon of Brookside silt loam, in an area of Brookside-Vandalia complex, 15 to 25 percent slopes, eroded, about 0.5 mile north of East Union, in Stock Township; 340 feet east and 1,740 feet north of the center of sec. 27, T. 7 N., R. 8 W.

Ap—0 to 6 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; moderate medium subangular blocky structure; friable; common fine roots; common faint yellowish brown (10YR 5/4) clay films on faces of peds; few black (10YR 2/1) iron and manganese oxide concretions; 5 percent coarse fragments; strongly acid; clear wavy boundary.

Bt1—6 to 18 inches; yellowish brown (10YR 5/4) silty clay loam; moderate medium subangular blocky structure; friable; common fine roots; common faint yellowish brown (10YR 5/4) clay films on faces of peds; few black (10YR 2/1) iron and manganese oxides; 5 percent coarse fragments; strongly acid; clear wavy boundary.

Bt2—18 to 24 inches; yellowish brown (10YR 5/4) silty clay; common medium distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; few fine roots; common faint yellowish brown (10YR 5/4) clay films on faces of peds; common faint pale brown (10YR 6/3) coatings on faces of peds; few distinct black (10YR 2/1) iron and manganese oxides; 5 percent coarse fragments; strongly acid; clear wavy boundary.

Bt3—24 to 37 inches; brown (10YR 5/3) silty clay; common medium faint pale brown (10YR 6/3) and few medium faint yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; firm; common distinct light olive brown (2.5Y 5/4) clay films on faces of peds; few distinct black (10YR 2/1) iron and manganese oxides; 5 percent coarse fragments; strongly acid; clear wavy boundary.

Bt4—37 to 50 inches; yellowish brown (10YR 5/4) shaly silty clay; few fine prominent light brownish gray (2.5Y 6/2) and common medium faint yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; common faint light olive brown (2.5Y 5/4) clay films on faces of peds; common distinct grayish brown (2.5Y 5/2) coatings on faces of peds; few distinct black (10YR 2/1) iron and manganese oxides; 20 percent coarse fragments; medium acid; clear wavy boundary.

C1—50 to 60 inches; light olive brown (2.5Y 5/4) silty clay; few medium distinct light olive gray (5Y 6/2) mottles; massive; firm; 5 percent coarse fragments; slightly acid; clear wavy boundary.

C2—60 to 78 inches; variegated light olive brown (2.5Y 5/4 and 5/6) and grayish brown (2.5Y 5/2) silty clay; massive; firm; 5 percent coarse fragments; mildly alkaline; slight effervescence.

The thickness of the solum ranges from 40 to 80 inches. The depth to bedrock ranges mainly from 5 to 10 feet. The content of coarse fragments ranges from 0 to 15 percent in the A horizon, from 5 to 25 percent in the Bt horizon, and from 5 to 35 percent in the C horizon.

The Ap horizon has hue of 10YR, value of 3 to 5, and chroma of 2 or 3. It typically is silt loam but is silty clay loam in some pedons. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is silty clay, clay, silty clay loam, or clay loam or their shaly analogs. The C horizon has hue of 7.5YR to 2.5Y, value of 3 to 5, and chroma of 2 to 6. It is clay loam, silty clay loam, silty clay, or clay or their shaly analogs.

Chagrin Series

The Chagrin series consists of deep, well drained, moderately permeable soils that formed in alluvium on flood plains. Slope ranges from 0 to 3 percent.

Chagrin soils are similar to Nolin soils and are commonly adjacent to Newark soils. Newark soils are somewhat poorly drained and are in the lower positions on flood plains. Nolin soils have less sand in the subsoil than the Chagrin soils.

Typical pedon of Chagrin silt loam, occasionally flooded, about 2.75 miles southeast of Dungannon, in Jackson Township; 315 feet north and 2,585 feet east of the southwest corner of sec. 33, T. 5 N., R. 9 W.

Ap—0 to 10 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; moderate medium granular structure; friable; many fine roots; 2 percent coarse fragments; medium acid; clear wavy boundary.

Bw1—10 to 25 inches; dark yellowish brown (10YR 4/4) silt loam; weak medium subangular blocky structure; friable; common fine roots; common faint brown (10YR 4/3) coatings on faces of peds; medium acid; clear wavy boundary.

Bw2—25 to 35 inches; dark yellowish brown (10YR 4/4) stratified silt loam and loam; weak medium subangular blocky structure; friable; few fine roots; common distinct brown (10YR 4/3) coatings on faces of peds; 2 percent charcoal fragments; medium acid; clear wavy boundary.

Bw3—35 to 44 inches; dark yellowish brown (10YR 4/4) silt loam; weak medium subangular blocky structure; friable; few fine roots; 5 percent charcoal fragments; slightly acid; clear wavy boundary.

Bw4—44 to 48 inches; brown (10YR 4/3) silt loam; weak medium subangular blocky structure; friable; 2 percent charcoal fragments; slightly acid; clear wavy boundary.

C1—48 to 58 inches; brown (10YR 5/3) silt loam; common medium distinct strong brown (7.5YR 5/6) mottles; massive; friable; 10 percent charcoal fragments; few thin lenses of loam; slightly acid; clear wavy boundary.

C2—58 to 63 inches; dark grayish brown (10YR 4/2) silt loam; common medium distinct yellowish brown (10YR 5/4) mottles; massive; friable; few thin lenses of loam; 10 percent coarse fragments; slightly acid.

The thickness of the solum ranges from 25 to 48 inches.

The Bw horizon has hue of 7.5YR or 10YR and value of 4 or 5. It commonly is silt loam or loam, but thin subhorizons of sandy loam are in some pedons. The C horizon has chroma of 2 to 4. It is silt loam, loam, or sandy loam.

Dekalb Series

The Dekalb series consists of moderately deep, well drained, rapidly permeable soils on hillsides and ridgetops in the uplands. These soils formed in colluvium and residuum derived from sandstone. Slope ranges from 25 to 70 percent.

Dekalb soils are similar to Berks soils and are commonly adjacent to Berks, Elba, Guernsey, Lowell, and Upshur soils. Dekalb soils and Berks, Elba, Guernsey, Lowell, and Upshur soils are in similar landscape positions. Berks soils have less sand in the subsoil than the Dekalb soils. Elba, Guernsey, Lowell, and Upshur soils are deep to bedrock.

Typical pedon of Dekalb channery loam, 40 to 70 percent slopes, about 3 miles southeast of Mount Ephraim, in Marion Township; 540 feet south and 1,500 feet east of the center of sec. 10, T. 7 N., R. 8 W.

Oe—1 inch to 0; partly decomposed leaf litter.

A—0 to 3 inches; very dark grayish brown (10YR 3/2) channery loam, brown (10YR 5/3) dry; weak fine granular structure; friable; many roots; 15 percent coarse fragments; very strongly acid; clear wavy boundary.

BA—3 to 8 inches; dark yellowish brown (10YR 4/4) very channery loam; weak fine granular structure; friable; common fine roots; 45 percent coarse fragments; very strongly acid; clear wavy boundary.

Bw1—8 to 15 inches; brown (10YR 5/3) channery loam; weak fine subangular blocky structure; friable; common roots; 30 percent coarse fragments; very strongly acid; clear wavy boundary.

Bw2—15 to 22 inches; yellowish brown (10YR 5/4) very channery sandy loam; weak fine subangular blocky structure; friable; common fine roots; 45 percent coarse fragments; strongly acid; clear wavy boundary.

C—22 to 34 inches; yellowish brown (10YR 5/4) extremely channery sandy loam; massive; very friable; 65 percent coarse fragments; strongly acid; clear wavy boundary.

R—34 to 38 inches; fractured, light yellowish brown (10YR 6/4), hard sandstone.

The thickness of the solum and the depth to bedrock range from 20 to 40 inches. The content of coarse fragments ranges from 15 to 25 percent in the A horizon and from 15 to 60 percent in the Bw horizon.

The A horizon has value of 3 or 4 and chroma of 2 or 3. Some pedons have an E horizon. The Bw horizon has value of 5 or 6 and chroma of 3 to 6. It is channery or very channery loam or sandy loam. The C horizon has chroma of 4 to 6. It is the very flaggy, extremely flaggy, very channery, or extremely channery analog of sandy loam.

Elba Series

The Elba series consists of deep, well drained, slowly permeable soils on ridgetops and hillsides in the uplands. These soils formed in residuum derived from limestone and calcareous shale. Slope ranges from 15 to 70 percent.

Elba soils are similar to Brookside and Lowell soils and are commonly adjacent to Berks, Brookside, Dekalb, Lowell, and Vandalia soils. Berks and Dekalb soils are moderately deep to bedrock. Brookside and Lowell soils do not have carbonates within a depth of 30 inches. Vandalia soils have redder hues in the subsoil than the Elba soils. Elba soils and Berks, Dekalb, and Lowell soils are in similar landscape positions. Brookside and Vandalia soils are on foot slopes and the lower parts of side slopes. Vandalia soils are also on benches on side slopes.

Typical pedon of Elba silty clay loam, 25 to 40 percent slopes, eroded, about 1.75 miles east of Batesville, in Beaver Township; 1,480 feet south and 1,110 feet east of the northwest corner of sec. 3, T. 8 N., R. 7 W.

Ap1—0 to 2 inches; dark grayish brown (10YR 4/2) silty clay loam, light brownish gray (10YR 6/2) dry; moderate medium granular structure; friable; many fine roots; slightly acid; clear wavy boundary.

Ap2—2 to 5 inches; brown (10YR 4/3) silty clay loam, light yellowish brown (10YR 6/4) dry; moderate medium subangular blocky structure; firm; common fine roots; slightly acid; abrupt smooth boundary.

Bt1—5 to 12 inches; yellowish brown (10YR 5/6) silty clay; moderate medium subangular blocky structure; firm, sticky and plastic; common fine roots; common faint yellowish brown (10YR 5/6) clay films on faces of peds; slightly acid; clear wavy boundary.

Bt2—12 to 16 inches; yellowish brown (10YR 5/6) silty clay; moderate medium subangular blocky structure; firm, sticky and plastic; common fine roots; common faint yellowish brown (10YR 5/6) clay films on faces of peds; 5 percent coarse fragments; neutral; clear wavy boundary.

Bt3—16 to 21 inches; yellowish brown (10YR 5/6) shaly silty clay; moderate medium subangular blocky structure; firm, sticky and plastic; common fine roots; common faint yellowish brown (10YR 5/6) clay films on faces of peds; 15 percent olive gray (5Y 5/2) shale fragments; moderately alkaline; slight effervescence; clear wavy boundary.

Bt4—21 to 26 inches; yellowish brown (10YR 5/4) silty clay; moderate medium subangular blocky structure;

firm, sticky and plastic; few fine roots; common faint yellowish brown (10YR 5/4) clay films on faces of peds; 5 percent shale fragments; slight effervescence; moderately alkaline; clear wavy boundary.

Bt5—26 to 33 inches; light olive brown (2.5Y 5/4) channery silty clay; moderate medium subangular blocky structure; firm, sticky and plastic; few fine roots; common distinct yellowish brown (10YR 5/4) clay films on faces of peds; 25 percent coarse fragments; strong effervescence; moderately alkaline; clear wavy boundary.

Bt6—33 to 42 inches; light olive brown (2.5Y 5/4) very channery silty clay; moderate medium subangular blocky structure; firm, sticky and plastic; common distinct yellowish brown (10YR 5/4) clay films on faces of peds; 45 percent coarse fragments; strong effervescence; moderately alkaline; clear wavy boundary.

Bt7—42 to 48 inches; yellowish brown (10YR 5/4) channery silty clay; common medium faint yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm, sticky and plastic; common faint brown (10YR 5/3) clay films on faces of peds; few dark stains (iron and manganese oxides) on faces of peds; 15 percent coarse fragments; strong effervescence; moderately alkaline; clear wavy boundary.

R—48 to 54 inches; light gray (10YR 7/1), fractured, hard limestone.

The thickness of the solum ranges from 24 to 48 inches. The depth to carbonates ranges from 10 to 24 inches. The depth to bedrock ranges from 40 to 60 inches. The content of coarse fragments ranges from 0 to 15 percent in the Ap horizon and from 0 to 45 percent in individual subhorizons of the Bt horizon.

The Ap horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 or 3. It is typically silty clay loam but is silt loam in some pedons. The Bt horizon has hue of 7.5YR to 2.5Y, value of 4 or 5, and chroma of 3 to 6. It is silty clay, clay, or silty clay loam or their channery, shaly, very channery, or very shaly analogs. Some pedons have a C horizon.

Enoch Series

The Enoch series consists of deep, well drained soils in surface-mined areas. These soils formed in a mixture of ultra acid, partly weathered fine earth and coarse fragments. The coarse fragments consist mainly of ultra acid shale with some medium- and coarse-grained sandstone and smaller amounts of fine-grained sandstone. Permeability is moderately slow. Slope ranges from 0 to 70 percent.

Enoch soils are similar to Barkcamp soils and are commonly adjacent to Barkcamp, Berks, Guernsey, Lowell, and Upshur soils. Barkcamp soils have more sand and less clay throughout the profile than the Enoch soils. Berks, Guernsey, Lowell, and Upshur soils are in unmined areas. They have a subsoil.

Typical pedon of Enoch shaly silty clay loam, 0 to 8 percent slopes, very stony, 2.2 miles southwest of Fulda, in Enoch Township; 2,305 feet south and 396 feet east of the northwest corner of sec. 17, T. 6 N., R. 8 W.

A—0 to 7 inches; dark grayish brown (2.5Y 4/2) shaly silty clay loam, light brownish gray (2.5Y 6/2) dry; weak fine and medium granular structure; friable; common voids; 20 percent shale fragments and 10 percent sandstone fragments; very dark gray (5Y 3/1) and dark olive gray (5Y 3/2), crushed, thin layer up to 2 inches thick on the surface; mainly ultra acid but neutral in the upper 2 inches; abrupt wavy boundary.

C1—7 to 14 inches; gray (N 5/0) very shaly clay loam; massive; firm; few thin strong brown (7.5YR 5/6) clay loam lenses; 25 percent shale fragments and 15 percent sandstone fragments; ultra acid; clear wavy boundary.

C2—14 to 24 inches; variegated 90 percent black (N 2/0) and very dark gray (N 3/0) and 10 percent gray (10YR 5/1) very shaly loam; massive; very firm; 25 percent shale fragments, 10 percent coal fragments, 5 percent sandstone fragments; ultra acid; abrupt wavy boundary.

C3—24 to 60 inches; variegated 90 percent yellowish brown (10YR 5/4 and 5/6), 5 percent black (N 2/0), and 5 percent gray (10YR 5/1) very channery loam; massive; friable; 50 percent sandstone fragments; ultra acid.

The A horizon has hue of 7.5YR to 5Y or is neutral. It has value of 2 to 6 and chroma of 0 to 6. It is typically shaly silty clay loam but is shaly or channery loam or clay loam in some pedons. The C horizon has hue of 7.5YR to 5Y or is neutral. It has value of 2 to 6 and chroma of 0 to 8. It is shaly, very shaly, channery, or very channery loam, clay loam, or silty clay loam. The textural control section ranges from 35 to 50 percent coarse fragments.

Gilpin Series

The Gilpin series consists of moderately deep, well drained, moderately permeable soils on ridgetops and hillsides in the uplands. These soils formed in residuum derived from interbedded fine-grained sandstone, siltstone, and shale. Slope ranges from 8 to 70 percent.

Gilpin soils are commonly adjacent to Lowell, Upshur, Vandalia, and Zanesville soils, all of which are deep to bedrock. Lowell and Upshur soils are on ridgetops and side slopes. Vandalia soils are on foot slopes, on the lower parts of side slopes, and on benches on side slopes. Zanesville soils are on ridgetops.

Typical pedon of Gilpin silt loam, in an area of Lowell-Gilpin silt loams, 35 to 70 percent slopes, about 1.5 miles northeast of East Union, in Marion Township; 950 feet east and 2,270 feet south of the northwest corner of sec. 23, T. 7 N., R. 8 W.

Oe—1 inch to 0; partly decomposed leaf litter.

A—0 to 4 inches; dark grayish brown (10YR 4/2) silt loam, pale brown (10YR 6/3) dry; moderate fine granular structure; friable; many fine roots; 5 percent coarse fragments; strongly acid; clear wavy boundary.

Bt1—4 to 8 inches; brown (7.5YR 5/4) silt loam; moderate medium subangular blocky structure; friable; many fine roots; common faint brown (7.5YR 5/4) clay films on faces of peds; 10 percent coarse fragments; very strongly acid; clear wavy boundary.

Bt2—8 to 16 inches; brown (7.5YR 5/4) channery silt loam; moderate medium subangular blocky structure; friable; many fine roots; common faint brown (7.5YR 5/4) clay films on faces of peds; 30 percent coarse fragments; very strongly acid; clear wavy boundary.

Bt3—16 to 26 inches; yellowish brown (10YR 5/4) very channery silt loam; moderate medium subangular blocky structure; friable; few fine roots; common faint yellowish brown (10YR 5/4) clay films on faces of peds; 40 percent coarse fragments; very strongly acid; clear wavy boundary.

R—26 to 28 inches; olive (5Y 5/3) shale bedrock.

The thickness of the solum ranges from 18 to 30 inches. The depth to bedrock ranges from 20 to 40 inches. The content of coarse fragments ranges from 10 to 40 percent in individual subhorizons of the Bt horizon. Some pedons have a C horizon that is 40 to 75 percent coarse fragments.

The A or Ap horizon has hue of 10YR, value of 3 to 5, and chroma of 2 to 4. The Bt horizon has chroma of 4 to 6. It is loam, silt loam, or silty clay loam or their channery, very channery, or shaly analogs. Some pedons have a C horizon that has hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 3 to 6. It is very channery, extremely channery, very shaly, or extremely shaly loam, silt loam, or silty clay loam.

Guernsey Series

The Guernsey series consists of deep, moderately well drained, moderately slowly permeable or slowly permeable soils on ridgetops and hillsides in the uplands. These soils formed in colluvium and in the underlying residuum derived from siltstone and shale and some limestone. Slope ranges from 1 to 35 percent.

Guernsey soils are similar to Lowell soils and are commonly adjacent to Berks, Dekalb, Elba, and Lowell soils. Berks, Elba, Dekalb, and Lowell soils are on ridgetops and hillsides. Berks and Dekalb soils are moderately deep to bedrock. Elba soils have free carbonates at a depth of 10 to 24 inches. Lowell soils do not have low-chroma mottles in the upper 10 inches of the argillic horizon.

Typical pedon of Guernsey silt loam, 15 to 25 percent slopes, 2.75 miles east of Belle Valley, in Center Township; 1,090 feet south and 50 feet east of the northwest corner of sec. 23, T. 7 N., R. 9 W.

Ap—0 to 8 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; moderate coarse granular structure; friable; many fine roots; 5 percent coarse fragments; strongly acid; abrupt smooth boundary.

BE—8 to 15 inches; yellowish brown (10YR 5/4) silt loam; weak medium subangular blocky structure; friable; common fine roots; common faint brown (10YR 4/3) coatings on vertical faces of peds; many fine pores; 2 percent coarse fragments; strongly acid; gradual smooth boundary.

Bt1—15 to 22 inches; brown (7.5YR 4/4) silt loam; moderate medium and coarse subangular blocky structure; firm; common fine roots; common faint brown (10YR 4/3) clay films on faces of peds; common fine pores; 5 percent coarse fragments; strongly acid; clear smooth boundary.

Bt2—22 to 37 inches; dark yellowish brown (10YR 4/4) silty clay; common medium distinct yellowish brown (10YR 5/8) and common medium prominent grayish brown (2.5Y 5/2) mottles; moderate medium subangular and angular blocky structure; firm, sticky and plastic when wet; many faint brown (10YR 4/3) clay films on faces of peds; 2 percent coarse fragments; few dark stains (iron and manganese oxides) on faces of peds; strongly acid; gradual smooth boundary.

Bt3—37 to 54 inches; grayish brown (2.5Y 5/2) silty clay loam; many medium prominent brown (7.5YR 4/4) and yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; firm; few fine roots; common faint light brownish gray (2.5Y 6/2) clay films on faces of peds; 5 percent coarse fragments increasing to 40 percent in a thin subhorizon in the lower part; medium acid; abrupt smooth boundary.

2C—54 to 60 inches; gray (N 5/0) and light olive brown (2.5Y 5/4) shaly silty clay loam; massive; firm; platy tendency in the lower part inherited from the soft, weathered shale; 25 percent coarse fragments; slightly acid; abrupt smooth boundary.

2Cr—60 to 72 inches; gray (N 5/0) and very dark gray (N 3/0), weathered shale bedrock; cuts with difficulty by spade.

The thickness of the solum ranges from 44 to 60 inches. The depth to bedrock ranges from 50 to 80 inches. The content of coarse fragments ranges from 0 to 10 percent in the A horizon. It ranges mainly from 0 to 20 percent in the Bt horizon, but in thin subhorizons it is as much as 40 percent.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. It is silt loam or silty clay loam. The upper part of the Bt horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 3 to 6. It is silt loam, silty clay loam, or silty clay. The lower part has chroma of 2 to 6. It is silty clay loam, silty clay, or clay or their shaly or channery analogs. The 2C horizon has hue of 10YR or 2.5Y or is neutral. It has value of 4 to 6 and chroma of 0 to 4. It is silty clay loam, silty clay, or clay or their shaly or channery analogs.

Lowell Series

The Lowell series consists of deep, well drained, moderately slowly permeable soils on hillsides and ridgetops in the uplands. These soils formed in colluvium and residuum derived from interbedded limestone, siltstone, and shale. Slope ranges from 8 to 70 percent.

Lowell soils are similar to Brookside, Elba, and Guernsey soils and are commonly adjacent to Elba, Gilpin, and Upshur soils. Brookside and Guernsey soils are moderately well drained. The free carbonates in the Elba soils are closer to the surface than those in the Lowell soils. Gilpin soils are moderately deep to bedrock. Upshur soils have redder hues in the subsoil than the Lowell soils. Lowell soils and Elba, Gilpin, and Upshur soils are in similar landscape positions.

Typical pedon of Lowell silt loam, in an area of Lowell-Gilpin silt loams, 25 to 35 percent slopes, about 1.5 miles northeast of Whigville, in Marion Township; 800 feet east and 630 feet north of the southwest corner of sec. 35, T. 7 N., R. 7 W.

A—0 to 3 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; moderate fine granular structure; friable; common fine roots; 3 percent coarse fragments; medium acid; clear wavy boundary.

BE—3 to 6 inches; yellowish brown (10YR 5/4) silt loam; weak medium subangular blocky structure; friable; common fine roots; many faint brown (10YR 5/3) silt coatings on faces of peds; medium acid; clear wavy boundary.

Bt1—6 to 13 inches; yellowish brown (10YR 5/6) silty clay; moderate fine subangular blocky structure; firm, sticky and plastic when wet; common fine roots; common faint yellowish brown (10YR 5/6) clay films on faces of peds; very strongly acid; clear wavy boundary.

Bt2—13 to 20 inches; yellowish brown (10YR 5/6) clay; moderate medium subangular blocky structure; firm, sticky and plastic when wet; common fine roots; common faint yellowish brown (10YR 5/6) clay films on faces of peds; very strongly acid; clear wavy boundary.

Bt3—20 to 26 inches; yellowish brown (10YR 5/6) silty clay; moderate medium subangular blocky structure; firm, sticky and plastic when wet; common fine roots; common distinct strong brown (7.5YR 5/6) clay films on faces of peds; very strongly acid; clear wavy boundary.

Bt4—26 to 37 inches; yellowish brown (10YR 5/6) silty clay; moderate medium subangular blocky structure; firm, sticky and plastic when wet; common fine roots; common distinct strong brown (7.5YR 5/6) clay films on faces of peds; 5 percent coarse fragments; strongly acid; clear wavy boundary.

BC1—37 to 44 inches; yellowish brown (10YR 5/4) silty clay; moderate medium subangular blocky structure; firm, sticky and plastic when wet; common fine roots; common distinct strong brown (7.5YR 5/6) clay films on faces of peds; 5 percent coarse fragments; strongly acid; clear wavy boundary.

BC2—44 to 59 inches; variegated yellowish brown (10YR 5/6) and light yellowish brown (2.5Y 6/4) silty clay; weak medium subangular blocky structure;

firm, sticky and plastic when wet; common faint yellowish brown (10YR 5/4) clay films on faces of peds; 5 percent coarse fragments; strongly acid in the upper part and medium acid in the lower part; clear wavy boundary.

C—59 to 64 inches; light yellowish brown (2.5Y 6/4) silty clay; massive; firm, sticky and plastic when wet; few distinct brown (7.5YR 5/4) coatings on faces of vertical partings; 5 percent coarse fragments; neutral.

The thickness of the solum ranges from 30 to 60 inches. The depth to hard bedrock ranges mainly from 40 to 80 inches. The content of coarse fragments ranges from 0 to 5 percent in the A horizon and the upper part of the Bt horizon, from 0 to 15 percent in the lower part of the Bt horizon, and from 1 to 40 percent in the C horizon.

The A horizon has hue of 7.5YR or 10YR, value of 3 to 5, and chroma of 2 to 4. It is silt loam or silty clay loam. The Bt horizon has hue of 7.5YR to 2.5Y and value and chroma of 4 to 6. It is silty clay loam, silty clay, or clay. The range in color and texture in the C horizon is similar to that in the Bt horizon but includes shaly analogs.

Morristown Series

The Morristown series consists of deep, well drained, moderately slowly permeable soils in surface-mined areas. These soils formed in a mixture of calcareous, partly weathered fine earth and fragments of shale and limestone and small amounts of sandstone, siltstone, and coal. Slope ranges from 0 to 70 percent.

Morristown soils are commonly adjacent to Elba, Guernsey, Lowell, Upshur, and Zanesville soils. These adjacent soils are in unmined areas and have a subsoil.

Typical pedon of Morristown silty clay loam, 15 to 25 percent slopes, about 0.5 mile west-southwest of Redrock, in Brookfield Township; 240 feet west and 1,240 feet north of the southeast corner of sec. 31, T. 8 N., R. 10 W.

Ap—0 to 10 inches; brown (7.5YR 4/4) silty clay loam, brown (7.5YR 5/4) dry; moderate medium subangular blocky structure; firm; many fine roots; 5 percent coarse fragments; slight effervescence in 30 percent of the horizon; neutral; abrupt smooth boundary.

C1—10 to 20 inches; olive gray (5Y 5/2) very channery silty clay loam; massive; firm; common fine roots; specks of dusky red (10R 3/4) material; 40 percent coarse fragments; strong effervescence; moderately alkaline; clear wavy boundary.

C2—20 to 30 inches; olive gray (5Y 5/2) extremely channery silty clay loam; massive; firm; few fine roots; specks of dusky red (10R 3/4) material; 65 percent coarse fragments; strong effervescence; moderately alkaline; clear wavy boundary.

C3—30 to 72 inches; variegated 80 percent light olive gray (5Y 6/2) and 20 percent pale olive (5Y 6/4) extremely channery silty clay loam; massive; firm; specks of dusky red (10R 3/4) material; 65 percent coarse fragments; strong effervescence; moderately alkaline.

The Ap horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 1 to 6. It is typically silty clay loam or channery silty clay loam but is clay loam or channery clay loam in some pedons. The Ap horizon in unreclaimed areas has hue of 10YR, value of 4 or 5, and chroma of 2 to 6. The C horizon has hue of 5YR to 5Y, value of 3 to 6, and chroma of 0 to 6. It is the very shaly, extremely shaly, or channery analog of loam, clay loam, or silty clay loam. The content of coarse fragments ranges from 35 to 70 percent.

Newark Series

The Newark series consists of deep, somewhat poorly drained, moderately permeable and slowly permeable soils on flood plains. These soils formed in recent mixed alluvium. Slope ranges from 0 to 3 percent.

Newark soils are adjacent to Chagrin, Nolin, and Sarahsville soils. Chagrin and Nolin soils are well drained and are in the higher positions on the flood plains. Sarahsville soils have more clay in the upper part than the Newark soils. In some areas they are on low slackwater terraces.

Typical pedon of Newark silt loam, occasionally flooded, 1.5 miles south-southwest of Carlisle, in Stock Township; 660 feet south and 1,745 feet west of the center of sec. 12, T. 6 N., R. 8 W.

Ap—0 to 7 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak fine granular structure; friable; common fine roots; common dark soft accumulations (iron and manganese oxides); few shale fragments; neutral; abrupt smooth boundary.

Bw—7 to 19 inches; brown (10YR 4/3) silt loam; many medium faint grayish brown (10YR 5/2) mottles; moderate fine subangular blocky structure; friable; common fine roots; thin strata of loam; few shale fragments; slightly acid; clear wavy boundary.

Bg—19 to 35 inches; dark grayish brown (2.5Y 4/2) silt loam; weak medium subangular blocky structure; friable; strong brown (7.5YR 5/6) oxidization zones along root channels; common coal fragments; slightly acid; clear wavy boundary.

Cg1—35 to 45 inches; grayish brown (2.5Y 5/2) silty clay loam; common prominent dark yellowish brown (10YR 4/4) mottles; massive; friable; common coal fragments; slightly acid; clear wavy boundary.

Cg2—45 to 63 inches; grayish brown (10YR 5/2) silty clay loam in the upper part and gravelly loam in the lower part; common distinct dark yellowish brown (10YR 4/4) mottles; massive; friable; 30 percent coarse fragments in the lower part; slightly acid.

The thickness of the solum ranges from 25 to 44 inches. The content of coarse fragments ranges from 0 to 5 percent to a depth of about 30 inches, from 0 to 15 percent at a depth of 30 to 40 inches, and up to 40 percent in individual subhorizons below a depth of 40 inches.

The Ap horizon has value of 4 or 5 and chroma of 2 or 3. The B horizon has value of 4 to 7 and chroma of 0 to 4. It commonly is silt loam or silty clay loam and less commonly is silty clay in the lower part. The C horizon has colors similar to those in the B horizon. The C horizon is silt loam, silty clay loam, or silty clay above a depth of 40 inches and silt loam, silty clay loam, or silty clay or their gravelly or very gravelly analogs below that depth.

Nolin Series

The Nolin series consists of deep, well drained, moderately permeable soils on flood plains. These soils formed in alluvium. Slope ranges from 0 to 3 percent.

Nolin soils are similar to Chagrin soils and are commonly adjacent to Newark and Sarahsville soils. Chagrin soils have more sand in the subsoil than the Nolin soils. Newark and Sarahsville soils are somewhat poorly drained. They are in the lower positions on the flood plains. Sarahsville soils are also on low slackwater terraces.

Typical pedon of Nolin silt loam, frequently flooded, about 2 miles northeast of Glenwood, in Buffalo Township; 265 feet west and 740 feet south of the northeast corner of sec. 20, T. 8 N., R. 9 W.

Ap—0 to 8 inches; brown (10YR 4/3) silt loam, light yellowish brown (10YR 6/4) dry; moderate medium granular structure; friable; many fine roots; medium acid; abrupt smooth boundary.

Bw1—8 to 28 inches; dark yellowish brown (10YR 4/4) silt loam; weak medium subangular blocky structure; friable; common fine roots; medium acid; clear wavy boundary.

Bw2—28 to 48 inches; dark brown (7.5YR 4/4) silt loam; weak fine subangular blocky structure; friable; few dark coatings (iron and manganese oxides) on faces of peds in the lower part; medium acid; clear wavy boundary.

C—48 to 72 inches; dark brown (7.5YR 4/4) silt loam; massive; friable; medium acid.

The thickness of the solum ranges from 40 to 60 inches. The content of coarse fragments ranges from 0 to 5 percent throughout the profile.

The Ap horizon has hue of 10YR or 2.5Y and value of 4 or 5. It is typically silt loam but is silty clay loam in some pedons. The Bw horizon has value of 4 or 5 and chroma of 3 or 4. It is silt loam or silty clay loam. The C horizon has hue of 7.5YR to 2.5Y, value of 4 or 5, and chroma of 2 to 4. It is silt loam, loam, silty clay loam, or sandy loam.

Omulga Series

The Omulga series consists of deep, moderately well drained soils mainly on high terraces along streams. A few areas are on broad interfluves between shallow drainageways. These soils formed in loess or old alluvium over lacustrine sediments. Permeability is moderate above the fragipan and slow in the fragipan. Slope ranges from 1 to 15 percent.

Omulga soils are similar to Zanesville soils and commonly are adjacent to Berks, Guernsey, and Vandalia soils. Zanesville soils commonly have more coarse fragments in the lower part of the soil than the Omulga soils. Berks and Guernsey soils do not have a fragipan. They are on ridgetops and hillsides. Vandalia soils are in the uplands on foot slopes and on benches on side slopes. They do not have a fragipan.

Typical pedon of Omulga silt loam, 1 to 6 percent slopes, about 2 miles northeast of Chaseville, in Wayne Township; 635 feet east and 1,320 feet south of the center of sec. 6, T. 8 N., R. 8 W.

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

Bt1—10 to 16 inches; brown (7.5YR 5/4) silt loam; moderate medium subangular blocky structure;

friable; common fine roots; common faint strong brown (7.5YR 5/6) clay films on faces of peds; strongly acid; clear wavy boundary.

Bt2—16 to 23 inches; strong brown (7.5YR 5/6) silt loam; moderate medium subangular blocky structure; friable; common fine roots; common faint strong brown (7.5YR 5/6) clay films on faces of peds; strongly acid; clear wavy boundary.

Bt3—23 to 28 inches; strong brown (7.5YR 5/6) silt loam; moderate medium subangular blocky structure; friable; few fine roots; common distinct light yellowish brown (10YR 6/4) clay films on faces of peds; few dark concretions (iron and manganese oxides); strongly acid; clear wavy boundary.

Bt4—28 to 34 inches; yellowish brown (10YR 5/4) silt loam; common medium distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; few fine roots; common faint light yellowish brown (10YR 6/4) clay films on faces of peds; few dark concretions (iron and manganese oxides); strongly acid; clear wavy boundary.

Btx1—34 to 40 inches; yellowish brown (10YR 5/4) silty clay loam; common medium distinct strong brown (7.5YR 5/6) and grayish brown (10YR 5/2) mottles; moderate coarse prismatic structure parting to moderate very coarse subangular blocky; very firm, brittle; few fine roots; common faint light yellowish brown (10YR 6/4) and common distinct grayish brown (10YR 5/2) clay films on faces of prisms; few dark concretions (iron and manganese oxides); strongly acid; clear wavy boundary.

Btx2—40 to 48 inches; yellowish brown (10YR 5/4) silty clay loam; common medium distinct strong brown (7.5YR 5/6) and grayish brown (10YR 5/2) mottles; moderate very coarse prismatic structure parting to moderate coarse subangular blocky; very firm, brittle; common distinct light yellowish brown (10YR 6/4) and common distinct grayish brown (10YR 5/2) clay films on faces of prisms; common dark concretions (iron and manganese oxides); strongly acid; clear wavy boundary.

B't—48 to 58 inches; yellowish brown (10YR 5/4) silt loam; common medium distinct grayish brown (10YR 5/2) and strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; friable; common distinct light brownish gray (10YR 6/2) clay films on faces of peds; common dark concretions (iron and manganese oxides); medium acid; clear wavy boundary.

2C—58 to 68 inches; reddish brown (5YR 4/4) silty clay; common medium distinct brown (7.5YR 5/4) and common prominent light brownish gray (2.5Y 6/2) mottles; massive; firm; common dark concretions (iron and manganese oxides); medium acid.

The thickness of the solum ranges from 40 to 100 inches. The depth to the fragipan ranges from 20 to 36 inches. The content of coarse fragments ranges from 0 to 5 percent in the solum and from 0 to 15 percent in the substratum.

The Ap horizon has value of 4 or 5. The Bt horizon has value of 4 or 5 and chroma mainly of 3 to 6. Some pedons have mottles with chroma of 2 or less in the lower part of the Bt horizon above the fragipan but not within the upper 10 inches of the argillic horizon. The Bt horizon is silt loam or silty clay loam. The Btx horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 3 to 6. It is silt loam or silty clay loam. The B't horizon has colors similar to those in the Btx horizon. The 2C horizon has hue of 5YR to 2.5Y, value of 4 to 6, and chroma of 2 to 6. It ranges from sandy loam to clay.

Sarahsville Series

The Sarahsville series consists of deep, somewhat poorly drained, very slowly permeable soils on low slackwater terraces and on flood plains. These soils formed in clayey lacustrine sediments or alluvium washed from upland soils that have large amounts of reddish clayey residuum, locally known as redbeds. Slope ranges from 0 to 3 percent.

Sarahsville soils are commonly adjacent to the well drained Nolin soils. Nolin soils are in the higher positions on the flood plains.

Typical pedon of Sarahsville silty clay, frequently flooded, about 1.5 miles northwest of Mount Zion, in Buffalo Township; 1,188 feet north and 1,425 feet west of the southeast corner of sec. 17, T. 8 N., R. 9 W.

Ap—0 to 8 inches; brown (10YR 4/3) silty clay, pale brown (10YR 6/3) dry; moderate medium granular structure; friable; common fine roots; few dark concretions (iron and manganese oxides); strongly acid; abrupt smooth boundary.

Bw1—8 to 13 inches; brown (7.5YR 5/4) silty clay; common medium distinct strong brown (7.5 YR 5/6) mottles; moderate medium subangular blocky structure; firm; common fine roots; common distinct brown (7.5YR 5/2) coatings on faces of peds and lining pores; few dark concretions (iron and manganese oxides); strongly acid; clear wavy boundary.

Bw2—13 to 20 inches; strong brown (7.5YR 5/6) silty clay; common medium prominent pinkish gray

(7.5YR 6/2) mottles; moderate medium subangular blocky structure; firm; few fine roots; many distinct brown (7.5YR 5/2) coatings on faces of peds and lining pores; common dark concretions (iron and manganese oxides); strongly acid; clear wavy boundary.

Bw3—20 to 36 inches; brown (7.5YR 5/4) silty clay; few fine distinct pinkish gray (7.5YR 6/2) and common medium distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; few fine roots; many distinct brown (7.5YR 5/2) and common faint brown (7.5YR 5/4) coatings on faces of peds; common dark stains (iron and manganese oxides) on faces of peds; medium acid; clear wavy boundary.

Bw4—36 to 63 inches; strong brown (7.5YR 5/6) silty clay in the upper part and silty clay loam in the lower part; common medium distinct brown (7.5YR 5/4) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; many prominent pinkish gray (7.5YR 6/2) and common faint reddish brown (5YR 4/4) coatings on faces of peds; few light gray (10YR 6/1) channel fillings; common dark stains (iron and manganese oxides) on faces of peds; medium acid in the upper part and slightly acid in the lower part; clear wavy boundary.

Bw5—63 to 68 inches; brown (7.5YR 4/4) silty clay loam; common medium distinct strong brown (7.5YR 5/6) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; many prominent reddish gray (5YR 5/2) and few distinct reddish brown (5YR 4/4) coatings on faces of peds; few light gray (10YR 6/1) channel fillings; common dark stains (iron and manganese oxides) on faces of peds; neutral; clear wavy boundary.

C—68 to 80 inches; reddish brown (5YR 5/4) silty clay; massive in places, but some vertical partings; firm; many distinct reddish gray (5YR 5/2) coatings and few prominent dark stains (iron and manganese oxides) on faces of partings; neutral.

The thickness of the solum ranges mainly from 40 to 80 inches. The particle-size control section is 40 to 60 percent clay.

The Ap horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 to 4. It is typically silty clay but is silt loam or silty clay loam in some pedons. The Bw horizon has hue of 5YR or 7.5YR and chroma of 3 to 6. It is silty clay, clay, or silty clay loam. The C horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 to 4. It is silty clay loam or silty clay.

Upshur Series

The Upshur series consists of deep, well drained, slowly permeable soils on ridgetops and hillsides in the uplands. These soils formed in colluvium and residuum derived from clay shale. Slope ranges from 3 to 70 percent.

Upshur soils are similar to Vandalia and Woodsfield soils and are commonly adjacent to Gilpin, Guernsey, and Lowell soils. Upshur soils and Gilpin, Guernsey, and Lowell soils are in similar landscape positions. Lowell soils have yellower hues in the subsoil than the Upshur soils. Gilpin soils are moderately deep to bedrock. Guernsey soils are moderately well drained. Vandalia soils have more sandstone fragments throughout than the Upshur soils, and Woodsfield soils have more silt and less clay in the upper part.

Typical pedon of Upshur silty clay, 8 to 15 percent slopes, severely eroded, 2.5 miles north of Belle Valley, in Noble Township; 395 feet west and 1,770 feet south of the center of sec. 5, T. 7 N., R. 9 W.

Ap—0 to 4 inches; reddish brown (5YR 4/4) silty clay, reddish brown (5YR 5/4) dry; moderate medium subangular blocky structure; firm, sticky and plastic; common fine roots; few coarse fragments; medium acid; abrupt smooth boundary.

Bt1—4 to 13 inches; reddish brown (2.5YR 4/4) silty clay; moderate medium subangular blocky structure; firm, sticky and plastic; common fine roots; common faint reddish brown (2.5YR 4/4) clay films on faces of peds; few coarse fragments; slightly acid; clear wavy boundary.

Bt2—13 to 21 inches; red (2.5YR 4/6) silty clay; moderate medium subangular blocky structure; firm, sticky and plastic; common fine roots; common faint red (2.5YR 4/6) clay films on faces of peds; few coarse fragments; slightly acid; clear wavy boundary.

Bt3—21 to 28 inches; red (2.5YR 4/6) silty clay; moderate medium subangular blocky structure; firm, sticky and plastic; common fine roots; common faint red (2.5YR 4/6) clay films on faces of peds; few coarse fragments; 10 percent weathered remnants of light olive brown (2.5Y 5/4) shale fragments; slightly acid; clear wavy boundary.

Bt4—28 to 33 inches; dark reddish brown (2.5YR 3/4) silty clay; weak medium subangular blocky structure; firm, sticky and plastic; few fine roots; common faint dark reddish brown (2.5YR 3/4) clay films on faces of peds; few coarse fragments; 20 percent weathered remnants of light olive brown (2.5Y 5/4) shale fragments; neutral; clear wavy boundary.

C—33 to 48 inches; light yellowish brown (2.5Y 6/4) silty clay loam; massive; firm; slight effervescence; mildly alkaline; clear wavy boundary.

Cr—48 to 50 inches; soft shale bedrock.

The thickness of the solum ranges from 26 to 50 inches. The depth to paralithic contact is 40 inches or more. The content of coarse fragments ranges from 0 to 25 percent in individual subhorizons of the Bt horizon. It ranges mainly from 0 to 25 percent in the C horizon but is as much as 70 percent in some subhorizons.

The Ap horizon has hue of 10YR to 5YR and value and chroma of 3 or 4. It is silt loam, silty clay loam, or silty clay. The Bt horizon has hue of 5YR to 10R, value of 3 or 4, and chroma of 3 to 6. It commonly is silty clay or clay, but in the lower part it ranges to shaly or channery silty clay or clay. The C horizon has colors similar to those in the B horizon but includes variegated olive, olive brown, or light yellowish brown. The C horizon is silty clay loam, silty clay, or clay or their shaly to extremely shaly or channery to extremely channery analogs.

Vandalia Series

The Vandalia series consists of deep, well drained, moderately slowly permeable or slowly permeable soils in the uplands. These soils formed in colluvium derived from shale and siltstone. They are on foot slopes, on the lower parts of side slopes, and on benches on side slopes. Slope ranges from 8 to 40 percent.

Vandalia soils are similar to Upshur and Woodsfield soils and are commonly adjacent to Berks, Brookside, Elba, Guernsey, Lowell, and Upshur soils. Berks, Elba, Lowell, and Upshur soils are on ridgetops and hillsides. Berks, Brookside, Elba, Guernsey, and Lowell soils have yellower hues in the subsoil than the Vandalia soils. Upshur soils have fewer sandstone fragments throughout than the Vandalia soils, and Woodsfield soils have more silt and less clay in the upper part.

Typical pedon of Vandalia silty clay loam, in an area of Vandalia-Guernsey silty clay loams, 15 to 25 percent slopes, eroded, about 2.4 miles east-southeast of Belle Valley, in Noble Township; 265 feet west and 1,360 feet north of the southeast corner of sec. 22, T. 7 N., R. 9 W.

Ap—0 to 3 inches; dark reddish brown (5YR 3/3) silty clay loam, reddish brown (5YR 4/3) dry; weak medium subangular blocky structure; firm, sticky and plastic when wet; many fine roots; dark reddish brown (2.5YR 3/4) specks of material from the B horizon; 10 percent coarse fragments; medium acid; abrupt smooth boundary.

Bt1—3 to 18 inches; dark reddish brown (2.5YR 3/4) and reddish brown (5YR 4/3) silty clay; moderate medium subangular blocky structure; firm; common fine roots; many faint dark reddish brown (2.5YR 3/4) clay films on faces of peds; few coarse fragments; neutral; clear wavy boundary.

Bt2—18 to 32 inches; reddish brown (2.5YR 4/4) silty clay; moderate medium subangular blocky structure; firm; few fine roots; many faint weak red (10R 4/4) clay films on faces of peds; 10 percent light yellowish brown (2.5Y 6/4) and 20 percent dusky red (10R 3/3) in the lower part (relict colors); few fine coarse fragments; slight effervescence; mildly alkaline; clear wavy boundary.

BC—32 to 37 inches; reddish brown (2.5YR 4/4) silty clay; weak medium subangular blocky structure; firm; many slickensides; weak red (10R 4/4) faces on slickensides; 5 percent coarse fragments; slight effervescence; mildly alkaline; clear wavy boundary.

C1—37 to 48 inches; dusky red (10R 3/3) silty clay loam; massive; firm; few fine roots; many slickensides; weak red (10R 4/4) faces on slickensides; 5 percent coarse fragments; slight effervescence; mildly alkaline; clear wavy boundary.

C2—48 to 72 inches; weak red (10R 4/3) and reddish brown (2.5YR 4/4) silty clay loam; massive; firm, sticky and plastic when wet; common slickensides; weak red (10R 4/3) faces on slickensides; 2 percent coarse fragments in the upper part of the horizon and 10 percent in the lower part; slight effervescence; mildly alkaline.

The thickness of the solum ranges from 30 to 50 inches. The depth to bedrock is more than 60 inches. The content of coarse fragments of siltstone, shale, and limestone ranges from 5 to 15 percent in the Ap horizon, from 0 to 20 percent in the Bt horizon, and from 5 to 30 percent in the C horizon.

The Ap horizon has hue of 5YR to 10YR, value of 3 to 5, and chroma of 2 to 4. The Ap horizon typically is silty clay loam but is silty clay in some pedons. The Bt horizon has hue of 10R to 5YR, value of 3 to 6, and chroma of 2 to 6. It is silty clay loam, silty clay, or clay or their channery or shaly analogs. The C horizon has hue of 10R to 5YR and value and chroma of 3 to 6. Some pedons have a 2C horizon. It has hue of 10R to

5Y, value of 3 to 6, and chroma of 2 to 6. It is silty clay or clay or their channery or shaly analogs.

Woodsfield Series

The Woodsfield series consists of deep, well drained soils that formed in loess and in the underlying residuum derived from interbedded clay shale and siltstone. These soils are on ridgetops and hillsides in the uplands. Permeability is moderate in the upper part and slow in the lower part. Slope ranges from 1 to 25 percent.

Woodsfield soils are similar to Upshur and Vandalia soils and are commonly adjacent to Guernsey, Lowell, Upshur, and Zanesville soils. Woodsfield soils and Guernsey, Lowell, and Upshur soils are in similar landscape positions. Guernsey and Lowell soils have yellower hues in the subsoil than the Woodsfield soils, and Upshur and Vandalia soils have less silt and more clay in the upper part. Zanesville soils are on ridgetops. They have a fragipan.

Typical pedon of Woodsfield silt loam, 6 to 15 percent slopes, about 2.5 miles southwest of Sharon, in Sharon Township; 1,715 feet south and 1,505 feet east of the northwest corner of sec. 19, T. 6 N., R. 9 W.

Ap—0 to 7 inches; brown (10YR 4/3) silt loam, light yellowish brown (10YR 6/4) dry; moderate medium granular structure; friable; many fine roots; very strongly acid; abrupt smooth boundary.

Bt1—7 to 13 inches; dark brown (7.5YR 4/4) silty clay loam; moderate fine subangular blocky structure; friable; common fine roots; common faint dark brown (7.5YR 4/4) clay films on faces of peds; very strongly acid; clear wavy boundary.

Bt2—13 to 19 inches; reddish brown (5YR 4/4) silty clay loam; moderate medium subangular blocky structure; friable; common fine roots; many faint reddish brown (5YR 4/4) clay films on faces of peds; very strongly acid; clear wavy boundary.

2Bt3—19 to 25 inches; reddish brown (5YR 4/4) clay; moderate medium subangular blocky structure; firm; few fine roots; many faint reddish brown (5YR 4/4) clay films on faces of peds; strongly acid; clear wavy boundary.

2Bt4—25 to 32 inches; dark reddish brown (2.5YR 3/4) clay; moderate coarse subangular blocky structure; firm; few fine roots; many faint dark reddish brown (2.5YR 3/4) clay films on faces of peds; strongly acid; clear wavy boundary.

2Bt5—32 to 42 inches; dusky red (2.5YR 3/2) clay; moderate coarse subangular blocky structure; firm; few fine roots; many faint dusky red (2.5YR 3/2) clay films on faces of peds; slightly acid; clear wavy boundary.

2Bt6—42 to 53 inches; variegated reddish brown (2.5YR 4/4) and light yellowish brown (2.5Y 6/4) clay; weak coarse subangular blocky structure; firm; few fine roots; many faint reddish brown (2.5YR 4/4) clay films on faces of peds; neutral; clear wavy boundary.

2C—53 to 66 inches; variegated yellowish brown (10YR 5/4), light brownish gray (2.5Y 6/2), and light yellowish brown (2.5Y 6/4) silty clay; massive; firm; few fine roots; common black (10YR 2/1) soft accumulations (iron and manganese oxides); slight effervescence; mildly alkaline; clear wavy boundary.

2Cr—66 to 72 inches; olive brown (2.5Y 4/4), soft shale.

The thickness of the solum ranges from 40 to 60 inches. The thickness of the silty mantle ranges from 14 to 26 inches. The depth to soft bedrock ranges from 40 to 72 inches. The content of coarse fragments ranges from 0 to 5 percent in the A and B horizons and from 0 to 15 percent in the 2B and 2C horizons.

The Ap horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 to 4. The Bt horizon has hue of 5YR to 10YR, value of 3 to 5, and chroma of 2 to 6. It is silty clay loam or silt loam. The 2Bt horizon has hue of 10R to 2.5Y, value of 3 to 6, and chroma of 2 to 6. It is silty clay or clay. The 2C horizon has hue of 10R to 5Y or is neutral. It has value of 3 to 6 and chroma of 0 to 6. It is silty clay or clay.

Zanesville Series

The Zanesville series consists of deep, moderately well drained and well drained soils on ridgetops in the uplands. These soils formed in loess and in the underlying residuum derived from shale, siltstone, and fine-grained sandstone. Permeability is moderate above the fragipan and slow or moderately slow in the fragipan. Slope ranges from 1 to 15 percent.

Zanesville soils are similar to Omulga soils and are commonly adjacent to Berks, Guernsey, Lowell, and Woodsfield soils. Omulga soils commonly have fewer coarse fragments in the lower part than the Zanesville soils. Berks, Guernsey, Lowell, and Woodsfield soils do not have a fragipan. They are on ridgetops and hillsides.

Typical pedon of Zanesville silt loam, 1 to 6 percent slopes, 3.5 miles north of Belle Valley, in Buffalo Township; 870 feet east and 1,240 feet north of the southwest corner of sec. 32, T. 8 N., R. 9 W.

Ap—0 to 9 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; moderate medium granular structure; friable; many roots; few very dark grayish brown (10YR 3/2) concretions (iron and manganese oxides); neutral; abrupt smooth boundary.

BE—9 to 13 inches; yellowish brown (10YR 5/4) silt loam; weak medium subangular blocky structure; friable; common roots; common faint light yellowish brown (10YR 6/4) silt coatings on faces of peds; very strongly acid; clear wavy boundary.

Bt1—13 to 17 inches; yellowish brown (10YR 5/4) silt loam; moderate medium subangular blocky structure; friable; common roots; common faint yellowish brown (10YR 5/4) clay films on faces of peds; few black (10YR 2/1) concretions (iron and manganese oxides); very strongly acid; clear wavy boundary.

Bt2—17 to 25 inches; brown (7.5YR 5/4) silty clay loam; moderate medium subangular blocky structure; friable; common roots; common faint brown (7.5YR 5/4) clay films on faces of peds; few distinct black (N 2/0) concretions (iron and manganese oxides); very strongly acid; clear wavy boundary.

2Btx1—25 to 31 inches; brown (7.5YR 5/4) silty clay loam; few fine distinct brown (10YR 5/3) mottles; moderate very coarse prismatic structure parting to weak medium platy; very firm, brittle; common distinct pinkish gray (7.5YR 6/2) and faint brown (7.5YR 5/4) clay films on faces of prisms; common distinct black (N 2/0) concretions (iron and manganese oxides); few coarse fragments; very strongly acid; clear wavy boundary.

2Btx2—31 to 47 inches; brown (7.5YR 5/4) silty clay loam; common fine distinct brown (10YR 5/3) mottles; moderate very coarse prismatic structure parting to weak coarse platy; very firm, brittle; common distinct pinkish gray (7.5YR 6/2) clay films on faces of prisms; many distinct black (N 2/0) coatings (iron and manganese oxides) on faces of prisms; strongly acid in the upper part, neutral in the lower part; clear wavy boundary.

2C—47 to 54 inches; brown (7.5YR 5/4) silty clay loam; massive; firm; few black (N 2/0) soft accumulations (iron and manganese oxides); 5 percent coarse fragments; neutral; clear wavy boundary.

2Cr—54 to 58 inches; brown (7.5YR 5/4), interbedded soft shale and siltstone bedrock.

The thickness of the solum ranges from 40 to 62 inches. The thickness of the loess mantle ranges from 24 to 48 inches. The depth to the fragipan ranges from 20 to 32 inches, and the depth to bedrock ranges mainly from 40 to 80 inches. The content of coarse fragments ranges from 0 to 5 percent in the solum and from 5 to 50 percent in the substratum.

The Bt and Btx horizons have hue of 10YR or 7.5YR and chroma of 4 to 6. The Btx horizon is silt loam or silty clay loam.

Formation of the Soils

This section describes the major factors of soil formation, how these factors have affected the soils of Noble County, and some of the processes of soil formation.

Factors of Soil Formation

Soils are the product of soil-forming processes acting on material deposited or accumulated by geologic forces. The major factors of soil formation are parent material, climate, relief, living organisms, and time.

Climate and living organisms, particularly vegetation, are the active forces in soil formation. Their effect on the parent material is modified by relief and by the length of time the parent material has been acted upon. The relative importance of each factor differs from place to place. In some places, one factor dominates and determines most of the soil properties, but normally the interaction of all five factors determines what kind of soil forms in any given place.

Parent Material

The soils of Noble County formed in several kinds of parent material: residuum, colluvium, loess, or a combination of these materials and lacustrine sediments and alluvium.

Residuum from shale, sandstone, siltstone, and limestone bedrock is the most extensive parent material in the county. Berks soils, for example, formed in residuum. Small areas of soils on the ridges and side slopes formed in as much as 48 inches of loess and in the underlying residuum. Zanesville soils are an example of soils that formed in loess and in the underlying residuum derived from shale, siltstone, and fine-grained sandstone.

Some of the soils on side slopes formed in residuum and colluvium. Colluvium is weathered bedrock and soil material that has been moved downhill by gravity. Residuum and colluvium derived from sandstone bedrock are coarse textured or moderately coarse textured. The soils that formed in this combination of parent materials dominantly are moderately coarse textured to medium textured in the subsoil. Dekalb soils are an example. Residuum and colluvium derived from clay shale or limestone are fine textured in the subsoil. Upshur soils formed in residuum derived from clay shale, and Vandalia soils formed in colluvium derived from similar bedrock. Residuum derived from siltstone, shale, and sandstone is medium textured or moderately fine textured. The soils that formed in this combination of parent materials, such as Gilpin soils, dominantly are medium textured or moderately fine textured in the subsoil.

Surface-mine spoils are a mixture of partly weathered fine earth and fragments of shale, sandstone, siltstone, and limestone that was piled or graded during surface mining for coal. Barkcamp and Morristown soils formed in surface-mine spoil dominated by fragments of rock and small amounts of sand, silt, and clay.

Areas of lacustrine sediments or alluvium are in small valleys, mostly in the northern part of the county. The layered characteristics of the parent materials in these areas are reflected in the Sarahsville soils.

Alluvium, deposited by floodwater, is the youngest parent material in the county. It continues to accumulate as fresh sediment is added by overflowing streams. The sediment originates in the surface layer of higher soils in the county and is the parent material for Nolin and Newark soils.

Some soils, such as Omulga soils, formed in loess or old alluvium over lacustrine sediments on high terraces along streams.

Climate

The climate of Noble County is uniform enough so that it has not greatly contributed to differences among the soils. It has favored physical change in and chemical weathering of parent materials and the activity of living organisms.

Rainfall has been adequate to leach from the solum of most soils the carbonates that were in the parent material, as in Lowell soils. Frequent rainfall resulted in wetting and drying cycles that are favorable to the translocation of clay minerals and formation of soil structure, as in Guernsey and Woodsfield soils.

The range of temperature variations has favored both physical change in and chemical weathering of the parent materials. Freezing and thawing aided the formation of soil structure. Warm temperatures in summer favored chemical reactions in the weathering of primary minerals.

Rainfall and temperature have been conducive to plant growth and the accumulation of organic matter in all the soils. More information about the climate is available under the heading "General Nature of the County."

Relief

Relief, along with parent material, affects the natural drainage of soils. It influences the amount of runoff and the depth to the ground water table. Water that runs off sloping soils collects in depressions or is removed through the drainage system. Therefore, from an equal amount of rainfall, sloping soils receive less total water and depressional soils more total water than flat, nearly level soils. Gently sloping soils generally show the most development because they are neither saturated nor droughty. Soil formation on steep slopes tends to be inhibited by erosion and the limited amount of water that penetrates the surface.

Relief can account for the formation of different soils from the same kind of parent material. For this reason, relief is commonly a dominant factor in differentiating soil series. Newark and Nolin soils, for example, both formed in alluvium. The well drained Nolin soils are in the higher positions on flood plains. Their seasonal high water table generally is not close to the surface. The somewhat poorly drained Newark soils are in the lower positions on the flood plains, and their water table generally is close to the surface during extended wet periods.

Living Organisms

Plants, animals, bacteria, fungi, and other living organisms affect soil formation. At the time that the county was settled, the vegetation was dominantly hardwood forest of oak, hickory, maple, yellow-poplar, and ash. The soils that formed in these forested areas, such as Lowell and Guernsey soils, are subject to acid leaching. As a result, the subsoil generally is lower in exchangeable bases than the substratum.

Small animals, insects, earthworms, and burrowing animals leave channels in the soil and make it more permeable. Animals also mix the soil material and contribute organic matter. Worm channels or casts are common in the surface layer of well drained soils, such as Elba and Upshur soils. Crawfish channels are evident in the somewhat poorly drained soils, such as Sarahsville soils.

Human activities include cultivation, seeding, installation of drainage systems, cutting and filling, and surface mining. Another example is the application of lime and fertilizer, which affects soil chemistry.

Time

Time is needed for the other factors of soil formation to produce their effects. The age of a soil is indicated, to some extent, by the degree of soil development. If the parent material weathers slowly, the profile forms more slowly. In many areas, however, factors other than time have been responsible for most of the differences in the kind and distinctness of layers in the different soils.

Most of the soils in the county are old and have a strongly expressed profile. The youngest soils are those that formed in strip-mine spoil, such as the Barkcamp and Enoch soils. Deposits of fresh sediments on flood plains periodically interrupt soil formation. As a result, Nolin and Chagrin soils do not have a strongly expressed profile.

Processes of Soil Formation

Most of the soils in Noble County have a strongly expressed profile because the processes of soil formation have distinctly changed the parent material. These are the upland soils on ridgetops and side slopes and the soils on terraces along the major streams. In contrast, the parent material on flood plains and in surface-mined areas is only slightly modified.

All the factors of soil formation act in unison to control the processes that form different layers in the soil. These processes are additions, removals, transfers, and transformations *(12)*. Some processes result in differences among the surface layer, subsoil, and substratum.

In this county the most important addition to the soil is that of organic matter to the surface layer. A thin layer of organic matter accumulates under forest vegetation. If the soil is cleared and cultivated, this organic matter is mixed with the underlying mineral material. In some severely eroded soils, such as Upshur soils, nearly all evidence of this addition has been removed.

Leaching of carbonates from calcareous parent materials is one of the most significant removals. It precedes many other chemical changes in the soil. The limestone and calcareous shale parent material underlying some soils, such as Elba soils, have a high content of carbonates when first exposed to leaching. They have carbonates 10 to 24 inches below the surface. Most of the soils on uplands do not have carbonates within 5 feet of the surface and are very strongly acid to medium acid in the subsoil. Other minerals in the soil are subject to the chemical weathering that results from leaching, but their resistance is higher and their removal is slower.

Seasonal wetting and drying of the soil are largely responsible for the transfer of clay from the surface layer to the faces of peds in the subsoil. The fine clay particles are suspended in the percolating water. They move through the surface layer and are then deposited in the subsoil. This transfer of fine clay accounts for the common clay films on the faces of peds in the subsoil of most of the soils on uplands and terraces, such as Guernsey and Omulga soils. Transformations of mineral compounds occur in most soils. The results are most apparent in the formation of layers not affected by rapid erosion or by accumulation of material at the surface. When the silicate minerals are weathered chemically, secondary minerals, mainly layer lattice silicate clays, are produced. Most of the layer lattice clays remain in the subsoil *(8)*.

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Glossary

AC soil. A soil having only an A and a C horizon. Commonly, such soil formed in recent alluvium or on steep rocky slopes.

Aeration sewage disposal system. A disposal system in which the decomposition of sewage is achieved through oxidation. The sewage is exposed to air for a period long enough to result in adequate treatment.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

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

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Argillic horizon. A subsoil horizon characterized by an accumulation of illuvial clay.

Aspect. The direction in which a slope faces.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

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.

Bedding system. A drainage system made by plowing, grading, or otherwise shaping the surface of a flat field. It consists of a series of low ridges separated by shallow, parallel dead furrows.

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

Bedrock-controlled topography. A landscape where the configuration and relief of the landforms are determined or strongly influenced by the underlying bedrock.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

California bearing ratio (CBR). The load-supporting capacity of a soil as compared to that of a standard crushed limestone, expressed as a ratio. First standardized in California. A soil having a CBR of 16 supports 16 percent of the load that would be supported by standard crushed limestone, per unit area, with the same degree of distortion.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena. A sequence, or "chain," of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a channer.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) 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 slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Dense layer (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Depth, soil. The depth of the soil over bedrock. Deep soils are more than 40 inches deep over bedrock; moderately deep soils, 20 to 40 inches; and shallow soils, 10 to 20 inches.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Erosion pavement. A layer of gravel or stones that remains on the surface after fine particles are removed by sheet or rill erosion.

Excess fines (in tables). Excess silt and clay in the soil.

The soil is not a source of gravel or sand for construction purposes.

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.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

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

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist, 6 to 15 inches (15 to 38 centimeters) long.

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

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

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.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also, the sorted and unsorted material deposited by streams flowing from glaciers.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are interbedded or laminated.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.6 centimeters) in diameter.

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

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Highwall. The unexcavated face of exposed overburden and coal in a surface mine.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

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

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

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

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.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

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

Landslide. The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Landslips. The downhill movement of a mass of soil and rock, generally when wet or saturated. Not of the magnitude of a landslide. The soil surface is undulating where landslips have occurred.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

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

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

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

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

Low strength. The soil is not strong enough to support loads.

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

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

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

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

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

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

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

Outslope. The exposed area sloping away from a bench-cut section in strip mines.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan*.

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

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil, adversely affecting the specified use.

Perimeter drain. A drain installed around the perimeter of a septic tank absorption field to lower the water table. Also called a curtain drain.

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, stoniness, and thickness.

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

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Poorly graded. Refers to a coarse-grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are—

Ultra acid	below 3.6
Extremely acid	3.6 to 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

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.

Rill. A steep-sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

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

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-sized particles.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

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.

Silica-sesquioxide ratio. The ratio of the number of molecules of silica to the number of molecules of alumina and iron oxide. The more highly weathered soils or their clay fractions in warm-temperate, humid regions, and especially those in the tropics, generally have a low ratio.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slip. The movement downslope of a soil mass under wet or saturated conditions; a microlandslide that produces microrelief in soils.

Slippage (in tables). Soil mass susceptible to movement downslope when loaded, excavated, or wet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

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

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to soil blowing 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 soil blowing and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Breaking up a compact subsoil by pulling a special chisel through the soil.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

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

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Till plain. An extensive flat to undulating area underlain by glacial till.

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

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

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.

Unstable fill (in tables). Risk of caving because of differential settling or sloughing on banks of fill material.

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

Valley fill. In glaciated regions, material deposited in stream valleys by glacial meltwater. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Varve. A sedimentary layer of a lamina or sequence of laminae deposited in a body of still water within a year. Specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by meltwater streams, in a glacial lake or other body of still water in front of a glacier.

Water bar. A shallow trench and a mound of earth constructed at an angle across a road or trail to intercept and divert surface runoff and control erosion.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse-grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.